

Malignant Hyperthermia (MH)

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 (Patients may not exhibit all of the signs and symptoms and the timing of early and late signs may vary)

Early signs and symptoms:

- Tachycardia
- Tachypnea
- Abrupt increase in end tidal carbon dioxide (ETCO₂)
- Muscle rigidity/masseter muscle rigidity
- Hyperthermia (temperature > 38.8°C)
- Mixed respiratory/metabolic acidosis
- Hypotension
- Cardiac arrhythmias
- Hypoxia
- Profuse sweating or generalized erythematous flush
- Mottling of the skin

Late signs and symptoms:

- Acute renal/circulatory failure
- Dark colored urine due to myoglobinuria
- Disseminated intravascular coagulation (*i.e.*, bleeding at wound sites or body orifices, blood in stool/urine, chest pain)
- 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 Anesthesia¹ and notify Pharmacy¹ STAT
• Bring MH cart² to bedside

MH suspicion confirmed by Anesthesia Provider?

Yes
No

MH team lead (Anesthesia Provider)³ assembles crisis team

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

Monitor in current location and make arrangements for patient to transfer to a higher level of care, if clinically indicated
• Notify ICU⁴ regarding possible transfer
• HALs⁵ will require a transfer to another facility

¹ See [Appendix A](#) for Contact Information

² MH cart locations: Carts may be moved to offsite anesthetizing locations as needed for patient care

- **Main building**
 - Main OR in Pod B across OR 18 (G5.3638) (Badge access only)
 - Main IR near G3.3301A
 - G5 PACU behind the bay/room 59
 - P3.3028 (Access code only)

- **Mays building**
 - ACB1.1269
 - Anesthesia storage room ACB4.2517
- **Proton Therapy Center**
 - Next to crash cart near PTCB.2075
- **Proton Therapy Center 2**
 - Hallway outside of PACU 2PTC1.1134

- **Houston Area Locations (HALs)**
 - The Woodlands PACU
 - West Houston PACU
 - NW Houston Surgery Center: in hallway across from OR2
- **Life Science Pavilion (LSP)**
 - Outside Preop Room 5 LSP7.2039A

³ Anesthesia Providers or Lead MD may refer to Optime Malignant Hyperthermia Intra-op Care Guidelines (in Epic) or Stanford manual (on MH cart or anesthesia machine) for an additional reference regarding management of MH

⁴ Patients < 18 years old (or 18 - 21 years old and Pediatrics is the primary service) contact Pediatric Intensive Care Unit (PICU) at 713-745-0570 or Charge RN at 832-312-4662.

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

⁵ Call 911 to have the patient transported via EMS to the nearest emergency center

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ACUTE PHASE TREATMENT

Note: Tasks listed below may be delegated to other team members as indicated

MH team lead

- Leads MH crisis team
- Assigns roles to MH team members to initiate acute phase treatment
- Stop volatile anesthetic and succinylcholine (if applicable)
- Provides 100% oxygen
- Adds charcoal filter to ventilation circuit (for intubated patients)
- Places arterial line (if needed)

Primary Nurse:

- Assists MH team lead
- Calls **MH hotline (1-800-644-9737)**
- Assists with placing nasogastric (NG) tube, foley catheter, and arterial line
- Obtains labs: ABGs, basic metabolic panel (BMP) with total calcium, creatine kinase, urine myoglobin, coagulation studies (PT/PTT/INR/fibrinogen), and additional labs as indicated

Cooling team member:

- Obtains IV NS bags, ice packs and ice
 - Packs IV NS bags in ice for infusion
 - Prepares ice packs
- Continuously monitors patient’s core temperature
- Initiates cooling measures **only** if temperature exceeds 38°C
 - **Surface cooling measures:**
 - Applies ice packs to body surfaces (groin, axilla, around head)
 - Places cooling blanket (set temperature at 32°C) on patient (if available)
 - **Internal cooling measures**
 - Places NG tube and performs stomach lavage using cold normal saline (NS)
 - Places foley catheter and performs cold NS bladder irrigation
 - Infuses cold NS intravenously (IV)
 - Performs peritoneal lavage with cold NS to cavity¹
- Discontinues cooling measures when core temperature < 38°C

Dantrolene Sodium (Ryanodex®) team member:

- Prepares and 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 2.5 mg/kg IV push should be given every 5 to 10 minutes as needed until the patient responds with a decrease in ETCO₂, decreased muscle rigidity, and/or reduction in heart rate. Cumulative doses of >10 mg/kg may be needed.
- Alternative diagnoses should also be considered if a cumulative dose of >10 mg/kg has been administered without symptom resolution

Medication team member:

- Assists with administration of dantrolene sodium
- Prepares and administers all other necessary medications

Documentation team member:

- Maintains documentation of all medications administered, procedures performed, and continued patient assessment

Other treatment as clinically indicated:

