Emergency Therapy for MALIGNANT HYPERTHERMIA

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

DIAGNOSIS

Signs of MH:
- Increasing $ETCO_2$ despite hyperventilation
- Trunk or total body rigidity
- Masseter spasm or trismus
- Tachycardia/tachypnea
- Mixed respiratory and metabolic acidoses (MH can occur without significant metabolic acidoses)
- Increased temperature (may be an early or a late sign)
- Myoglobinuria

Sudden/Unexpected Cardiac Arrest in Young Male Patients:
- Presume hyperkalemia and initiate treatment (see #6)
- Measure blood gases and electrolytes
- Measure CK, myoglobin, ABGs, until normalized
- Usually secondary to myocarditis (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 non-triggering agents, evaluate and monitor the patient, and consider dantrolene treatment.
- Check CK immediately and at 6-8 hr intervals until returning to normal. Observe for dark or cola-colored 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.

POST ACUTE PHASE

Dysrhythmias
- Usually responds to treatment of acidoses and hyperkalemia.
- Use standard drug therapy

EXCEPT avoid calcium channel blockers—(may cause hyperkalemia or cardiac arrest in the presence of dantrolene).

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, 0.1 units regular insulin/kg and 50 mL 50% dextrose
- Calcium gluconate 10.50 mg/kg IV for life-threatening hyperkalemia
- Check glucose levels hourly.

Follow...

ETCO$_2$, minute ventilation electrolytes, blood gases, CK, core temperature, urine output and color, coagulation studies. If CK and/or CAK rise more than transient 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.

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

ACUTE PHASE TREATMENT

1. GET HELP. GET DANTROLENE. Notify Surgeon. Call MH Hotline.
- Discontinue volatile agents and succinylcholine.
- Hyperventilate with 100% oxygen at flows of 10 L/min. to flush volatile anesthetics and lower $ETCO_2$.
- If available insert activated charcoal filters into the inspiratory and expiratory limbs of the breathing circuit. The VaporClean® filter may become saturated after one hour; therefore, a replacement set of filters should be substituted after each hour of use.
- Halve the procedure as soon as possible, if it is not possible to stop surgery, continue with non-triggering anesthetic technique.
- Don’t waste time changing the circle system and CO$_2$ absorbent.

2. Dantrium®/Revonto®/Ryanodex®
- 2.5 mg/kg rapidly IV, if possible through large-bore IV
- To convert kg to lbs for amount of dantrolene, give patients 1 mg/kg (0.5 mg/kg approximates 1 mg/lb)
- Dantrium/Revonto—Each 20 mg vial should be reconstituted with at least 60 mL sterile water for injection, USP (without a bacteriostatic agent) and administered at a rate of 2 mL/ms.
- Ryanodex—Each 250 mg vial should be reconstituted with 5 mL sterile water for injection, USP (without a bacteriostatic agent) and administered at a rate of 2 mL/ms.
- Limiting the rate of administration is necessary.
- Sometimes more than 10 mg/kg (up to 30 mg/kg) of dantrolene is necessary.

3. Bicarbonate for metabolic acidoses
- 1.2 mEq/kg if blood gas values are not yet available

4. 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.

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