Malignant Hyperthermia

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Introduction

Pathophysiology

Malignant hyperthermia (MH) is an inherited autosomal-dominant disease that occurs in individuals shortly after the induction of anesthesia who encounter inhalation anesthetics or depolarizing muscle relaxants.

Signs & Symptoms

MH is an emergent condition which initially manifests itself as a severe increase in CO2 production (hypercapnia) with abrupt hyperventilation and increased end tidal CO2. Also occurring is tachycardia, ventricular arrhythmias, and muscular spasms. More signs and symptoms of MH include skin that is flush, generalized body rigidity, hypotension, respiratory acidosis, and coagulopathy. Despite the name’s implication, a quick increase in temperature (>38°C) is predictably a late sign. As the MH crisis continues, there is disintegrative muscle breakdown which results in rhabdomyolysis. Myoglobinemia, hyperkalemia, and an increased creatinine phosphokinase all lead to an acute renal failure. If left untreated, the end stage of MH is displayed by circulatory collapse, multi-organ failure, and death (Schneiderbanger, Johannson, Roewer, & Schuster, 2014).

Implications for Nursing Care

It is of paramount importance for nurses to understand and be familiar with the treatment for MH. Anesthesiologists provide much accurate preoperative assessment, ensuring a precise temperature of the patient before anesthesia induction. The anesthesiologist or MH provider recognize the abrupt increase in temperature commonly found in MH. This could lead to prompt treatment of the disease (Dirksen, Roewer, & Schuster, 2014). When a crisis is recognized, immediate analgesics must be utilized as well as other MH triggering drugs. The surgery or procedure should be postponed and the patient monitored very closely. The primary treatment for MH is dantrolene sodium. A medication that is reconstituted with sterile water and pushed quickly through a large bore IV catheter. Because of the unique design of this medication and time-consuming demand for reconstitution, accurate and swift administration can prove as difficult (Safar, Wahe, Pace, Cochran, & Baglia, 2014). In addition to dantrolene administration, nurses must also prepare cooling blankets and refrigerated crystalloid IV’s to combat the hyperthermia involved with the crisis. The anesthesiologist provider should deliver 100 FIO2 to avoid hypotension and subsequent anesthetic depression, lactic acid accumulation, and acidosis (Dirksen et al., 2013). Sodium bicarbonate should be considered to treat acidosis. If cardiac arrest should occur, regular ALS should continue. With cautious education, experience, and familiarity of an MH crisis, nurses can effectively treat the disease which will not only save patients lives, but will also improve patient satisfaction and decrease length of stay in the hospital (Schneiderbanger et al., 2014).

Conclusion

Malignant hyperthermia is a rare disease that can take place in a variety of settings. If not treated in a timely manner, the consequences through treatment will be dire. It is recommended that nurses and other health care professionals be properly educated on MH crisis. By detecting the signs and symptoms associated with the disease, providers can efficiently remedy the crisis and save lives (Safar, 2014). Since the discovery of dantrolene in 1975 and the advancement of genetics regarding MH, deaths have dropped from about 80 to about 5% (Schneiderbanger et al., 2014). Today there is a low group called Malignant Hyperthermia Association of the United States which offers education and support for victims of MH. There is also a 24-hour hotline for people to call during an MH emergency (Dirksen et al., 2013).

References Cited

Additional Sources

Cain et al.,(2014). Malignant hyperthermia crisis: Optimizing patient outcomes through simulation and interdisciplinary collaboration. Critical Care Medicine, 42(6), 1230-1236. doi:10.1097/CCM.0000000000000038

Figure 3: Dantrolene sodium medication label. “Administer dantrolene by intravenous push at a maximum dose of 1 mg/kg. If the administration of dantrolene sodium continues, administer additional intravenous boluses up to the maximum cumulative dosage of 10 mg/kg. If the symptoms reappear, repeat dantrolene dosing by intravenous push starting with 1 mg/kg.” Graphix with text sourced from: http://www.drugs.com/pr/ryanodine.html

Figure 2: “Uncontrolled myocellular Ca2+ release is the key to malignant hyperthermia.” The most prominent cytosolic Ca2+ elevation results from the freeing of stored sarcoplasmic Ca2+ mediated by ryanodine receptor type 1 (RYR1). While volatile anesthetics stimulate Ca2+ release via RYR1, succinylcholine acts indirectly by activating the nicotinic acetylcholine receptor (nAChR), a non-selective cationic channel, resulting in continuous local depolarization. The depolarization can trigger propagated actions potentials that will further activate the already overloaded intracellular stores of Ca2+ into muscle cells which causes disintegrative muscle breakdown, ultimately a hypertensive state (Riuni et al., 2014).