

Mixing with NS causes cloudiness and undissolved particles

With saline, amount of Dantrolene "in solution" is reduced by 40%



Dantrolene

It is not wrong to administer dantrolene **before** the diagnosis is definitive.

Side-effects are generally self-limiting.

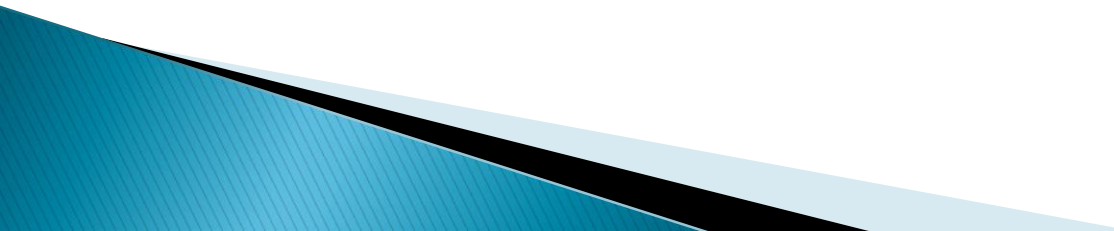


Dantrolene

Better to give dantrolene early than to miss the opportunity to reverse the process at an early stage.



Continue Dantrolene until:

- End tidal CO₂ improved
 - Decreased ventilation required and CO₂ levels <45
 - Decrease Heart Rate
 - Acidosis resolved
 - Decrease muscle rigidity
 - If situation worsen may have to increase Dantrolene dose.
- 

How the 3 MH Antidotes Stack Up



Revonto



Dantrium

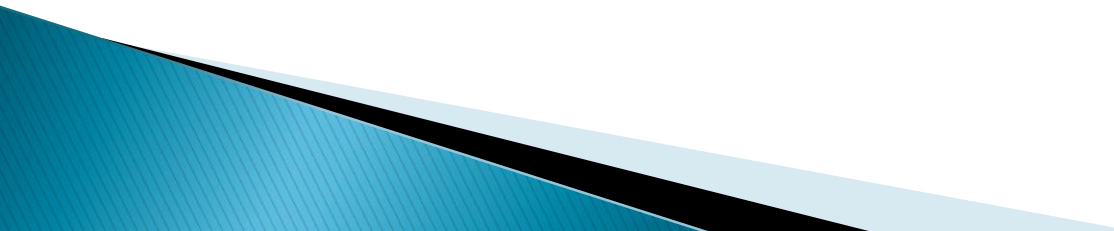


Ryanodex

| Manufacturer | US WorldMeds | Par Pharmaceutical | Eagle Pharmaceuticals |
|-----------------------------------|------------------|--------------------|-----------------------|
| Dantrolene dose per vial | 20 mg | 20 mg | 250 mg |
| Number of vials for initial dose* | 8 vials (520 mL) | 8 vials (560 mL) | 1 vial (5 mL) |
| Water to reconstitute 1 vial | 60 mL | 60 mL | 5 mL |
| Vials required to stock | 36 | 36 | 3 |
| Price | \$2,500 | \$2,340 | \$7,500 |
| Shelf life | 3 years | 3 years | 2 years |

Assumes a 143-lb. person at 2.5 mg/kg

Other Drugs That May Be Needed:

- ▶ **Regular Insulin** (Blue Bin)-Treatment of hyperkalemia
 - ▶ **Calcium Chloride**-Treatment of life-threatening hyperkalemia (Drawer #1)
 - ▶ **Lidocaine or Amiodarone**-To treat arrhythmias
 - ▶ **Sodium Bicarb**-Metabolic acidosis (Drawer #1)
 - ▶ **Lasix**-Increase urine output to prevent renal failure (Drawer #2)
- 

MHAUS 1982 Developed 24 Hour Hotline

MH Hotline: 1-800-644-9737

M-Malignant
H-Hyperthermia
A-Association
U-United
S-States



Standard Diagnostic Test:

- ▶ Not performed on children
- ▶ **Caffeine-halothane contracture test.** Incision in quadriceps muscle. Small piece of muscle removed. Immersed in solution of caffeine/or halothane.



