

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

## INITIAL EVALUATION

Assess signs and symptoms of MH:

### Early signs and symptoms:

- Tachycardia
- Tachypnea
- Abrupt increase in end tidal carbon dioxide (ETCO<sub>2</sub>)
- Muscle rigidity/masseter muscle rigidity
- Hyperthermia (temperature > 38.8°C)
- Mixed respiratory/metabolic acidosis
- Hypotension
- Cardiac arrhythmias
- Hypoxia
- Profuse sweating
- Mottling of the skin

### Late signs and symptoms:

- Acute renal/circulatory failure
- Dark colored urine due to myoglobinuria
- Disseminated intravascular coagulation
- Rhabdomyolysis (*i.e.*, myalgia, elevated creatinine kinase and blood myoglobin levels)
- Hyperkalemia
- Hyperthermia (temperature > 38.8°C)
- Hypotension
- Cardiac arrhythmias/cardiac arrest

• If MH suspected, page Anesthesia<sup>1</sup> and notify Pharmacy<sup>1</sup> STAT  
 • Bring MH cart<sup>2</sup> to bedside

MH confirmed?

Yes

**MH team lead (anesthesiologist)<sup>3</sup> assembles crisis team**

- Assigns roles to MH team members
- Assists with drawing arterial blood gases (ABGs) as needed
- Calls **MH hotline (1-800-644-9737)**

For acute phase treatment, see [Page 2](#)

No

- Monitor in current location and make arrangements for patient to transfer to a higher level of care, if clinically indicated
  - Notify ICU<sup>4</sup> regarding possible transfer
  - HALs<sup>5</sup> will require a transfer to another facility
- Initiate a Goals of Care (GOC) conversation<sup>6</sup> with the patient or if clinically indicated, with Surrogate Decision-Maker and the Primary Oncologist/Primary Team/Attending Physician. The Advance Care Planning (ACP) note should be used to document GOC discussion.

<sup>1</sup> See [Appendix A](#) for Contact Information

<sup>2</sup> **MH cart locations: Carts may be moved to offsite anesthetizing locations as needed for patient care**

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>• <b>Main building</b> <ul style="list-style-type: none"> <li>◦ Main OR in Pod B across OR 18 (G5.3638) (Badge access only)</li> <li>◦ Main IR near G3.3301A</li> <li>◦ G5 PACU behind the bay/room 59</li> <li>◦ P3.3028 (Access code only)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Mays building</b> <ul style="list-style-type: none"> <li>◦ ACB1.1269</li> <li>◦ Anesthesia storage room ACB4.2517</li> </ul> </li> <li>• <b>Proton Therapy Center</b> <ul style="list-style-type: none"> <li>◦ Next to crash cart near PTCB.2075</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Houston Area Locations (HALs)</b> <ul style="list-style-type: none"> <li>◦ The Woodlands PACU</li> <li>◦ West Houston PACU</li> </ul> </li> </ul> |
|--|---|---|

<sup>3</sup> Anesthesia providers may refer to the Optime Malignant Hyperthermia Intra-op Care Guidelines in OneConnect for an additional reference regarding management of patients with MH

<sup>4</sup> Patients < 18 years old, contact Pediatric Intensive Care Unit (PICU) at 713-745-0570 or Charge RN at 713-483-8143.

If patients are 18 – 21 years old and Pediatrics is the primary service, contact PICU at 713-745-0570 or Charge RN at 713-483-8143.

Patients ≥ 18 years old, contact Adult Intensive Care Unit (ICU) at 713-792-1101 or ICU Triage at 281-851-0979.

