

**OLIVE VIEW-UCLA MEDICAL CENTER
DEPARTMENT OF ANESTHESIOLOGY
POLICY & PROCEDURE**

NUMBER: 523

VERSION: 4

SUBJECT/TITLE: 109-MALIGNANT HYPERTHERMIA

POLICY: MALIGNANT HYPERTHERMIA (MH)

- PURPOSE:**
1. TO HAVE A POLICY IN EFFECT FOR EASY REFERENCE IN CASE OF A MALIGNANT HYPERTHERMIA CRISIS.
 2. TO CONFORM TO THE MALIGNANT HYPERTHERMIA ASSOCIATION OF THE UNITED STATES IN REGARDS TO TREATMENT PROTOCOL.
 3. TO HAVE KEY FACTS REGARDING MH READILY AVAILABLE THROUGHOUT THE HOSPITAL:
 - A) MALIGNANT HYPERTHERMIA MAY OCCUR IN ANY LOCATION THAT SUCCINYLMCHOLINE OR INHALATIONAL AGENTS ARE USED.
 - B) MALIGNANT HYPERTHERMIA MAY OCCUR AFTER A TRIGGERING AGENT IS USED, EVEN WELL INTO THE RECOVERY PERIOD.
 - C) MALIGNANT HYPERTHERMIA MAY OCCUR OUTSIDE OF THE OPERATING ROOM, INCLUDING, BUT NOT LIMITED TO THE RECOVERY ROOM, SAME DAY SURGERY, THE EMERGENCY ROOM, AND THE ICU.
 3. TO RECOGNIZE THE KEY COMPONENTS OF EMERGENCY THERAPY FOR ACUTE PHASE TREATMENT OF MH:
 - A) Get help. Get Dantrolene. Notify surgeon
 - B) Dantrolene Sodium for Injection 2.5 mg/kg rapidly IV through large-bore IV, if possible
 - C) Bicarbonate for metabolic acidosis
 - D) Cool the patient
 - E) Dysrhythmias: usually responds to treatment of acidosis and hyperkalemia
 - F) Hyperkalemia
 - G) Follow: ETCO₂, electrolytes, blood gasses, CK, serum myoglobin, core temperature, urine output and color, and coagulation studies.

SUBJECT/TITLE: 109-MALIGNANT HYPERTHERMIA

Policy Number: 523

Page Number: 2

DEPARTMENTS: ANESTHESIOLOGY

DEFINITIONS: Malignant Hyperthermia (MH) is an inherited muscle disorder triggered by certain types of anesthesia (Succinylcholine and inhalational agents) that may cause a fast-acting life-threatening crisis.
The incidence of MH is low, but, if untreated, the mortality rate is high.

PROCEDURE: **PREOPERATIVE PLANNING (Anesthesia for MH-Susceptible Patient):**

Ask about personal and family past history of Malignant Hyperthermia.

1. Anesthesia machine preparation: change circuits, disable or remove the vaporizers, flush the machine. The kinetics of Sevoflurane (inhalational agents) clearance in the Fabius anesthesia machine may require flushing the machine for upwards of 90 minutes at a flow of 10 LPM.
2. Anesthesia: use local or regional anesthesia but general anesthesia with non-triggering agents is acceptable.
3. Safe drugs include: barbiturates, benzodiazepines, opioids, nondepolarizing neuromuscular blockers and their reversal drugs, and nitrous oxide.
4. Body temperature monitoring.
5. Capnography.
6. Dantrolene immediately available.
7. Pre-operative planning for outpatients may include discharge planning.

INTRAOPERATIVE (emergency therapy for UNEXPECTED MH episode):

1. **RECOGNIZE AND TREAT POSSIBLE MH:**
(Masseter spasm/rigidity after succinylcholine may portend MH)
 - May begin treatment with dantrolene for:
Limb muscle rigidity,
Unexplained tachycardia, tachypnea/hyperpnea or sweating,
Unexplained temp rise (>0.5° C/15 mins (Body temperature monitoring and capnographic monitoring for all patients having anesthesia with potential triggering agents)
Unexplained rise in ET CO₂
 - For emergent procedures, continue with non-triggering agents, evaluate and monitor the patient, and consider dantrolene treatment.
 - The carbon dioxide absorbent should be replaced, and a clean breathing circuit and breathing bag should be placed. Placing an activated charcoal filter may eliminate anesthetic gases rapidly. The filters come as a pack and are placed on both the inspiratory limb and the expiratory limb of the breathing circuit. (Published articles indicate that the activated charcoal filter scrubs the gases from the circuit. It is thought that anesthetic

SUBJECT/TITLE: 109-MALIGNANT HYPERTHERMIA

Policy Number: 523

Page Number: 3

concentration may be reduced to less than 5 ppm in fewer than 10 min.)

- Follow CK and urine myoglobin for 36 hours.

- Check CK immediately and at 6 hour intervals until returning to normal.

Observe for dark or cola colored urine. If present, liberalize fluid intake and test for myoglobin

- Observe in PACU or ICU for at least 12 hours

2. **MAKE THE DIAGNOSIS:**

DO NOT DELAY TREATMENT WITH DANTROLENE !!

Check temp with another, calibrated setup.

Check for another cause of hyperthermia.

Draw an arterial blood gas (ABG).