- ▶ Most develop within 1 hour of anesthesia, but delayed MH can occur in PACU or ICU
- ▶ Physiological changes may not present in any particular sequence

ASC



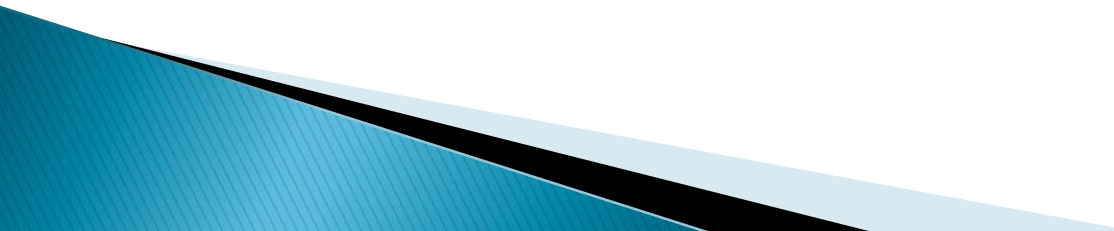
- ▶ Initial efforts should be focused on administration of Dantrolene.
- ▶ Emergency Medical Services should be notified ASAP to transport patient to a full service medical center with intensive care services.
- ▶ Yearly review of MH with drills.
- ▶ MH cart/Pharmacy has 36 vial on hand within 5 minutes of onset.

In ICU



- ▶ Dantrolene 1m/kg every 6 hours x 24–36 hours,
- ▶ EKG, art line, urinary catheter, temperature, 2nd IV line
- ▶ Capnography
- ▶ Monitor and treatment for specific abnormalities

Discharge

- ▶ Refer patient and family to MH center for testing
 - ▶ Recommend registry in MHAUS data base
 - ▶ Recommend medical alert bracelet
- 

| | |
|-----------|---|
| 1960 | 1 st case of MH |
| 1963 | Inherited Component Suggested |
| 1960's | Toronto and Wisconsin MH Families Identified |
| 1971 | International Symposium Toronto |
| 1971 | CHCT muscle biopsy described |
| 1975 | Dantrolene found to be specific treatment (FDA approved in 1979) |
| 1981-1982 | Patient advocacy groups formed |
| 1982 | Use of intraoperative capnography helped to determine early detection |
| 1990's | R1RT gene mutation discovery |
| 2000's | Genetic testing available |

