

# EMERGENCY THERAPY FOR MALIGNANT HYPERTHERMIA

## DIAGNOSIS

### Signs of MH:

- Increased ETCO<sub>2</sub>
- Trunk or total body rigidity
- Masseter spasm or trismus
- Tachycardia/tachypnea
- Acidosis
- Increased temperature (may be late sign)

### Sudden/Unexpected Cardiac Arrest in Young Patients

- Presume hyperkalemia and initiate treatment (see #6)
- Measure CK, myoglobin, ABGs, until normalized
- Consider dantrolene
- Usually secondary to occult myopathy (e.g., muscular dystrophy)
- Resuscitation may be difficult and prolonged

### Trismus or Masseter Spasm with Succinylcholine

- Early sign of MH in many patients
- If limb muscle rigidity, begin treatment with dantrolene
- For emergent procedures, continue with non-triggering agents; consider dantrolene
- Follow CK and urine myoglobin for 36 hours at least. Check CK immediately and at 6-hour intervals until returning to normal. Observe for cola colored urine. If present, test for myoglobin.
- Observe in PACU or ICU for at least 12 hours

## ACUTE PHASE TREATMENT

### GET HELP. GET DANTROLENE –

#### 1 Notify Surgeon.

- Discontinue volatile agents and succinylcholine.
- Hyperventilate with 100% oxygen at flows of 10 L/min. or more.
- Halt the procedure as soon as possible; if emergent, use non-triggers.

*(The circle system and CO<sub>2</sub> absorbent need not be changed.)*

#### 2 Dantrolene 2.5mg/kg rapidly IV through large-bore IV, if possible

*To convert kg to lbs for amt of dantrolene, give patients 1 mg/lb (2.5 mg/kg approximates 1 mg/lb).*

- Repeat until there is control of the signs of MH.
- Sometimes more than 10 mg/kg (up to 30 mg/kg) is necessary.
- Dissolve the 20 mg in each vial with at least 60 ml **sterile preservative-free water** for injection. Prewarming (not to exceed 38°C) the sterile water will speed solubilization of dantrolene.

- The crystals also contain NaOH for a pH of 9; each 20 mg bottle has 3 gm mannitol for isotonicity.

#### 3 Bicarbonate for metabolic acidosis.

- 1-2 mEq/kg if blood gas values are not yet available.

#### 4 Cool the patient with core temperature >39°C.

- Lavage open body cavities, stomach, bladder, or rectum. Apply ice to surface. Infuse cold saline intravenously. Stop cooling if temp. <38°C and falling to prevent drift <36°C.

#### 5 Dysrhythmias usually respond to treatment of acidosis and hyperkalemia.

- Use standard drug therapy **except calcium channel blockers, which may cause hyperkalemia or cardiac arrest in the presence of dantrolene.**

#### 6 Hyperkalemia - Treat with hyperventilation, bicarbonate, glucose/insulin, calcium.

- Bicarbonate 1-2 mEq/kg IV.

- For **pediatric**, 0.1 units insulin/kg and 1 ml/kg 50% glucose **or** for **adult**, 10 units regular insulin IV and 50 ml 50% glucose.

- Calcium chloride 10 mg/kg or calcium gluconate 10-50 mg/kg for life-threatening hyperkalemia.
- Check glucose levels hourly.

#### 7 Follow ETCO<sub>2</sub>, electrolytes, blood gases, CK, core temperature, urine output and color, coagulation studies.

- If CK and/or K<sup>+</sup> rise more than transiently or urine output falls to less than 0.5 ml/kg/hr, induce diuresis to >1 ml/kg/hr urine to avoid myoglobinuria-induced renal failure.
- Venous blood gas (e.g., femoral vein) values may document hypermetabolism better than arterial values.
- Central venous or PA monitoring as needed and record minute ventilation.
- Place Foley catheter and monitor urine output.

## POST ACUTE PHASE

- A** Observe the patient in an ICU for at least 24 hours, due to the risk of recrudescence.

- B** Dantrolene 1 mg/kg q 4-6 hours or .25 mg/kg/hr by infusion for at least 24 hours. Further doses may be indicated.

- C** Follow vitals and labs as above (see #7)
- Frequent ABC
  - CK every 6 hours

- D** Follow urine myoglobin and institute therapy to prevent myoglobin precipitation in renal tubules and the subsequent development of Acute Renal Failure. Follow standard intensive care therapy for acute rhabdomyolysis and myoglobinuria (urine output > 200 ml/h, alkalinization of urine with Na-bicarbonate infusion with careful attention to both urine and serum pH values, etc.).

- E** Counsel the patient and family regarding MH and further precautions; refer them to MHAUS. Fill out and send in the Adverse Metabolic Reaction to Anesthesia (AMRA) form ([www.mhreg.org](http://www.mhreg.org)) and send a letter to the patient and her/his physician. Refer patient to the nearest Biopsy Center for follow-up.

### Non-Emergency Information

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**CAUTION:** This protocol may not apply to all patients; alter for specific needs.