Chemicals and Materials

Waste Anesthetic Gases, Hazards of

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What are waste anesthetic gases?

Healthcare workers in a variety of settings can be exposed to the anesthetic gases that are released or leak out during medical procedures. These gases and vapours are known as waste anesthetic gases (WAGs).

People who work in hospitals in areas such as operating, labour and delivery rooms, recovery rooms, and in remote anesthetic locations such as radiology or post anesthetic care unit, as well as those who work in dental offices and veterinary clinics and animal research facilities may be exposed to waste anesthetic gases.

What are some examples of anesthetic gases?

Gases most commonly used include nitrous oxide, isoflurane, desflurane, and sevoflurane.

What are the health effects of occupational exposure to waste anesthetic gases (WAGs)?

NIOSH (the National Institute for Occupational Safety and Health) (2007) states that "exposure to high concentrations of waste anesthetic gases - even for a short time - may cause the following health effects:

- Headache

- Irritability
- Fatigue
- Nausea
- Drowsiness
- Difficulties with judgment and coordination
- Liver and kidney disease”

NIOSH (2007) continues: “Although some studies report no adverse health effects from long-term exposure to low concentrations of waste anesthetic gases, several studies have linked such 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.”

NIOSH (2015) later reports that “Some studies have documented adverse health effects (e.g., headaches, fatigue, irritability, birth defects, miscarriages, liver and kidney disease, cancer) from *excessive* exposure to anesthetic gases. These health effects were mainly noted for older anesthetics (e.g., trichloroethylene, methoxyflurane) that are no longer commonly in use. ... Studies are inconclusive on the potential health effects from occupational exposure to some of the newer anesthetics, such as isoflurane,”

How does exposure to WAGs occur?

Health workers can be exposed in a variety of ways.

- Anesthetic gas may escape when filling refillable vapourizers.
- WAGs may escape during the initial hooking up and checking of the anesthesia system or the scavenging system.
- WAGs can escape from around the patient's anesthesia mask, especially if the mask is a poor fit.
- WAGs can escape from around the patient's endotracheal tube (ETT) or laryngeal mask airway (LMA) if the cuff is not properly inflated or the wrong size is used.
- Leaks in the anesthesia system.
- Leaks in the high pressure system between the nitrous oxide (N_2O) cylinder and yoke assembly or between the anesthetic gas column outlets and the (N_2O) hose.
- When the system is flushed or purged at the conclusion of a medical procedure.
- Ineffective or poor ventilation or gas scavenging systems.
- Leakage from any tubing, seals, and gaskets.

What are some measures for controlling exposure to WAGs?

An effective waste anesthetic gas management program includes:

- Engineering Controls,
- Work Practices,
- Air Monitoring and,
- Hazard Communication and Training.

Engineering Controls

A well-designed WAG scavenging system to collect, remove, and properly dispose of the gases - Care should be exercised so that the gases are not discharged near the air intake of the building or surrounding buildings. The scavenging system should be kept in good repair to prevent leaks using a maintenance and inspection program as listed below.

- Room ventilation designed to ensure air exchange in the surgical suites is able to ventilate any WAG that escapes the patient circuit and thereby reducing exposure to all staff.
- Insure that there is no object such as a desk, cart or chair that blocks the ventilation in the surgical suite, reducing the air exchanges.
- The scavenger system must be independent of the main hospital ventilation system. In the event of a “Code RED”, hospital ventilation is shut down to reduce the potential spread of a fire but the scavenger system must continue to work. If the scavenger system is shut off, the decision to provide a total intravenous anesthetic (TIVA) must be considered and anesthetic gases stopped if clinically safe for the patient.
- Consider using a WAG collection canister that can be attached to an anesthetic gas machine before the scavenger. It will capture the agents (except for nitrous oxide). This technology reduces emissions to the atmosphere by capturing the agents and recycling them.

Properly designed equipment - For example, a mask should consist of a shroud large enough to capture gases exhaled from the patient's mouth.

- The WAG scavenging system is the primary line of defense against exposure, however, a properly designed heating, ventilation, and air conditioning (HVAC) system can also help contribute to the dilution and removal of WAGs not collected by the scavenging system that escape from leaks in the anesthesia equipment, or result from poor work practices.

- Consider using an airway gas monitor that is connected to the anesthetic breathing circuit to determine the levels of anesthetic agents in the patient circuit.

Proper maintenance and inspection programs should be written and carried out for the WAG scavenging system, anesthesia machines, and the ventilation system. The scavenging system, anesthesia machines, and respirators must be checked daily for leaks and properly monitored.

- Regular preventive maintenance should include inspection, cleaning, testing, lubrication, and adjusting of the components of the WAG scavenging system and the anesthesia systems. Damaged or worn out parts should be promptly replaced. Proper and posted documentation of the maintenance and preventive maintenance programs should be kept. Documentation should include the type of work performed and the date. It should also include the name(s) of the trained workers who serviced the equipment.
- Inspection and preventive maintenance programs for the anesthetic gas machines should follow recommended manufacturer guidelines.
- The anesthetic gas machine must be inspected and pass the check out procedure before administering an anesthetic as outlined by the Canadian Anesthesiologists Society (CAS) or equivalent for your area.

Use of appropriate equipment that minimizes leaks when filling or refilling vapourizers. There is a risk of a leak while filling or refilling a vaporizer. In some situations, use of a local ventilation hood, ventilation cabinet, or a local scavenging device is preferred. Follow the manufacturer's instructions for use and safety for each type of equipment.

- Note that a portable fume hood is not sufficient if the gas is circulated into a High Efficiency Particulate Air (HEPA) filter or equivalent. All gases and vapours must be scavenged to outside of the building.

Work Practices

Proper work practices are a vital aid in reducing exposure of health care personnel to WAGs.

Improper anesthetizing techniques may include:

- not using low flow anesthesia when appropriate,
- poorly selected, fitted or positioned face masks,
- an insufficiently inflated tracheal tube or laryngeal mask airway cuff,
- improperly connected tubes and fittings for the anesthesia machine,
- turning on the anesthetic gas before the scavenging system is active, and

- not turning the gas off when the mask is removed from the patient's face or removing the mask too quickly before the system has been flushed.

Air Monitoring

One of the tools used to measure exposure to waste anesthetic gases is air monitoring. The information collected through air monitoring is critically important to the proper design and implementation of engineering controls and work practices.

Monitoring may be continuous or periodic but should adequately measure exposure in the work areas and surrounding areas.

Monitoring can aid in identifying the presence and location of leaked gases and the effectiveness of corrective measures.

As most halogenated anesthetic gases cannot be detected by smell (unless they are in high concentration) proper monitoring becomes all the more critical. Nitrous oxide is an odourless and colourless gas and can only be detected by WAG monitor.

Hazard Communication and Training

Employers should develop and implement a written hazard communication program regarding WAGs that includes description of the physical and health hazards of anesthetic agents in use, the compiling and availability of up to date material safety data sheets on all anesthetic gases used; proper labelling of canisters, tanks, and containers; and a comprehensive employee training and information program.

The training program should list steps workers can take to protect themselves from the hazards of WAGs. The program should include information on steps taken by the employer such as engineering controls, clearly outline emergency procedures to contain spills, describe safe work practices and the use of any personal protective equipment, and detail the use of continuous monitoring devices.

The training program should clearly outline all methods and observable indicators that can detect the presence and release of anesthetic gases.

Spills should be treated as emergencies. Spills of anesthetic agents must only be cleaned up and controlled by properly trained and equipped personnel.

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