Top of cart

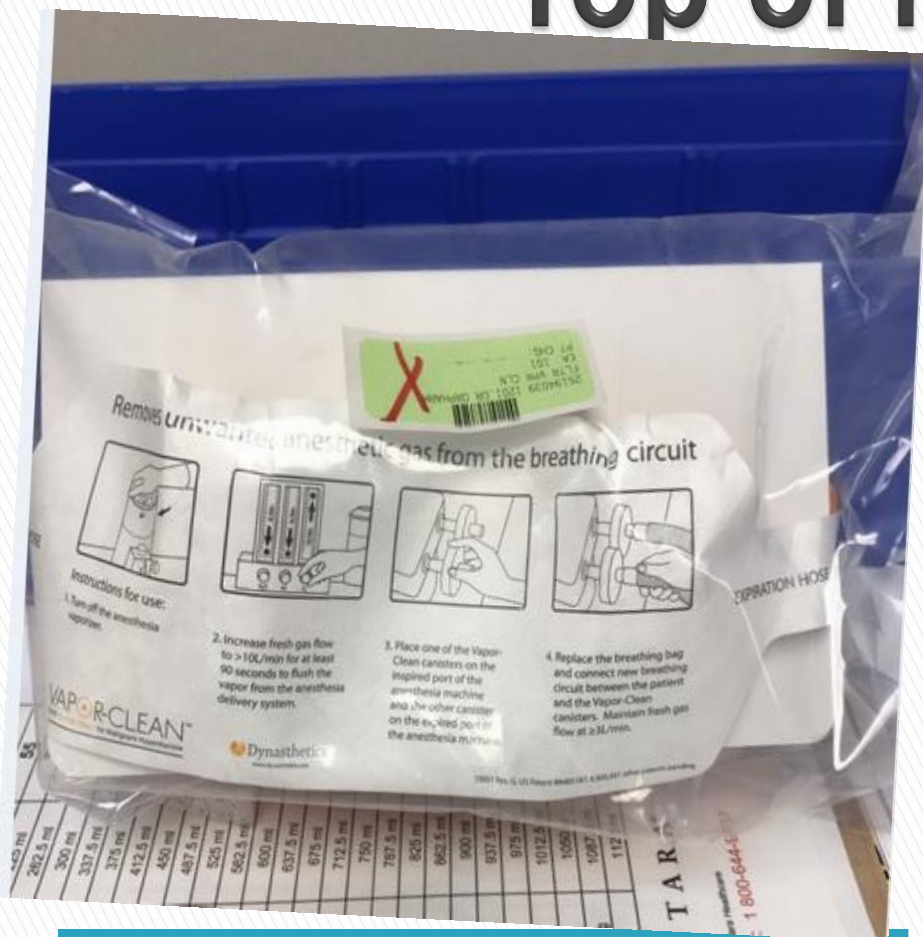
MALIGNANT HYPERTHERMIA CART

ATTENTION!!! TAKE REFRIG ITEMS

MH EMERGNCEY HOTLINE

00-644-9739 ASK FOR INDEX

Top of MH Cart



Vapor Clean



90 Second Anesthesia Machine Preparation
For MH-Susceptible Patients

Vapor Clean



Drawer 1



BLOOD TUBING

10% CALCIUM CHLORIDE

50% DEXTROSE

