MALIGNANT HYPERTHERMIA

Malignant hyperthermia (MH) is an uncommon pharmacogenetic disorder of muscle induced by exposure to suxamethonium and all the volatile anaesthetic agents. It is characterized by hypermetabolism, muscle rigidity and muscle injury.

SIGN AND SYMPTOMS

The clinical features are a direct consequence of loss of skeletal muscle calcium homeostasis, resulting in increased intracellular calcium ion concentration, which causes **muscle rigidity, hypermetabolism,** and **rhabdomyolysis.** The diagnosis may be difficult as there is no one sign that is unique to MH, and the onset may be rapid or insidious.

1.Unexplained **increased CO2 production** and **tachycardia.** The rise in CO2 production results in **tachypnoea** in the spontaneously breathing patient or a rise in end-tidal CO2 in a ventilated patient.

Elevation of the end-tidal CO2 - earliest, most sensitive and specific signs of MH.

2. **BP** is often unstable, with a tendency for decreasing SpO2.

3. **Increase in body temperature** occurs later, and may be at a rate of > 1 ◦ C every 5 minutes.

4. **Generalised muscle rigidity, raised plasma CK** and **myoglobinuria** are late signs.

5. **Cardiac arrhythmias, hyperkalaemia and disseminated intravascular coagulation may develop**

6. **Arterial blood gas analysis -** hypercarbia with respiratory and metabolic acidosis.

Masseter muscle spasm

Rigidity of the jaw muscles after administration of suxamethonium, referred to as masseter muscle spasm (MMS) may be the first sign of possible susceptibility to MH. It is defined as impeding intubation and lasting for 2 minutes. It is more common in children and young adults.

Sudden or unexpected cardiac arrest in young patient

ACUTE PHASE TREATMENT

1. **GET HELP. GET DANTROLENE and Notify Surgeon**
    - Discontinue volatile agents and succinylcholine
    - Hyperventilate with 100% oxygen at flows of 10L/min or more
    - Halt the procedure as soon as possible; if emergent, use non-triggers. (Use GA machine without vaporisers or use ICU ventilator)
2. **Dantrolene 2.5mg/kg rapidly IV**
    - Repeat until there is control of the sign of MH

	• Sometimes more than 10 mg/kg (Up to 30mg/kg) is necessary
	• Dissolve the 20mg in each vial with at least 60ml **sterile preservative-free water** for injection. Prewarming (not to exceed 38^{o}C) the sterile water will speed solublization of dantrolene.
	• The crystals also contain NAOH for a PH of 9, mannitol 3g.
3.	**Bicarbonate for metabolic acidosis**
	• 1-2mEq/kg if blood gas values are not yet available
4.	**Cool** the patient with core temperature >39^{o}C, via cold saline IV. Lavage open body cavities, stomach, bladder or rectum. Apply ice to surface. Stop cooling if temp. <38^{o}C and falling to prevent drift <36^{o}C.
5.	**Dysrhythmias** usually respond to treatment of acidosis and hyperkalaemia
	• Use standards drug therapy **except calcium channel blockers which may cause hyperkalaemia or cardiac arrest in the presence of dantrolene**
6.	**Hyperkalaemia** – Treat with hyperventilation, bicarbonate, glucose/insulin, calcium
	• Bicarbonate 1-2mg/kg IV
	• For **Paediatric,** 0.1 units insulin/kg and 1ml/kg 50% glucose or for **Adult,** 10 units regular insulin IV and 50ml 50% glucose
	• Calcium gluconate 10% 10-50mg/kg for life-threatening hyperkalaemia
	• Check glucose level hourly
7.	**Monitor** – $ETCO_2$, electrolytes, blood gases, CK, core temperature, urine output and colour, coagulation studies
	• Venous blood gas (e.g., femoral vein) values may document hypermetabolism better than arterial values
	• Central venous or PA monitoring as indicated • Minute ventilation
POST ACUTE PHASE	
A	Observe the patients in an ICU for at least 36 hours, due to the risk of recrudescence
B	Dantrolene 1mg/kg q 4-6 hours or 0.25mg/kg/hr by infusion for at least 36 hours. Further doses may be indicated.
C	Monitor vitals and labs as above (see #7)
	• Frequent ABG
	• CK every 6-8 hours
D	Counsel the patient and family regarding MH and further precautions

