Malignant Hyperthermia

Chase Contri
Otterbein University, chase.contri@otterbein.edu

Follow this and additional works at: https://digitalcommons.otterbein.edu/stu_msn

Part of the Anesthesiology Commons, Medical Pathology Commons, and the Nursing Commons

Recommended Citation
Contri, Chase, "Malignant Hyperthermia" (2014). Master of Science in Nursing (MSN) Student Scholarship. 3.
https://digitalcommons.otterbein.edu/stu_msn/3
Malignant Hyperthermia
Chase Contri SRNA
Otterbein University, Westerville, Ohio

Introduction

Although very rare, occurring one out of every 100,000 anesthesia cases, malignant hyperthermia is a potentially lethal disorder that anesthesia providers screen and interrogate patients prior to every case they are administering anesthesia to. Numerous studies about anesthesia induced malignant hyperthermia have explored new methods of testing for the genetic susceptibility for malignant hyperthermia and into hospital based protocols when a patient starts to show the signs and symptoms of malignant hyperthermia.

PATHOPHYSIOLOGY

Malignant hyperthermia is a hypermetabolic disorder caused by mutation of the ryanodine receptor located on the major regulatory calcium channel of the sarcoplasmic reticulum of skeletal muscle. As a result, there is an increased release of calcium into the sarcoplasmic reticulum. This increased calcium results in sustained muscle contraction. The release of calcium is specific to the ryanodine receptor located on the sarcoplasmic reticulum. ATP stores are depleted, calcium is removed and pumped back into the sarcoplasmic reticulum by ATP. ATP stores are depleted due to exhaustion of attempting to replace the abundant calcium from the sarcoplasmic reticulum and the binding of calcium to muscle’s response to elicit contraction. When ATP stores are depleted and oxygen cannot be utilized, anabolic reactions needed to maintain homeostasis fail leading to an acidic and potentially fatal state.

Preoperative Evaluation

Malignant hyperthermia can be a difficult disorder to diagnose while a patient is in the anesthetized state. The anesthesiologist must be knowledgeable of the early 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 hypercarbia. Hypercarbia can be defined as carbon dioxide level above 45 mmHg. This can be measured by an arterial blood gas analysis or through Capnography. This can increase in carbon dioxide in order to increase oxygen consumption. When the hypercarbia is present, a patient will become tachypneic to compensate for the increase in carbon dioxide. Tachypnea will not be present with a patient who is in a paralytic state as during some surgical cases. In this case carbon dioxide monitoring will be crucial. Tachycardia is another early sign of malignant hyperthermia. Tachycardia is present when there is an increase in heart rate. This is another early sign of malignant hyperthermia. Calcium release and increase in oxygen consumption causes a patient to become hypotensive. A patient with malignant hyperthermia can also have a decrease in muscle performance and a release of calcium, causing cardiac arrhythmias. Hyperthermia typically is one of the latest symptoms that a patient becomes increasingly acidotic, cells will try to regulate the abundance of hydrogen ions in order to maintain the pH. The increase in carbon dioxide causes hypercarbia, hyperthermia, hyperkalemia, acidosis and metabolic acidosis. A patient can become extremely acidotic during a malignant hyperthermia crisis.

Signs and Symptoms

Table 1. Early and Late S/S of Malignant Hyperthermia

<table>
<thead>
<tr>
<th>Early Signs</th>
<th>Late Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachycardia</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Tachypnea</td>
<td>Metabolic Acidosis</td>
</tr>
<tr>
<td>Hyperthermia</td>
<td>Hypokalemia</td>
</tr>
<tr>
<td>Hypercarbia</td>
<td>Respiratory Acidosis</td>
</tr>
</tbody>
</table>

Table of signs and symptoms of malignant hyperthermia. Early signs and symptoms include tachycardia, tachypnea, hyperthermia, and hypercarbia. Late signs and symptoms include hypotension, hypokalemia, metabolic acidosis, and respiratory acidosis.

Anesthesia Testing

<table>
<thead>
<tr>
<th>Malignant Hyperthermia Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic Testing</td>
</tr>
<tr>
<td>Medical History</td>
</tr>
<tr>
<td>Physical Examination</td>
</tr>
<tr>
<td>Newborn Umbilical Cord G 6</td>
</tr>
</tbody>
</table>

Table of testing methods for malignant hyperthermia. Genetic testing, medical history, physical examination, newborn umbilical cord g 6 are methods of testing for malignant hyperthermia.

References


Chase Contri, SRNA

Figure 1. Mutation of RY1 receptor causes abundant release of calcium from sarcoplasmic reticulum that leads to a hypertensive state.

Treatment

The first step in a malignant hyperthermia crisis is to identify a patient that is undergoing a reaction and to stop the entire medical team present and aware of the situation. All potential triggers must be eliminated, this includes anything that could potentially cause the patient to become hypertensive. The progression of malignant hyperthermia will be slowed down by the use of the depolarizing muscle relaxant. The use of the depolarizing muscle relaxant will slow down the progression of malignant hyperthermia. Dantrolene is a skeletal muscle relaxant by the mechanism of inhibiting calcium release from the sarcoplasmic reticulum. By inhibiting calcium release, malignant hyperthermia can be prevented from occurring. The use of Dantrolene for a malignant hyperthermia crisis can decrease patient mortality from 70% to 5%.


Chase Contri, SRNA

Figure 1. Mutation of RY1 receptor causes abundant release of calcium from sarcoplasmic reticulum that leads to a hypertensive state.