- 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

Proceed to post acute phase treatment after the acute phase of MH has resolved (see [Page 3](#))

ABG = arterial blood gas ¹ Applicable to OR only

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POST ACUTE PHASE TREATMENT

- Perform ongoing evaluation for signs and symptoms of MH recurrence (see [Page 1](#))
- Transfer patient to a higher level of care:
 - Notify ICU¹ regarding transfer
 - HALs² will require a transfer to another facility
- 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 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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If patients are 18 - 21 years old and Pediatrics is the primary service, contact PICU at 713-745-0570 or Charge RN at 832-312-4662.
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APPENDIX A: Contact Information

Location	Information	Contact number
Anesthesia - TMC Anesthesia control room Anesthesia airway pager ACB Anesthesia Proton Therapy Center Proton Therapy Center 2 Life Science Pavilion	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 Please contact the Anesthesiologist assigned for the day Please contact the Anesthesiologist assigned for the day Monday - Friday 6:30 AM – 6:30 PM	713-792-2524 (phone) 713-404-2946 (pager) 713-834-6520 (phone) 713-792-2524 (phone) 713-563-8961 (phone) 713-563-8961 (phone) 713-410-3899 (phone)
Anesthesia - HALs The Woodlands West Houston Northwest Houston Surgery Center	Please contact the Anesthesiologist assigned for the day Please contact the Anesthesiologist assigned for the day	832-657-2505 (phone) 281-785-9766 (phone) 713-501-6694 (phone)
Main OR Pharmacy	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)
ACB OR Pharmacy	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)
The Woodlands Pharmacy	Please contact the Pharmacist assigned for the day Monday - Friday 6:30 AM – 6:00 PM	936-446-5034 (phone)
West Houston Pharmacy	Please contact the Pharmacist assigned for the day Monday - Friday 6:30 AM – 6:30 PM	281-646-4341 (phone)
Northwest Houston Surgery Center Pharmacy	Please contact the Pharmacist assigned for the day Monday - Friday 6:00 AM – 10:30 PM	713-794-1116 (phone)
Life Science Pavilion Pharmacy	Monday - Friday 6:30 AM – 6:30 PM	832-750-7525 (phone)

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SUGGESTED READINGS

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DEVELOPMENT CREDITS

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

Core Development Team Lead

- Leigh Avery, MSN, RN (Nursing ICU)
- Jessica K. Brown, MD (Anesthesiology & PeriOper Medicine)
- Jeff Bruno, PharmD, BCCCP, FCCM (Pharmacy Clinical Programs)
- Garry Brydges, DNP, MS, RN (Anesthesiology)
- Staci Eguia, MSN, RN (Nursing Post Anesthesia - West Houston)
- Kenneth Sapire, MD (Anesthesiology & PeriOper Medicine)
- Clint Westaway, MSN, APN (Anesthesiology)

Workgroup Members

- | | |
|---|--|
| Raina Auzenne, MSN, RN (Nursing Education) | Sarah Morana, MSN, RN, CNOR (Nursing Education) |
| LaSandra Brown, PhD, MBA, RN, CNOR, NPD-BC (Nursing Education) | Julie P. Nguyen, PharmD (Pharmacy – The Woodlands) |
| Karen Chen, MD (Critical Care Medicine) | Soo Ok, RN (Nursing Post Anesthesia) |
| Mary Ann Del Rosario, MSN, RN, CAPA (Nursing Post Anesthesia) | Kimberly A. Potts, MSN, RN, CNOR (Main OR Nursing) |
| Olga N. Fleckenstein, BS♦ | Elsy Puthenparampil, DNP, RN (Nursing Post Anesthesia) |
| Stefani Gautreaux, PharmD, MBA (Pharmacy Operations) | Jenise Rice, MSN, RN (Perioperative Nursing) |
| Thoa Kazantsev, MSN, RN, OCN♦ | Jermeca Robinson, MSN, RN (Nursing Education) |
| Cori Kopecky, MSN, RN (Nursing – Sugar Land) | Leonard H. Roes III, PharmD (Pharmacy Inpatient) |
| Piotr A. Kwater, MD (Anesthesiology & PeriOper Medicine) | Maritza Salazar-Abshire, M.Ed, RN (Nursing Education) |
| Lorraine S. Layton, BSN, RN (Hemovigilance Office) | Mark Templonuevo, BA, BS, RN (Nursing Informatics) |
| Brittnee MacIntyre, MSN, APRN, FNP-C♦ | Armond C. Trimier, PharmD (Pharmacy – West Houston) |
| Maria F. Ramirez Manotas, MD (Anesthesiology & PeriOper Medicine) | Uduak Ursula Williams, MD (Anesthesiology & PeriOper Medicine) |
| M. Estela Mireles, PharmD (Pharmacy Clinical Programs) | Acsa Zavala, MD (Anesthesiology & PeriOper Medicine) |

♦ Clinical Effectiveness Development Team