

Mindray A-Series Anesthesia Systems: Preparation for Malignant Hyperthermia Susceptible Patients



Malignant Hyperthermia Causes, Effects and Treatment

Malignant Hyperthermia (MH) is an uncommon inherited, life-threatening pharmacokinetic skeletal muscle disorder involving the dysregulated myoplasmic Ca²⁺, hypercontracture, and hypermetabolism. Triggering factors include exposure to potent volatile anesthetic gases and depolarizing muscle relaxants.¹⁻⁴

The disorder is characterized by skeletal muscle hypermetabolism, which is related to an uncontrolled release of calcium from skeletal muscle sarcoplasmic reticulum. This results in increased carbon dioxide production, increased core temperature, and generalized muscle rigidity with resultant rhabdomyolysis, acidosis, and hyperkalemia. If untreated, MH may lead to cardiac arrhythmia, multiorgan system failure, and death.^{2,3}

MH has had a reported mortality rate decrease from 70%-80% to less than 5% if preventive measures and effective management are adopted.² The early therapy requires immediate discontinuation of all the triggering agents, adequate oxygenation and ventilation, institution of aggressive cooling measures, administration of dantrolene

sodium, and appropriate treatment for hyperkalemia. Ultimately, the only effective treatment for an MH crisis is the intravenous administration of dantrolene sodium and supportive therapy to combat the symptoms.^{1,2}

Malignant Hyperthermia Washout

To prevent MH in susceptible patients or to treat MH occurring during inhalational anesthesia, all inhalational anesthetics should be removed from the anesthesia machine. Avoidance of potent vapor anesthetics, such as Sevoflurane, Isoflurane or Desflurane,⁴ in patient cases is more challenging, based on the complex newer generation anesthesia machines and breathing circuits which retain anesthetic vapors long after discontinuation. The ultimate goal is to eliminate the residual anesthetic vapor concentration within the breathing system. The recommended instructions for clearing residual anesthetic gases include removal or disabling of vaporizers, flushing the machine using the ventilator with a fresh gas flow rate more than 10 L/min, and replacement of the carbon dioxide absorbent and anesthesia circuit.^{1,3}

The following guidelines are recommended by the Malignant Hyperthermia Association of the United States (MHAUS)*

Preparation of Anesthesia Workstations to Anesthetize MH Susceptible Patients

Recommendations (4 alternatives):

1. *Flush and prepare workstation according to manufacturer's recommendations or published studies; this may take 10 to >90 minutes. Most studies also physically disconnect vaporizers from the workstation; use a new, disposable breathing circuit; and replace the carbon dioxide absorbent. During the case, fresh gas flow should be kept at 10 liters per minute to avoid "rebound phenomenon" (increased release of residual volatile anesthetic agent when fresh gas flow is reduced after a set period of flushing).*

OR

2. *Use commercially available charcoal filters that have been shown to remove trace levels of volatile anesthetic agents within 10 minutes of application, without additional preparation. These filters may have to be regularly replaced during the anesthetic.++*

OR

3. *If available, use a dedicated "vapor free" machine for MH susceptible patients. The machine must be regularly maintained and safety-checked.*

OR

4. *If appropriate to the institution, use an ICU ventilator that has never been exposed to volatile anesthetic agents.*

For further information contact the Malignant Hyperthermia Association of the United States at <http://www.mhaus.org/>

