Malignant Hyperthermia

Chase Contri

Otterbein University, chase.contri@otterbein.edu

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Malignant Hyperthermia
Chase Contra SRNA
Otterbein University, Westerville, Ohio

**Introduction**

Malignant hyperthermia is a hypermetabolic disorder caused by mutations of the RYR1 receptor (Hines & Marschall, 2012). This mutation causes an increase in release of calcium from the sarcoplasmic reticulum when triggered that leads to sustained muscle contraction. The release of calcium has much more abundant compared to the body’s abilities to remove the calcium from the intracellular spaces. This causes an increased metabolic scale that increases oxygen consumption, increases carbon dioxide production, increases the likelihood of anaerobic metabolism, and decreases ATP stores. Calcium is involved in many of our body’s primary functions, including the sarcoplasmic reticulum by ATP. ATP stores are depleted due to exhaustive efforts to replace the abundance of calcium in the sarcoplasmic reticulum and the binding of calcium to muscle’s response to each contraction. When ATP stores are depleted, oxygen can no longer be utilized, anaerobic metabolism occurs, and the muscle becomes acidic.

**Preoperative Evaluation**

- **CHCT** have been shown to be 97%-99% sensitive for diagnosis of malignant hyperthermia (Roseberg, Antignoni, & Muldoon, 2002). The CHCT determines if there is any amount of calcium involved in the release of calcium in the sarcoplasmic reticulum, which is used to determine if there is any amount of calcium involved in the release of calcium in the sarcoplasmic reticulum. If the CHCT determines that there is no calcium involved in the release of calcium in the sarcoplasmic reticulum, it could lead to an acute ischemic event.

**Signs and Symptoms**

<table>
<thead>
<tr>
<th>Table 1. Early and Late Signs of Malignant Hyperthermia</th>
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</thead>
<tbody>
<tr>
<td><strong>Early Signs</strong></td>
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<tr>
<td>Muscle rigidity</td>
</tr>
<tr>
<td>Lethargy</td>
</tr>
<tr>
<td>Tachypnea</td>
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<tr>
<td>Respiratory difficulty</td>
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<tr>
<td>Hypertension</td>
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</table>

Malignant hyperthermia can be difficult to diagnose during the anesthetized state. The diagnosis must be made based on the early and late signs and symptoms of malignant hyperthermia. Early signs and symptoms can be vague and subtle at first and resemble side effects of the rapid and increased calcium release. The first sign of early progression of malignant hyperthermia is hyperthermia. Hyperthermia can be defined as carbon dioxide level above 45 mmHg. This can be measured by an arterial blood gas analysis or through Capnography. Hyperthermia can increase in carbon dioxide in some cases of MAH.

**Anesthesia Triggers**

- **Desflurane**
- **Isoflurane**
- **Succinylcholine**

The administration of halogenated agents such as Desflurane, Isoflurane, and Succinylcholine can be an anesthesia trigger for malignant hyperthermia. The administration of these triggers can cause a delay of six hours to the occurrence of malignant hyperthermia with the use of Desflurane and Sevoflurane (Hopkins, 2000).

**Treatment**

- **Dantrolene**
- **Suxisodycline**

When a patient has been determined to be at high risk for malignant hyperthermia either from preoperative testing or previous malignant hyperthermia reaction, a safe and preventative anesthesia plan is developed by the anesthesiologist. The plan could include avoiding the use of halogenated agents such as Desflurane, Isoflurane, Sevoflurane, and Succinylcholine. Nitrous Oxide should also be avoided as it is not a trigger for malignant hyperthermia and is considered safe. It is also advisable of the use of the depolarizing muscle relaxants to ensure a patient’s muscle relaxant is safe for use in malignant hyperthermia. Muscle rigidity will still occur in these locations even if a patient has received neuromuscular blocking drugs (Edwards et al., 2015).

- **Dantrolene**
- **Suxisodycline**

Late signs and symptoms can be more detrimental to the patient as it reflects anesthetic metabolism and deterioration. A patient can become comatose during a malignant hyperthermia crisis. Medications can include muscle relaxants to relax the patient, sedation, sodium bicarbonate to increase pH, and calcium replacement to replace the calcium levels. The use of Dantrolene can help control the muscle rigidity by inhibiting calcium release from the sarcoplasmic reticulum. By inhibiting calcium release, muscle rigidity can be reversed.

**References**


**Figure 1. Mutation of RYR1 receptor causes abundant release of calcium from sarcoplasmic reticulum that leads to a hypermetabolic state.**