

MH-Susceptibility and Operating Room Personnel: Defining the Risks

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Topic

The contraindications for the administration of succinylcholine and the potent volatile inhalational anesthetics to Malignant Hyperthermia Susceptible (MHS) individuals are well documented and defined. However, there are no published data on risks to these individuals associated with environmental exposure to waste gases in the operating room.

In recent years, the question has been raised whether or not MHS individuals or their relatives are at greater risk than the general population to operating room environmental exposures. Since there are no clinical trials that have addressed this question, nor is it likely that such protocol would receive IRB approval, the Malignant Hyperthermia Association of the United States (MHAUS) convened a group of experts to develop a Consensus Statement to guide clinicians in providing recommendations to MHS families.

Background:

MH is a life-threatening pharmacogenetic disorder triggered by the administration of commonly used volatile anesthetics (halothane, enflurane, isoflurane, desflurane, and sevoflurane), the depolarizing muscle relaxant succinylcholine, or both (1). Clinical presentation of the disorder is highly variable, but there is strong evidence that fulminant MH episodes result from a rapid sustained rise in myoplasmic calcium caused by fundamental defect in the ability of muscle to regulate calcium (2). A fulminant MH episode consists of a hypermetabolic crisis manifesting as metabolic and respiratory acidosis, tachycardia, cardiac arrhythmias, skeletal muscle rigidity, and rhabdomyolysis. The incidence of anesthetic-related episodes of MH is between 1 in 15,000 in children and 1 in 50,000 in adults (3). Suspicion of MHS is based on family history of the disorder, or on a history of adverse clinical events during anesthesia suggestive of the syndrome. Since most often MHS is inherited as a dominant trait, when MH is diagnosed in one family member, all first-degree relatives are treated as MHS, despite there being only a 50% probability of transmission of a mutant gene in each individual case. To diagnose an individual's risk of MHS, the in vitro contracture test (CHCT) and the caffeine-halothane contracture test (CHCT) have been developed and standardized by European and North American MU study groups, respectively (4, 5). Significant progress has been made in the last decade in developing a genetic test as an alternative to the invasive muscle biopsy required to perform the IVCT or CHCT (6). While the gene responsible for MH susceptibility in ~50-70% of families is known to be that of the skeletal muscle ryanodine receptor, the calcium release channel in sarcoplasmic reticulum responsible for calcium release during excitation-contraction coupling, the genes responsible for susceptibility in the other 30-50% of MHS families remain elusive at the present time. As such, the IVCT or CHCT remain the gold-standard tests for determining MH-susceptibility.

Waste gas exposure in the operating room

While there is a single report of a suspected episode of MH in a nurse attempting to clean up an isoflurane spill, (7) confirmation by muscle biopsy was never performed, and the level of exposure most likely exceeded that which is commonly experienced in hospital operating rooms (OR). The National Institute for Occupational Safety and Health (NIOSH) standard for acceptable OR levels of halothane is 2 parts per million (ppm), which is equivalent to 0.0002%. An abstract published by Maccani reported that MH susceptible swine (a species exquisitely more sensitive than human) did not trigger after exposure to 5 ppm halothane (8). Therefore, in the modern OR with high air turnover, low level exposure is unlikely to trigger MH. There are multiple anecdotal reports of MHS individuals, including anesthesia providers, who have worked and thrived for many years in the OR without adverse incidence (9). Conversely, there are no reports of MH episodes in hospital ORs as a consequence of inhaling waste gases.

Environmental gas exposure outside of the operating room

There are reports of MH-like episodes in biopsy proven individuals from environmental exposures outside of the OR due to the inhalation of halogenated gases from fire extinguishers (10) and gasoline vapors (11). It is not recommended that anyone inhale noxious vapors in a closed, poorly ventilated space, especially MHS individuals. MHS laboratory personnel working with vapors

should perform such work under a hood. MHS veterinary personnel anesthetizing animals should adhere to the same NIOSH requirements for human hospitals, and avoid prolonged exposure to poorly scavenged mask breathing devices.

Summary:

There is no evidence to support restricting the professional choices of MHS individuals; however, caution should be exercised regarding the inhalation of any noxious vapor in a poorly ventilated area.

References

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