CONTENTS OF MALIGNANT HYPERTHERMIA CART

	Items	**Quantity**	**Purpose**
1	Dantrolene	At least 12 vials	——
2	Sterile water for injection	3 liter	Reconstitution of dantrolene
3	50mL syringes and 14 gauge needles	12	Draw up dantrolene
4	Lignocaine	5 ampoules	Bolus and continuous infusion
5	Amiodarone	5 ampoules	Bolus and continuous infusion
6	Dextrose 50%	4 ampules	Treatment of hyperkalemia
7	Mannitol 25%	1 bag	Renal protection
8	Frusemide	200 mg	Renal protection
9	Sodium bicarbonate 8.4%	(10 ampules)	Treatment of metabolic acidosis
10	Calcium gluconate 10%	4 ampules	Treatment of hyperkalemia
11	Adrenaline 1 mg	4 ampules	Treatment of hypotension
12	Normal saline (refrigerated)	6 L	For injection and irrigation

OTHERS :

Also included on the cart: crushed ice or ice maker, irrigating Foley catheter, rectal tube, cooling blanket, central venous access kits,
pulmonary artery catheter, new fresh gas hose, carbon dioxide–absorption canisters, anesthesia breathing circuit,ventilator bellows,
blood-collection tubes, lab slips, labels

PRIVATE AND CONFIDENTIAL **Report for suspected Malignant Hyperthemia Reaction**			
Hospital :			
Patient Contact Details (or Sticker)			
Patient Name :			
IC :			
Address :			
Phone :		Mobile :	
Date of Birth :		sex :	
Name and Contact details of Doctor Completing This Form :			
Name :			
Address (Hosp) :			
Phone :	Mobile :	Email :	
Events			
Date of Procedure :			
Name of Procedure :			
Name of Anaesthetist :			
Drugs administered and doses **(attach a copy of the anaesthetic chart) :**			
Description of events and suspected drug (s) :			
Patient's usual medications :			
Family history of muscle disorders, anaethetics reactions or sudden unexplained death ?			
Number of previous uneventful anaesthetic procedures :			
Untoward events during previous anaesthetic procedures ?			
Reaction (s) :			
Muscle Rigidity			
Generalized Rigidity		Masseter Rigidity shortly following Succinyl choline administration	

Myonecrosis				
Elevated Creatinine Kinase > 10,000 IU (no sux)			Myoglobin in Urine (> 60mcg/L)	
Elevated Creatinine Kinase > 20,000 IU (with sux)		Blood /plasma/serum K^+ >6 mEq/L in the absence of renal failure		
Cola Coloured Urine		Myoglobin in serum > 170 mcg/L		
Respiratory Acidosis				
ET CO2 > 55 mmHg with appropriately controlled ventilation		Inappropriate hypercarbia		
ET CO2 > 60 mmHg with spontaneous ventilation		Inappropriate tachypnoea		
PaCO2 > 60 mmHg with controlled ventilation		PaCO2 > 65 mmHg with spontaneous ventilation		
Temperature Increase				
Rapid increase in temperature		Inappropriate temperature > 38.8^{o}C in the perioperative period		
Cardiac Involvement				
Inappropriate tachycardia		VT or VF		
Other				
Rapid reversal of MH signs with Dantrolene		Base excess >- 8meq/L or pH < 7.25		
Positive MH family history together with another indicator from the patients own anaesthetic experience other than elevated resting serum creatine kinase				
Resting elevated serum creatine kinase (in patient with a family history of MH)				
Family History (Used to determine MH susceptibility only)				
Positive MH family history in relative of first degree				
Positive MH family history in relative not of first degree				
*** Please send the completed form to Anaesthetic Department, Hospital Kuala Lumpur.**				