



Isoflurane (as waste anesthetic gas)

Updated: April 2016

Isoflurane (Forane®), CAS no. 26675-46-7) is a halogenated hydrocarbon. It is a colorless liquid with a mildly pungent ethereal odor. Isoflurane is commonly used as an inhalation anesthetic.

Exposure

Small amounts of volatile waste anesthetic gases leak from the patient's anesthetic breathing circuit* into the air in operating rooms during the delivery of anesthesia.

It is estimated that more than 200,000 U.S. health care professionals are potentially exposed to anesthetic waste gases and are at risk of occupational illness. These workers include anesthesiologists, nurse anesthetists, surgical and obstetric nurses, operating room technicians, nurses' aides, surgeons, anesthesia technicians, postanesthesia care nurses, dentists, dental assistants, dental hygienists, veterinarians and their assistants, emergency room staff, and radiology department personnel [OSHA].

Personnel who work in operating facilities with no automatic ventilation or scavenging systems, operating facilities where these systems are in poor condition, or in recovery rooms where gases exhaled by recovering patients are not properly vented or scavenged are most likely to be exposed to anesthetic waste gases. Even when scavenging and ventilation systems are in place, personnel may still be exposed if certain conditions exist:

1. Leaks occur in the anesthetic breathing circuit which may leak gas if the connectors, tubing, or valves are not maintained and tightly connected
2. Anesthetic gases escape during hookup and disconnection of the system
3. Anesthetic gas seeps over the lip of the patient's mask or from endotracheal coupling (particularly if the mask is poorly fitted. This often occurs during pediatric anesthesia), dental operations, or during induction of anesthesia [CDC].

The vapor of isoflurane is heavier than air. It therefore sinks and accumulates in low areas, causing a deficiency of oxygen. A harmful contamination of the air can be reached extremely rapidly when the substance evaporates at 20°C [NIOSH].

Routes of exposure

Isoflurane can be absorbed into the body by inhalation of its vapors and by ingestion.

Metabolism

Studies of patients undergoing anesthesia indicated that a small amount of isoflurane (approximately 0.2% of what is systemically absorbed) is metabolized to trifluoroacetic acid and inorganic fluoride by cytochrome P450 2E1, and that this metabolism is inhibited by disulfiram [OSHA].

Health Hazards

Acute Effects

Short-term exposure can cause irritation of the eyes, skin, and respiratory tract, coughing, sore throat, headache, drowsiness, and dizziness [EHS].

Exposure to high concentrations of waste anesthetic gases - even for a short time - may cause headache, irritability, fatigue, nausea, drowsiness, difficulties with judgment and coordination, and liver and kidney disease [CDC].

Chronic Effects

The health effects from long term exposure are not well known. However, halogenated anesthetics in general, have been linked to reproductive problems in women and developmental defects in their offspring [EHS].

Some studies report no adverse health effects from long-term exposure to low concentrations of waste anesthetic gases. However, several studies have linked exposure to miscarriages, genetic damage, and cancer among operating-room workers. Studies have also reported miscarriages in the spouses of exposed workers and birth defects in their offspring [CDC].

There is evidence that exposure to trace amounts of volatile anesthetics may constitute a health hazard and is associated with neurobehavioral effects. People exposed to waste anesthetic gas experience significantly longer reaction times compared to a control group [Friembichler].

Hoerauf et al. investigated the frequency of sister chromatid exchanges in peripheral lymphocytes of operating room personnel who were exposed to

trace concentrations of isoflurane and nitrous oxide. Sister chromatid exchange frequency increased significantly among exposed personnel. It was concluded that exposure to low concentrations of waste anesthetic gases may result in an increased risk of genetic damage that is comparable to smoking 11-20 cigarettes per day. Whether the observed genetic damage may lead to increased morbidity remains unclear [Hoerauf].

Carcinogenicity

There is no evidence for isoflurane carcinogenicity in humans. The IARC classified isoflurane as “not classifiable regarding its carcinogenicity to humans” (Group 3) [IARC].

* The anesthetic breathing circuit includes the mask, endotracheal tube, anesthetic gas machine, ventilator, pumps, scavenging devices, all connecting tubing, and other elements. These elements vary depending on the type of anesthesia delivery system.

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