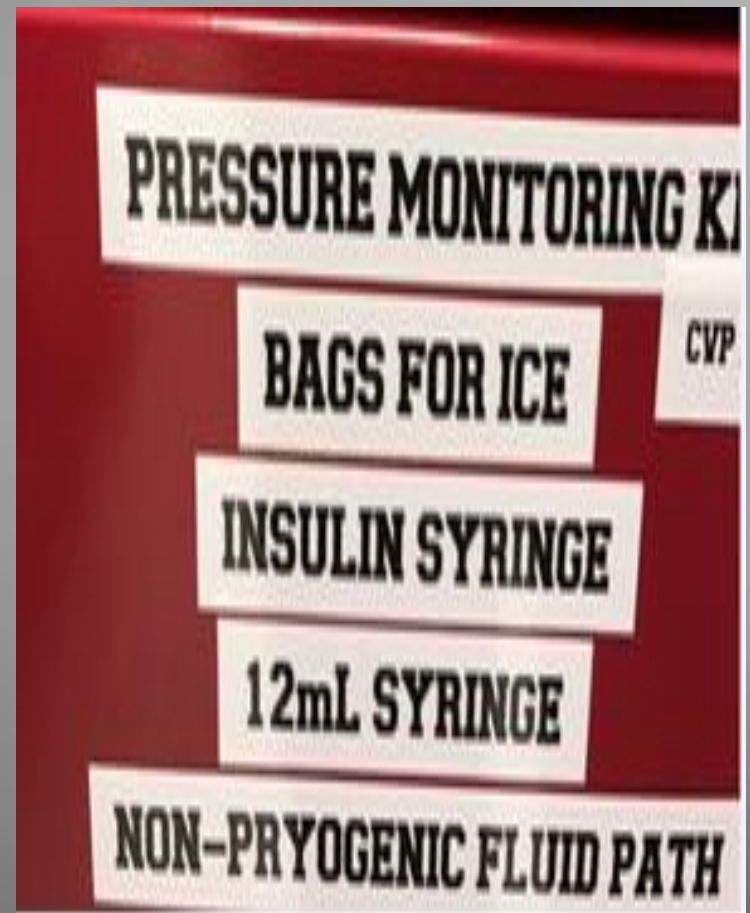
60mL SYRINGE

EXTENSION SET

MICRO PIN

8.4% SODIUM BICARB

Drawer 2

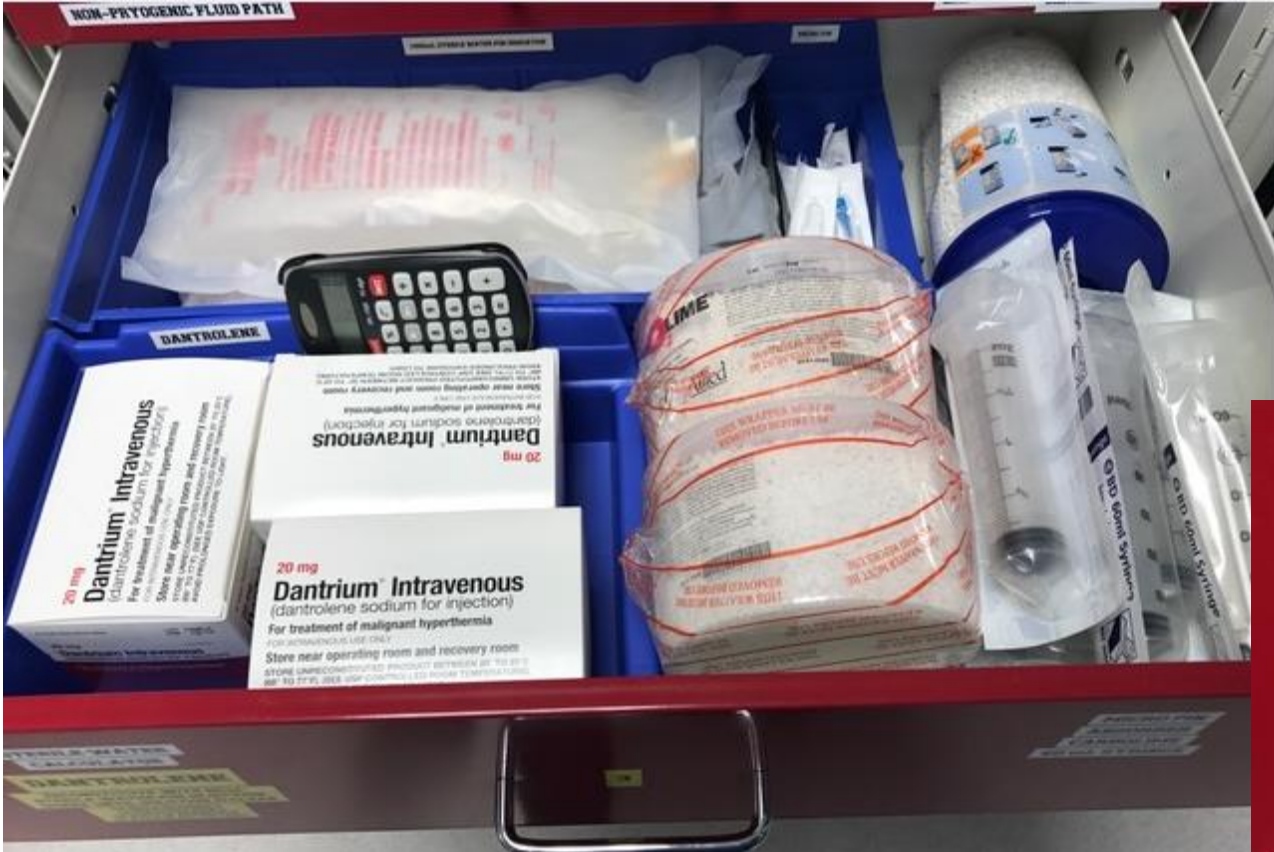


Labs-Drawer 2

Arterial and/or venous blood gas
Electrolytes
Glucose
Calcium
CK
CBC
PT and PTT
Myoglobin on urine specimen.
(Lab slips marked with usual test
are in the MH cart ready for
stamping.)

