Preparation of Modern Anesthesia Workstations for Malignant Hyperthermia Susceptible Patients

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Introduction: Malignant hyperthermia (MH) is a rare, potentially fatal genetic disorder characterized by increased cellular metabolism of skeletal muscle in response to succinylcholine and certain inhalational anesthetics. The Malignant Hyperthermia Association of the United States (MHAUS) has established guidelines for the perioperative management of MH-susceptible patients to minimize their risk. These guidelines include flushing the anesthesia machine with high-flow oxygen and replacing relatively simple components of the anesthesia workstation, but are based upon data from older generation anesthesia machines in which egress of anesthetics was more rapid. We therefore sought to review studies on newer-generation anesthesia workstations to determine if the current guidelines were applicable to these devices.

Methods: A literature search was conducted using the PUBMED database to find articles that evaluated the preparation of modern anesthesia workstations for MH-susceptible patients. These preparations were evaluated and compared to existing MHAUS guidelines.

Results: With the Drager Primus/Apollo anesthesia workstation, flushing the machine with high-flow oxygen required 67 (±6.5) min to achieve a volatile anesthetic concentration <5 ppm. In contrast, when the integrated breathing system and diaphragm were replaced with autoclaved components, this concentration was achieved in 3.2 (±0.4) min. With the Drager Fabius, flushing with high flow oxygen alone required 104 min to achieve <5 ppm volatile anesthetic; attempts to hasten egress by further increasing gas flow resulted in only modest enhancement of anesthetic washout. In contrast, attachment of an activated charcoal filter to the inspiratory limb of the anesthesia circuit resulted in suitably low anesthetic concentrations in less than 10 min. With the Drager Fabius GS workstation, flushing the machine for 151 min was required to reduce volatile anesthetic concentration to <5 ppm; this time could be reduced to 42 min when the ventilator diaphragm and tubing was replaced with autoclaved components. With the Siemens-KION workstation, 25 min of flush time were required to decrease the anesthetic concentration to <10 ppm. Attempts to decrease the purge time by replacement of internal components were not evaluated.

Discussion: Using the current MHAUS guidelines, many of the modern anesthesia workstations (Drager Primus/Apollo, Drager Fabius, Drager Fabius GS, and Siemens KION) would not be effectively purged of residual anesthetic. Although the minimum concentration of anesthetic gas required to trigger a malignant hyperthermia event has not been established, it is generally regarded as <5ppm. The anesthesia workstation has undergone increasing sophistication since the advent of the MHAUS guidelines, with particular complexity of the internal breathing circuitry. Given the complexity of these workstations, new guidelines are required that reflect the individual properties of these machines. In addition, further research is required to find optimal methods to prepare anesthesia workstations for MH-susceptible patients.