<sup>5</sup> Call 911 to have the patient transported via EMS to the nearest emergency center

<sup>6</sup> Refer to [GOC home page](#) (for internal use only)

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## ACUTE PHASE TREATMENT

### Cooling team member:

- Initiates cooling process **only** if patient's temperature exceeds 39°C
- Brings cold IV normal saline (NS) bags and ice
  - Packs IV NS bags in ice for infusion
  - Prepares ice packs
- **Surface cooling measures:**
  - Ice packs to body surfaces
  - Cooling blankets set temperature at 32°C, if available
- **Internal cooling measures:**
  - Nasogastric (NG) tube for stomach lavage using cold NS
  - Indwelling foley catheter for irrigation using cold NS
  - Peritoneal lavage with cold NS to cavity<sup>1</sup>
- Continuously monitors patient's temperature
- Discontinue cooling measures when temperature < 38°C

### Dantrolene Sodium (Ryanodex®) team member:

- Administers dantrolene sodium 2.5 mg/kg IV push
  - Reconstitute each vial by adding 5 mL of sterile water for injection (without a bacteriostatic agent), shake vial for over 10 seconds to ensure an orange-colored uniform suspension, and visually inspect the vial for particulate matter and discoloration prior to administration
- Subsequent doses of 1 – 2.5 mg/kg IV push should be given as needed until the patient responds with a decrease in ETCO<sub>2</sub>, decrease muscle rigidity, and/or reduction in heart rate

**Note:** Cumulative doses of 10 to 30 mg/kg may be needed.

### Medication team member:

- Assists with preparation and administration of **dantrolene sodium** and other medications

### Ventilation team member:

- Ventilates with 100% oxygen
- Adds activated charcoal filter to the ventilation circuit

### Primary nurse:

- Maintains documentation of all medications administered, procedures performed, and continued patient assessment
- Infuses cold NS intravenously
- Inserts NG tube for cold NS lavage
- Inserts foley catheter for cold NS irrigation
- Assists MH team leader
- Draws labs: ABGs, basic metabolic panel (BMP) with total calcium, creatine kinase, urine myoglobin, coagulation studies (PT/PTT/INR), and additional labs as clinically indicated

### Other symptomatic treatment:

- Manage acidosis, hyperkalemia, and dysrhythmias according to standards of care
- Avoid calcium channel blockers given risk of cardiovascular collapse when administered with dantrolene sodium
- Diurese to a target urine output of >1 mL/kg/hour

<sup>1</sup> Applicable to OR only

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## POST ACUTE PHASE TREATMENT

- Perform ongoing evaluation for signs and symptoms of MH (see [Page 1](#))
- Transfer patient to a higher level of care:
  - Notify ICU<sup>1</sup> regarding transfer
  - HALs<sup>2</sup> will require a transfer to another facility
- Initiate a Goals of Care (GOC) conversation<sup>3</sup> with the patient or if clinically indicated, with Surrogate Decision-Maker and the Primary Oncologist/Primary Team/Attending Physician. The Advance Care Planning (ACP) note should be used to document GOC discussion.
- Administer dantrolene sodium 1 mg/kg every 4-6 hours for a minimum of 24 hours. Dantrolene sodium can be stopped or the interval increased to every 8 or 12 hours, followed by discontinuation if all of the following criteria are met:
  - Metabolic stability for 24 hours
  - Core temperature < 38°C
  - Decreasing creatinine kinase level
  - No evidence of myoglobinuria
  - Resolution of muscle rigidity
- Consider sodium bicarbonate IV infusion to alkalinize urine and diuresis (target urine output > 2 mL/kg/hour) to minimize nephrotoxicity associated with myoglobinuria/rhabdomyolysis

- Complete a safety intelligence (SI) report
- Report to Malignant Hyperthermia Association of the United States (MHAUS)
  - Call **MH hotline (1-800-644-9737)**
- Provide patient education regarding MH and future precautions

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## APPENDIX A: Contact Information