Call the MH Hotline 1-800-644-9737

3. **IF MH IS CONFIRMED:**

If the suspected MH episode is outside of the Operating Room, immediately call the Anesthesiologist on duty (AOD) STAT, who will bring the MH cart which contains Dantrolene.

Call for additional help, including the Pharmacist on duty.

If in the Operating room, stop anesthesia and surgery.

4. **GIVE DANTROLENE: THIS IS THE SINGLE MOST IMPORTANT THERAPY!**

RYANODEX®

Time to administer 2.5 mg/kg loading dose of RYANODEX® for a 100 kg patient is approximately 1 minute

One vial of RYANODEX® contains the same amount of dantrolene sodium as 12.5 vials of other approved formulations.

Each vial of RYANODEX® contains 250 mg of dantrolene sodium and requires reconstitution with only 5 mL of sterile water for injection vs 60 mL per vial with other formulations.

5. Increase Fresh Gas Flow (FGF) as high as possible with 100% O₂, hyperventilate and start surface cooling with ice packs. Change IV to iced NS. If a body cavity is open or an NG tube is in place, irrigate those with iced saline.

6. Start arterial line, consider central venous catheter. Draw labs: ABG, CK, myoglobin, electrolytes, Liver Function Studies, CBC, Coagulation studies.

7. Assess for acidosis. Assess initial and subsequent arterial OR venous blood gases. Give NaHCO₃ 1-2 meq/kg IV guided by the pH, base deficit.

8. Place a Foley catheter and maintain urine output (UO) at >1cc/kg/hr. Give lasix 1 mg/kg or mannitol 1 gm/kg if UO is low.

SUBJECT/TITLE: 109-MALIGNANT HYPERTHERMIA

Policy Number: 523

Page Number: 4

9. Adjust ventilation as needed, based on ABG results.
10. Treat metabolic acidosis as needed with NaHCO_3 . (kg wt x BE x 0.3)
11. Continue follow-up: repeat arterial and venous blood gases, body core temperature (avoid hyper/hypothermia), ETCO_2 , Coagulation tests, diuresis and electrolytes.
12. Stop cooling at 38°C . Patient's temp will drift downwards.

13. **MISCELLANEOUS:**

➤ **TO TREAT Dysrhythmias:**

Lidocaine may be used as the 1st medication for arrhythmias.

Arrhythmias can be treated with amiodarone, lidocaine, procainamide, adenosine, or other drugs indicated according to the ACLS protocol.

Remember impact of hyperkalemia.

NO CALCIUM CHANNEL BLOCKERS to be given !!!!!

➤ **TO TREAT HYPERKALEMIA:** CaCl_2 1 gm/5 mins or insulin 20 units in 50 cc 50% Dextrose, or bicarbonate.

Pediatric dose: 2 cc 50% dextrose/kg and 0.3 units insulin/kg.

➤ **TO TREAT DIC:** The usual measures: platelets, FFP, etc.

14. **POST OPERATIVE:**

1. Patient should go to the ICU for 24-48 hours. Watch for recurrence, arrhythmias, hyperkalemia, and renal failure, DIC. Continue dantrolene for 48 hours at least. Alkalinize urine & diurese, monitor for ARF.
2. Beware of hypothermia, hyperkalemia, hypokalemia and hypervolemic overshoot. Do serial monitoring of filling pressures, fluid balance, electrolytes, temp, K, Ca, coags, hct.
3. CK levels track severity of rhabdomyolysis. Evaluate for compartment syndrome.
4. DIC with coagulopathy, thrombocytopenia, hemolysis and abnormal bleeding may follow major crises.
5. Elevated liver functions are often observed 12-36 hours post-MH crisis.
6. Follow CNS function serially after MH crisis.

SUBJECT/TITLE: 109-MALIGNANT HYPERTHERMIA

Policy Number: 523

Page Number: 5

7. Good communication and follow-up among medical specialists to prevent secondary crisis-related organ insults. Care may be transferred from an anesthesia care provider to a pediatric, medical or surgical Intensivist.

15. Post-Acute Phase:

1. Be aware of recrudescence signs.
2. Ask the relatives about anesthesia problems/neuromuscular disorders.
3. Contact MHAUS for further information/referral of patient.
4. Dantrolene 1mg/kg IV q 4-6h and continued for 24 – 48 hr after an episode of MH.
5. Documentation: submit forms to the MH Registry: www.mhreg.org
6. Give information on patient to Chief of Anesthesia for inclusion in the department's file of MH patients.
7. Counsel family and patients. A letter is suggested.
8. Biopsy: Send the patient to a biopsy center for evaluation.

24 Hour MH Emergency Hotline:

1 (800) 644-9737
(800) MH HYPER

References:	
a) Preparation of Modern Anesthesia Workstations for Malignant Hyperthermia–susceptible Patients: A Review of Past and Present Practice. Tae W. Kim, M.D.; Michael E. Nemergut, M.D., Ph.D. Anesthesiology 1 2011, Vol.114, 205-212. doi: https://doi.org/10.1097/ALN.0b013e3181ee2cb7	
b) Malignant Hyperthermia Association of the United States website for latest updates	
Approved by: Rima Matevosian (Chief Medical Officer)	Date: 02/13/2020
Review Date: 12/13/2010, 12/22/2011, 08/24/2016, 02/13/2020	Revision Date: 9/26/2011; 12/22/2011; 8/23/2016
Next Review Date: 02/13/2023	
Distribution: Anesthesiology	
Original Date: 12/13/2010	