[illegible]

Drawer 3



STERILE WATER

CALCULATOR

DANTROLENE

**RECONSTITUTE WITH 60mL
STERILE WATER FOR INJECTION,
SHAKE UNTIL SOLUTION IS CLEAR**

18 VIALS DRAWER 3
18 VIALS DRAWER 5
18 VIALS IN PHARMACY
36 VIALS IN ASC MH CART

MICRO PIN

ABSORBER

CARBOLIME

60 mL SYRINGE

Drawer 4



GLOVING BASIN

60mL LL SYRINGE

60mL CATHETER TIP SYRINGE

ASEPTO

SPECIMEN CUP

Y-TYPE TUR IRRIGATION SET

ADD-A-FOLEY TRAY

8Fr FOLEY

10Fr FOLEY

18Fr FOLEY

24Fr FOLEY

Drawer 4

RINSE BASIN

BAG DECANter

NG TUBES

DANTROLENE

PHARMACY #77687

ASC TEAM LEADER #17981



MALIGNANT HYPERTHERMIA MEDICATION CHART

This chart is intended to provide a guide for calculating patient weight, medication dosage in relation to weight, and the amount of sterile water needed for reconstitution.

Dantrolene Sodium (Dantrium)

Dosage: 2.5 mg/kg intravenous. Pediatric dose: Refer to adult dosing.

Reconstitution: Supplied as a lyophilized powder that contains 20 mg of dantrolene sodium, 3,000 mg of mannitol, and sufficient sodium hydroxide to yield a pH of 9.5 when powder is reconstituted. During an MH crisis, it may take from two to four licensed individuals to reconstitute the required amounts of dantrolene sodium to accomplish rapid administration.

- Reconstitute each vial by adding 60 mL of preservative-free sterile water. Do not use bacteriostatic water for injection. Warming the mixing solution will help convert the lyophilized powder into solution.
- Shake vigorously until solution is clear.
- Do not use glass IV bottles for infusion.
- Protect from light.
- Use within six hours after reconstitution.¹²

| Weight | Initial Dose: 2.5 mg/kg (continuous, rapid IV push) | # of vials to have on hand for four doses** | Sterile water necessary for four doses |
|--------|--|--|---|
| 10 kg | 25 mg (1.25 vials) | 5 | 300 mL |
| 30 kg | 75 mg (3.75 vials) | 15 | 900 mL |
| 40 kg | 100 mg (5 vials) | 20 | 1,200 mL |
| 50 kg | 125 mg (6.25 vials) | 25 | 1,500 mL |
| 60 kg | 150 mg (7.5 vials) | 30 | 1,800 mL |
| 70 kg | 175 mg (8.75 vials) | 35 | 2,100 mL |
| 80 kg | 200 mg (10 vials) | 40 | 2,400 mL |
| 90 kg | 225 mg (11.25 vials) | 45 | 2,700 mL |
| 100 kg | 250 mg (12.5 vials) | 50 | 3,000 mL |

**8-10 mg/kg is needed for an MH crisis; repeat 2.5 mg/kg doses up to four doses.¹⁴ Risk of phlebitis is decreased if infused through largest possible vein.¹ Note that dantrolene sodium can be administered for spasticity associated with other clinical conditions. Warnings include caution when a patient has impaired cardiac function or impaired pulmonary function. The liver metabolizes dantrolene sodium, and there is a potential for hepatotoxicity. It is contraindicated when there is active hepatic disease.¹⁴

****DO NOT USE CALCIUM CHANNEL BLOCKERS.****
Calcium channel blockers can cause hypotension and myocardial depression.⁷

| kg | mg | vials |
|-----|-----|-------|
| 10 | 25 | 5 |
| 20 | 50 | 10 |
| 30 | 75 | 15 |
| 40 | 100 | 20 |
| 50 | 125 | 25 |
| 60 | 150 | 30 |
| 70 | 175 | 35 |
| 80 | 200 | 40 |
| 90 | 225 | 45 |
| 100 | 250 | 50 |
| 110 | 275 | 55 |
| 120 | 300 | 60 |
| 130 | 325 | 65 |
| 140 | 350 | 70 |
| 150 | 375 | 75 |
| 160 | 400 | 80 |
| 170 | 425 | 85 |
| 180 | 450 | 90 |