Location	Information	Contact number
<b>Anesthesia</b> Anesthesia control room Anesthesia airway pager ACB Anesthesia  Proton Therapy Center	Monday - Friday 6:00 AM – 9:00 PM After hours 9:00 PM – 6:00 AM and weekends coverage  Please contact the Anesthesiologist assigned for the day	713-792-2524 (phone) 713-404-2946 (pager) 713-834-6520 (phone)  713-792-2524 (phone) 713-563-8961 (phone)
<b>Anesthesia</b> HAL – The Woodlands HAL – West Houston	Please contact the Anesthesiologist assigned for the day	832-657-2505 (phone) 281-785-9766 (phone)
<b>Main OR Pharmacy</b>	Monday - Friday 6:00 AM – 11:30 PM After hours coverage 11:30 PM – 6:00 AM	713-794-1258 (phone) 713-404-2946 (pager)
<b>ACB OR Pharmacy</b>	Monday - Friday 6:00 AM – 7:00 PM For coverage between 7:00 PM – 10:00 PM call ATC Pharmacy After hours coverage 10:00 PM – 6:00 AM	713-563-8242 (phone) 713-745-1010 (phone) 713-404-2946 (pager)
<b>The Woodlands Pharmacy</b>	Please contact the Pharmacist assigned for the day	936-446-5034 (phone)
<b>West Houston Pharmacy</b>	Please contact the Pharmacist assigned for the day	281-646-4341 (phone)

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## SUGGESTED READINGS

- Aderibigbe, T., Lang, B. H., Rosenberg, H., Chen, Q., & Li, G. (2014). Cost-effectiveness analysis of stocking dantrolene in ambulatory surgery centers for the treatment of malignant hyperthermia. *Anesthesiology: The Journal of the American Society of Anesthesiologists*, *120*(6), 1333-1338. doi:1097/ALN.0000000000000257
- Glahn, K. P., Ellis, F. R., Halsall, P. J., Müller, C. R., Snoeck, M. M., Urwyler, A., & Wappler, F. (2010). Recognizing and managing a malignant hyperthermia crisis: Guidelines from the European Malignant Hyperthermia Group. *British Journal of Anaesthesia*, *105*(4), 417-420. doi:10.1093/bja/aeq243
- Herlich, A. (personal communication, March 12, 2020)
- Hopkins, P. M., Rüffert, H., Snoeck, M. M., Girard, T., Glahn, K. P., Ellis, F. R., ... Urwyler, A. (2015). European Malignant Hyperthermia Group guidelines for investigation of malignant hyperthermia susceptibility. *British Journal of Anaesthesia*, *115*(4), 531-539. doi:10.1093/bja/aev225
- Karlet, M.C. (1998). Malignant Hyperthermia: Considerations for Ambulatory Surgery. *Journal of PeriAnesthesia Nursing*, *13*(5), 304-312. doi:10.1016/S1089-9472(98)80035-X
- Larach, M. G., Localio, A. R., Allen, G. C., Denborough, M. A., Ellis, F. R., Gronert, G. A., ... Wedel, D. J. (1994). A clinical grading scale to predict malignant hyperthermia susceptibility. *Anesthesiology*, *80*(4), 771-779. doi:10.1097/00000542-199404000-00008
- Malignant Hyperthermia Association of the United States. (2022). *Healthcare professionals*. Retrieved from <https://www.mhaus.org/healthcare-professionals/>
- MD Anderson Institutional Policy #CLN1202 - Advance Care Planning Policy  
Advance Care Planning (ACP) Conversation Workflow (ATT1925)
- Redmond, M. C. (2001). Malignant Hyperthermia: Perianesthesia Recognition, Treatment, and Care. *Journal of PeriAnesthesia Nursing*, *16*(4), 259-270. doi:10.1053/jpan.2001.25566
- Rosenberg, H., Pollock, N., Schiemann, A., Bulger, T., & Stowell, K. (2015). Malignant Hyperthermia: A review. *Orphanet Journal of Rare Diseases*, *10*(1), 93. doi:10.1186/s13023-015-0310-1

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## DEVELOPMENT CREDITS

This practice consensus algorithm is based on majority expert opinion of Malignant Hyperthermia workgroup at the University of Texas MD Anderson Cancer Center for the patient population. These experts include:

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