Emergency Therapy for MALIGNANT HYPERTERMIA

CAUTION! This protocol may not apply to all patients; refer for specific needs. Effective February 2015

DIAGNOSIS

Signs of MH:
• Increasing ETCO₂ (despite hyperventilation)
• Trunk or total body rigidity
• Masseter spasm or trismus
• Tachycardia/tachypnea
• Mixed respiratory and metabolic acidosis (MH can occur without significant metabolic acidosis)
• Increased temperature (may be an early or late sign)
• Myoglobinuria

Sudden/Unexpected Cardiac Arrest in Young Male Patients:
• Presume hyperkalemia and initiate treatment (see #5)
• Measure blood gases and electrolytes
• Measure CK, myoglobin, ABGs, until normalized
• Usually secondary to occult myopathy (e.g., muscular dystrophy)
• Resuscitation may be difficult and prolonged
• Myoglobinuria is common

Trismus or Masseter Spasm with Succinylcholine
• Early sign of MH in many patients
• If limb muscle rigidity, begin treatment with dantrolene
• For emergency procedures, continue with nontriggering agents, evaluate and reorient the patient, and consider dantrolene treatment
• Check CK immediately and at 6-8 hr intervals until returning to normal. Observe for dark or colocalized urine. If present, liberalize fluid intake and test for serum and urine myoglobin. (see D below)
• Observe in PACU or ICU for at least 24 hours if metabolic signs of MH were present.

ACUTE PHASE TREATMENT

GET HELP. GET DANTROLENE. Notify Surgeon. Call MH Hotline.

• Discontinue volatile agents and succinylcholine.
• Hyperventilate with 100% oxygen at flows of
• Muscle spasm or trismus
• Tachycardia/tachypnea
• Mixed respiratory and metabolic acidosis
• Halt the procedure as soon as possible; if it is not possible to stop surgery, continue with nontriggering anesthetic technique
• Don’t waste time changing the circle system and CO₂ absorbent.

Dantrolene®/Revonto®/Ryanodex®

2.5 mg/kg rapidly IV if possible through large-bore IV
• Dantrolene—Each 250 mg vial should be reconstituted with 5 mL sterile water for injection, USP (without a bacteriostatic agent). There are 3 grams of mannitol in each 250 mL vial of Ryanodex.
• Dantrium—Each 20 mg vial should be reconstituted with at least 60 mL sterile water for injection, USP without a bacteriostatic agent. There are 3 grams of mannitol in each 20 mg vial of Dantrium and Revonto.

• Ryanodex—Each 250 mg vial should be reconstituted with 5 mL sterile water for injection, USP (without a bacteriostatic agent) and shaken to ensure an orange-tinged uniform, opaque suspension. There are 125 mg of mannitol in each 250 mg vial of Ryanodex.
• Repeat until signs of MH are reversed.
• Sometimes more than 10 mg/kg (up to 30 mg/kg) of dantrolene may be needed.

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

Cool the patient
• If core temperature > 39°C Apply ice to surface
• Infuse cold saline intravenously
• Lavage open body cavities
• Other cooling techniques may be applied at clinician’s discretion
• Stop cooling if temperature > 38°C and failing to prevent hyperthermia

Hyperkalemia
• Treat with hyperventilation, bicarbonate, glucose/insulin, calcium.
• Bicarbonate 1-2 mEq/kg IV
• For pediatric, 0.1 units regular insulin/kg and 2 mL/kg 25% dextrose or for adult, 10 units regular insulin IV and 50 mL 50% dextrose
• Calcium gluconate 10-50 mg/kg IV for life-threatening hyperkalemia
• Check glucose levels hourly.

Follow...

ETCO₂, minute ventilation 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 and prevent myoglobinuria-induced renal failure (see D below)
• Venous blood gas (e.g., femoral vein) values may document hypermetabolism earlier than arterial values
• Central venous or PA monitoring as needed
• Place Foley catheter and monitor urine output.

POST ACUTE PHASE

• CK every 4 hours, less often if the values trend downward
• Follow urine myoglobin and induce therapy to prevent myoglobin 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 acute rhabdomyolysis and myoglobinuria by hydration and diuretics (urine output >2 mL/kg/hr) along with alkalization of urine with Na-bicarbonate infusion and careful attention to both urine and serum pH values.
• Constant 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/registry) and send a letter to the patient and/or her physician. Refer patients the North American MH Registry and the nearest B霹yp Center for follow-up.

DIAGNOSIS

Dysrhythmias
• Usually responds to treatment of acidosis and hyperkalemia.
• Use standard drug therapy EXCEPT avoid calcium channel blockers — (may cause hyperkalemia or cardiac arrest in the presence of dantrolene)

Non-Emergency Information:
MHAUS
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Phone: 1-800-986-4287 (617-674-7910)
Fax: 617-674-7910

Email: info@mhaus.org
Website: www.mhaus.org

MH Hotline: 1-800-644-9737 • Outside the US: 001-209-417-3722

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