OR Pharmacy=Cold Fluids

MH Cold Fluids Bin

- 3 NS 1000 ml bottle
- 13 NS 1000ml bags
- Regular Insulin



MH POLICY

Malignant Hyperthermia, Care of the Patient

Page 1 of 8

| | | | | | |
|-----------------------------------|--------------------------|--|------------------------------|--|--|
| Subject: | | Malignant Hyperthermia, Care of the Patient | | | |
| Policy/Procedure #: | 905.09.02.01 | Supersedes Policy # | 905.09.02.01 | | |
| Effective Date: | 7/18/05 | Supersedes Date: | 7/5/00 | | |
| Document Type: | Procedure | Department: | Patient Care Services | | |
| Scope: | Interdepartmental | Originating Area: | Surgery | | |
| Date of Review and Initial | 6-2-2008 | | | | |

DISTRIBUTION:

Surgery
PACU
Anesthesia
OB

Side of cart

DEFINITION:

Malignant Hyperthermia (MH) is a potentially lethal syndrome caused by a hypermetabolic state that can be precipitated by the administration of volatile inhalation anesthetic agents and depolarizing muscle relaxants such as, but not limited to, succinylcholine. This triggering agent causes an increase in intracellular calcium ion concentration causing a rapid and severe onset of chain of reactions. The primary defect in MH resides in the skeletal muscle at the level of calcium transfer in the muscle cell. This intracellular hypercalcemia leads to hypermetabolism resulting in increased sympathetic activity, increased carbon dioxide production, increased oxygen consumption and disruption of the cell membranes. Primary signs of MH begin to appear because of the inability of muscle tissue to return to a resting stage in the patient. Rapid recognition of the signs and symptoms related to hypermetabolism is important.

Sign and symptoms of malignant hyperthermia include but are not limited to:

- Tachycardia (Abnormally fast heart rate faster than 100 beats per minute in adults)
- Dysrhythmias (Abnormal, disordered or disturbed heart rhythm)
- Tachypnea (Abnormally rapid respirations)
- Hypercarbia (Increased CO₂ in the blood)
- Respiratory and metabolic acidosis
- Generalized and Masseter (Muscles that close the mouth) muscle rigidity
- Elevated body temperature (Core temperature above 41 degrees C)
- Myoglobinuria (Iron-containing protein found in muscle cells that stores muscle oxygen for use in cell respiration is found in the urine)
- Rhabdomyolysis (By-products of skeletal muscle destruction accumulate and cause acute renal failure, brown or cola-colored urine)

Side of cart

LOOK FOR • tachycardia • rigidity • hypercarbia • tachypnea • cardiac arrhythmias
• respiratory & metabolic acidosis • fever • unstable rising blood pressure • cyanosis/mottling • myoglobinuria

Emergency Therapy for Malignant Hyperthermia

* Revised 1995 *

ACUTE PHASE TREATMENT

1. Immediately discontinue all volatile inhalation anesthetics and succinylcholine. Hyperventilate with 100% oxygen at high gas flows; at least 10 L/min. The circle system and CO₂ absorbent need not be changed.
2. Administer dantrolene sodium 2-3 mg/kg initial bolus rapidly with increments up to 10 mg/kg total. Continue to administer dantrolene until signs of MH (e.g., tachypnea, rigidity, increased end-tidal CO₂ and temperature elevation) are controlled. Dantrolene, a total dose greater than 10 mg/kg may be needed. Each vial of dantrolene contains 20 mg of dantrolene and 3 grams mannitol. Each vial should be mixed with 10 mL of sterile water for injection USP without a bacteriostatic agent.
3. Administer bicarbonate to correct metabolic acidosis as guided by blood gas analysis. In the absence of blood gas analysis, 1-2 mEq/kg should be administered.
4. Administer with the above, actively cool the hyperthermic patient. Use IV cold saline (not tap water) 10-20 mL/kg q 15 min 2-3.
5. Large amounts of cold saline may lead to hypothermia.
6. Large amounts of cold saline may lead to hypothermia.
7. Large amounts of cold saline may lead to hypothermia.
8. Large amounts of cold saline may lead to hypothermia.
9. Large amounts of cold saline may lead to hypothermia.
10. Large amounts of cold saline may lead to hypothermia.

