

PURPOSE:

Malignant hyperthermia is a rare genetic disorder that manifests following treatment with anesthetic agents, most commonly Succinylcholine and halothane. Other potent inhalational anesthetics (e.g., sevoflurane, desflurane, isoflurane) can also cause malignant hyperthermia.

Background

- The onset of malignant hyperthermia is usually within one hour of the administration of general anesthesia, but rarely may be delayed up to 10 hours after induction.
- Early clinical findings in malignant hyperthermia include
 - Muscle rigidity (especially masseter stiffness or tetany)
 - Sinus tachycardia,
 - Increased CO₂ production (**first hallmark sign**)
 - Skin cyanosis with mottling.
- Marked hyperthermia (up to 45°C [113°F]) can occur minutes to hours after induction; core body temperature tends to rise 1°C every 5 to 60 minutes.
 - Hypotension, complex dysrhythmias, rhabdomyolysis, electrolyte abnormalities, disseminated intravascular coagulation (DIC), and mixed acidosis commonly accompany the elevated temperature.
- Although mortality from malignant hyperthermia appears to be declining, reported death rates range from 1 to 17 percent.
- Patients with advancing age, greater co-morbid illness, muscular build, and those who develop DIC may be at greater risk of cardiac arrest or death

Risk Factors

1. Patient with previous Malignant hyperthermia episodes
2. Family member who has experienced a Malignant hyperthermia crisis
3. Patient with a positive caffeine-halothane contracture test or who has a family member with a positive test
4. Patients with pre-existing muscle disease, e.g. Duchenne muscular dystrophy, Central Core disease, myotonia, and other unusual myopathies

Inclusion Criteria

- Patient undergoing medical care involving inhalational anesthetic or succinylcholine
 - Primarily applicable to inter-facility transports but consider in 911 responses involving ambulatory surgery center or if succinylcholine is administered by EMS

Exclusion Criteria

- Patients without immediate prior exposure to inhalational anesthetic or succinylcholine (consider other etiologies for hyperthermia)

Signs and Symptoms

1. Increasing End-Tidal CO₂
2. Muscle Rigidity
 - a. Masseter muscle spasm after administration of succinylcholine
 - b. Generalized truck or total body rigidity
3. Tachycardia/tachypnea
4. Mixed respiratory and metabolic acidosis
5. Temperature elevation (often a late sign)
6. Myoglobinuria – cola colored urine

Protocol

1. Discontinue any anesthetic or neuromuscular blockade medications or infusions.
2. If malignant hyperthermia develops during transport: Contact **MEDICAL CONTROL** to discuss diversion to closest appropriate facility with Dantrolene therapy
3. Ensure a patent airway and provide supplemental oxygen
 1. Consider hyperventilation of hypercarbia.
4. Determine core temperature and monitor frequently.
5. Expose patient and provide external cooling: For temperatures greater than 38 Celsius
 1. Wet skin with lukewarm water and allow for evaporative cooling.
 2. Place cold packs in axilla, groin, and behind knees.
6. Monitor for cardiac dysrhythmias.
7. If not already present, place (2) large bore IVs with room temperature or slightly cooled fluids [AEMT]
8. Establish continuous temperature monitoring via monitor probe.
9. If intubated, closely monitor ETCO₂ for increases despite adequate ventilation. Increase FiO₂ to 100% unless contraindicated.
10. Consider **MIDAZOLAM (VERSED) 2-5 mg IV/IO [PARA]** to control shivering and for continued sedation if intubated.
11. Assess for and treat Hyperkalemia
12. **DANTROLENE [Critical Care]:** Obtain/continue from sending facility OR help facilitate administration at receiving facility
 1. Bolus of **2.5 mg/kg IV/IO every (5) minutes** until symptoms resolve. Doses greater than **10mg/kg IV/IO** may be needed
 2. Infusion: **0.25mg/kg/hr**
 3. Dantrolone Side Effects
 - a. Difficulty in walking
 - b. Fatigue
 - c. Muscle weakness
 - d. Dizziness
 - e. Blurred vision
 - f. Nausea
 - g. Thrombophlebitis (late effect)