EMERGENCY THERAPY FOR
MALIGNANT HYPERThERMIA

DIAGNOSIS vs. ASSOCIATED PROBLEMS

Signs of MH:
- Increasing ETCO2
- Trunk or total body rigidity
- Masseter spasm or trismus
- Tachycardia/tachypnea
- Mixed Respiratory and Metabolic Acidosis
- Increased temperature (may be late sign)
- Myoglobinuria

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, evaluate and monitor the patient, and consider dantrolene treatment
- 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

ACUTE PHASE TREATMENT

1 GET HELP. GET DANTROLENE – 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, continue with non-triggering anesthetic technique.
- Don’t waste time changing the circle system and CO2 absorbant.

2 Dantrolene 2.5 mg/kg rapidly IV through large-bore IV, if possible
To convert kg to lbs for amount of dantrolene, give patients 1 mg/lb (2.5 mg/kg approximates 1 mg/lb).
- Dissolve the 20 mg in each vial with at least 60 ml sterile, preservative-free water for injection.
- Prewarming (not to exceed 39º C.) the sterile water may expedite solublization of dantrolene.
- Infuse cold saline intravenously. Stop cooling if temp. <38ºC and falling to prevent drift < 36ºC.

3 Bicarbonate for metabolic acidosis
- 1-2 mEq/kg if blood gas values are not yet available.

4 Cool the patient with core temperature >39ºC. Lavage open body cavities, stomach, bladder, or rectum. Apply ice to surface.

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 ETCO2, electrolytes, blood gases, CK, core temperature, urine output and color, coagulation studies. If CK and/or K+ rise more than transiently or urine output falls to less than 0.5 ml/kg/hr, induce diuresis to >1 ml/kg/hr and give bicarbonate to alkalize urine to prevent myoglobinuria-induced renal failure. (See D below)
- 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

8 Observe the patient in an ICU for at least 24 hours. Due to the risk of recrudescence.
9 Dantrolene 1 mg/kg q 4-6 hours or 0.25 mg/kg/hr by infusion for at least 24 hours. Further doses may be indicated.
- Follow vitals and labs above (see #7)
- Frequent ABGs as per clinical signs
- CK every 8-12 hours; less often as the values trend downward

Follow urine myoglobin and institute therapy to prevent myoglobin precipitation in renal tubules and the subsequent development of Acute Renal Failure. CK levels above 10,000 IU/L is a presumptive sign of rhabdomyolysis and myoglobinuria. Follow standard intensive care therapy for a acute rhabdomyolysis and myoglobinuria (urine output >2 ml/kg/hr by hydration and diuretics along with alkalization of urine with Na-bicarbonate infusion with careful attention to both urine and serum pH values).
- 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) and send a letter to the patient and her/his physician. Refer patient to the nearest Biopsy Center for follow-up.

CAUTION:

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