MALIGNANT HYPERTHERMIA

Role Cards: Top of Cart



Role Cards:

Side of Cart Pass out to staff



#1



#2

Medication Giver (2-3 RN's)

1 - 2 RN's mix Dantrolene 20mg vial with 60ml of sterile water. (Drawer 3) If you don't have enough help:

Call Pharmacy to help mix Dantrolene stat!! #77687

2 - One RN assist anesthesia if needed.

3 - One RN to chart: Foley / Ice placement / Lavage ect.



#3

Runner 1

(Anyone available)

Obtain ice and fill ice bags.

Ice bags - drawer 2 MH cart.

#4

Runner 2 (Anyone Available)

- 1 – Fill metal basin, drawer #5 of MH Cart, with ice from OR 3 cubby, OR kitchenette, or PACU.
- 2 – Help fill ice bags.
- 3 – Maintain & refresh ice as needed.



A photograph of a clipboard with a white sheet of paper. The paper has black text. At the top, it says '#5' and 'Icer'. Below that, it says 'Apply ice to 6 points:' followed by 'Both arm pits, bilateral groins, under knees'. At the bottom, it says 'Anticipate ice needs and communicate with runner.' in a larger, bold font. The clipboard is held by a red clip at the top.

#5

Icer

Apply ice to 6 points:

Both arm pits, bilateral groins, under knees

**Anticipate ice needs and
communicate with runner.**

#6

Lavage Nurse (2 RN's)

- 1** – Use saline from pharmacy refrigerator (blue bin) and pour into metal basin from drawer #5.
- 2** – Lavage cavities: rectal, bladder, peritoneal / chest cavities if open, NG tube. Assign nurse to cavity to lavage.
- 3** – Irrigation supplies: Aseptos, catheter tip syringes, Salem sumps in MH cart. Drawer #5
- 4** – NG Lavage
- 5** – Foley lavage: Insert Foley if patient does not have one and monitor urinary output for color amount and consistency. 18 Fr. 3 way Foley in MH cart drawer #4.

Roles

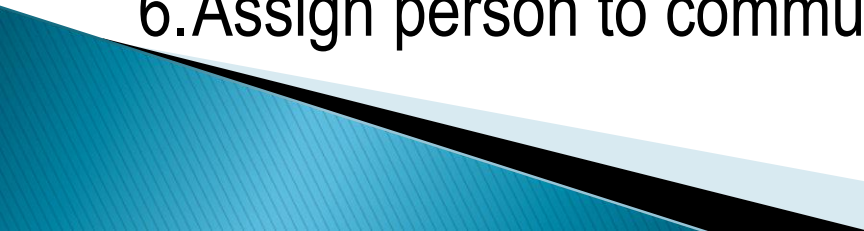
Anesthesiologist

- I. Make initial diagnosis
 - A. Alert surgeon and staff in room (OR/PACU)
- II. Supervise and direct treatment while surgery stopped/wound closed.
 - A. Follow MH Protocol
 - B. Assess need for IV access, Central Line and arterial Line insertion.
 - C. Insert and secure esophageal temp probe and NG
- III. Supervise and direct team
 - A. Order initial Dantrolene dose
 - B. Order labs
 - C. Oversee application of hypothermia measures.
 - D. Report available data and assessment to record.
- IV. Initiate transfer to PACU/ICU

Surgeon

1. Close incision
2. Communicate with family regarding patient's condition

Circulator

1. Get MH Cart and blue MH bin from the OR pharmacy refriger. Get code cart.
 2. **GET HELP!** Call for a Code Blue when minimal staff available.
 3. PASS out tasks cards on the top of the MH cart as help arrives to the appropriate staff.
 4. Start mixing Dantrolene STAT!! **This is the most important task taking priority above all other supportive measures!!!**
 5. Liaison within PACU/OR.
 6. Assign person to communicate and provide family support.
- 

Labs usually ordered:

- ▶ Arterial and /or venous blood gases
 - ▶ Electrolytes
 - ▶ Glucose
 - ▶ Calcium
 - ▶ CK
 - ▶ CBC
 - ▶ PT and PTT
 - ▶ Myoglobin on urine specimen. (Lab slips marked with usual test are in the MH cart ready for stamping.)
- 