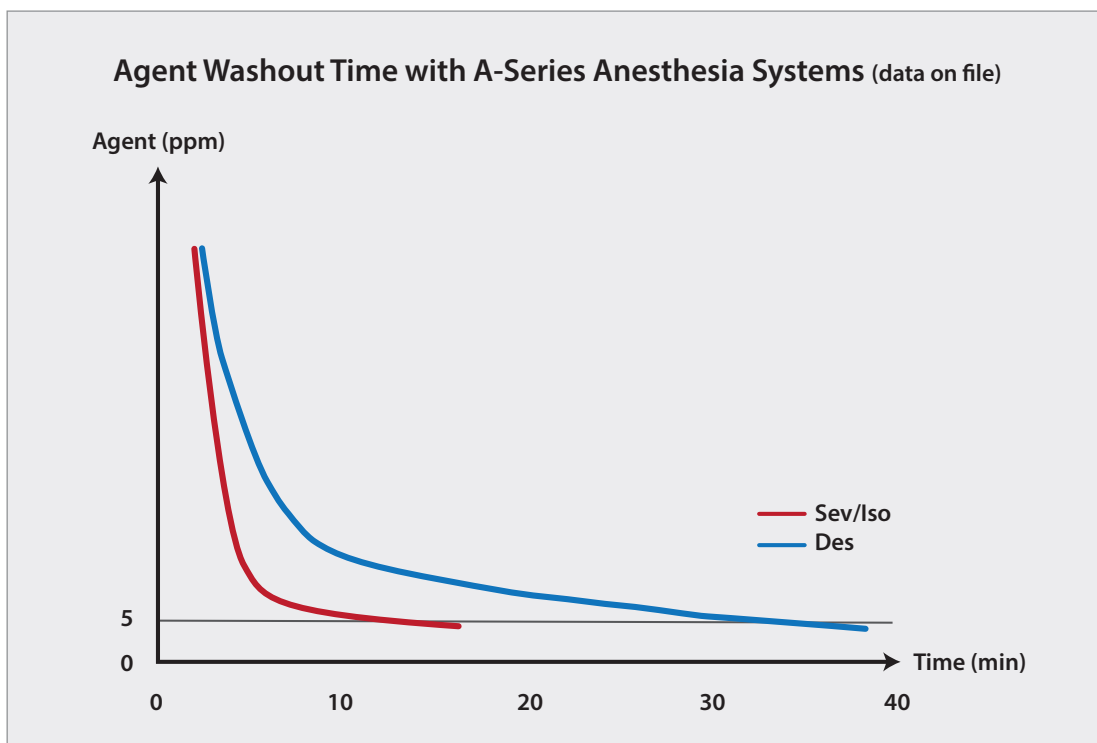
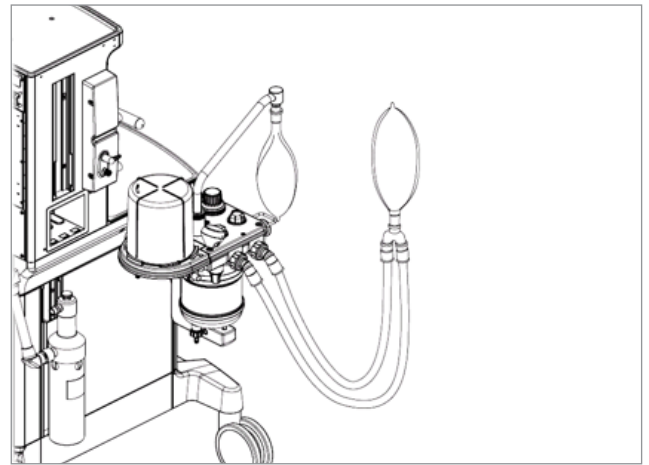
*Guidelines are excerpted from the MHAUS website and do not replace the indicated instructions for preparation of the Mindray A-Series machines.

++This method has not been tested with the Mindray A-Series

Washout Procedure for Malignant Hyperthermia Susceptible Patients with Mindray A-Series Anesthesia Delivery Systems

The minimum inhaled concentration for triggering an episode of MH is unknown. Studies assumed a trace concentration of inhalational anesthetics below 5 ppm to be safe.⁵⁻⁸ The following steps are recommended to prepare a Mindray A-Series anesthesia system for an MH-susceptible patient.

1. Turn off and remove all the vaporizers from the anesthesia system to prevent their inadvertent use.
2. Remove the carbon dioxide absorbent, breathing bag and the entire patient breathing circuit, filters, sampling line, water trap, and airway adapter and replace with new circuit and parts, connect a new breathing bag or test lung to the patient Y-piece.
3. Ventilate for a minimum of 40 minutes using mechanical ventilation with the following settings, 700 ml tidal volume, I:E ratio of 1:2, 12 breaths/minute, PEEP Off, and oxygen fresh gas flow rate of 15 L/min.
4. Upon completion of the 40 minute flush, remove the patient breathing circuit. Allow the bellows to deflate completely. Replace with a new patient breathing circuit, including bag and new carbon dioxide absorbent. Perform the pre-operative checkout.
5. Maintain the oxygen fresh gas flow rate of 15 L/min throughout the case to functionally create a non-rebreathing system and minimize rebound of volatile concentration at low fresh gas flow rates.



References:

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8. Prinzhausen H, Crawford MW, O'Rourke J, Petroz GC. Preparation of the Dräger Primus anesthetic machine for malignant hyperthermia-susceptible patients. *Can J Anesth* 2006; 53: 885-90.