POLICY ON SCAVENGING OF WASTE ANESTHETIC GAS

INTRODUCTION

Inhalant anesthetic gases (e.g. isoflurane) are commonly used for purposes of anesthesia and euthanasia. Scientific literature contains evidence linking exposure to trace anesthetic gases with genetic mutations, cancer, spontaneous abortions, hepatic and renal disease, immunological effects, and psychomotor changes in humans.

The Animal Care and Use Committee (ACUC) developed this policy to protect personnel from potential occupational exposure to waste anesthetic gases generated in biomedical research using laboratory animals.

REGULATIONS AND GUIDELINES

Scavenging of waste anesthetic gas (WAG) is addressed in the Guide for the Care and Use of Laboratory Animals, Eighth Edition (National Academies Press, 2011) in the sections pertaining to limiting occupational exposure (page 21) and proper provisioning for animal surgery (page 145) and imaging facilities (page 147):

1. **Occupational Exposure**: “Waste anesthetic gases should be scavenged to limit exposure.”

2. **Imaging Facilities**: “As imaging [modalities] may require the subject to be immobile, often for extended time periods during image acquisition, provisions should be made for delivery of anesthetics and carrier gas, the scavenging of waste anesthetic gas, and adequate animal monitoring.”

CRITICAL COMPLIANCE CONCEPTS

1. Preferred measures for limiting occupational exposure to waste anesthetic gases include: passive scavenging using activated charcoal canisters, certified chemical fume hoods and active scavenging into building vacuum or waste gas systems.

2. When canisters are used, a log must be kept documenting the weight increase of the canister.

3. Chemical fume hoods must be certified annually by EHS.

4. Alternative strategies to control exposure to waste anesthetic gases must be evaluated and approved by EHS.

5. Because pharmaceutical grade methoxyflurane is unavailable, the use of chemical grade methoxyflurane has been approved for use in rodent anesthesia but must be justified in the animal protocol.
3. **Operative Theater**: “Other operating room features to consider include surgical lights to provide adequate illumination; sufficient electric outlets for support equipment; gases to support anesthesia, surgical procedures, and gas-powered equipment; vacuum; and gas-scavenging capability.”

OSHA requires employers to maintain a system to prevent waste gases from building up in the area of use with the exposure limit being a time-weighted average of less than 2 ppm per hour regardless of the type of anesthetic gas, and that a medical surveillance program be in place for all personnel potentially exposed to WAG. ([https://www.osha.gov/dts/osta/anestheticgases/index.html](https://www.osha.gov/dts/osta/anestheticgases/index.html))

The National Institute for Occupational Safety and Health (NIOSH) also recommends that exposure to nitrous oxide not exceed 25 ppm over the period of anesthetic administration, and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that nitrous oxide exposure should not exceed 50 ppm as an eight hour time weighted average.

**POLICY**

Waste anesthetic gas (WAG) must be scavenged in a manner which protects personnel from exposure. Scavenging must be accomplished using engineering control measures.

**EXAMPLES OF PREFERRED ENGINEERING CONTROLS:**

A. **Passive scavenging**: When used properly, vaporizers equipped with activated charcoal canisters (e.g. F/Air) are effective in removing halogenated waste gases, but not nitrous oxide. A log documenting the weight increase must be indicated on the canister. Canisters that exceed 50 grams of accumulated weight must not be used unless indicated by the manufacturer’s written instructions.

B. **Chemical fume hoods**: Hoods that have been certified by Environmental Health and Safety within the past twelve months may be used to control exposure to personnel when gases are applied in an induction chamber, nose cone, open drop technique or other means.

C. **Active scavenging into building vacuum or waste gas systems**: When possible, WAG can be discharged actively into a negatively pressurized building vacuum system. This is best accomplished through a thimble type connection where the volume/unit time of waste gas is less than the volume scavenged by the vacuum system, the difference being made up by drawing room air through the thimble connection.

Alternative engineering control techniques such as ducted biological safety cabinets (e.g. Class II, Type B2), downdraft tables, commercially available scavenging equipment, and other devices may also be used to effectively control exposure to anesthetic gases during induction of anesthesia or euthanasia.

Non-traditional (creative) engineering controls must be suitable for the application of WAG scavenging and used appropriately to be effective in the protection of personnel. Investigators should consult with Environmental Health and Safety (EHS) for assistance in the selection, use, and evaluation of WAG scavenging especially when using alternative engineering control methods.
When the effectiveness of gas scavenging requires validation, EHS will perform air monitoring to determine airborne exposure to anesthetic gas and provide documentation of the evaluation.

**Strategies used to control exposure to anesthetic gases that do not employ engineering controls must be evaluated and approved by EHS.**

**METHOXYFLURANE CONSIDERATIONS**

Methoxyflurane (Metofane, Penthrane) is a volatile inhalation anesthetic that the Food and Drug Administration (FDA) no longer approves for manufacture. The withdrawal of FDA approval (Federal Register vol. 70, p. 53019) was due to the association of nephrotoxicity and hepatotoxicity in humans who underwent prolonged anesthesia with this anesthetic agent. However, due to methoxyflurane’s low vapor pressure (4%), improvement of myocardial contractility, profound analgesic properties, and rapid onset of action, methoxyflurane is a popular anesthetic agent for use in laboratory rodents for short-term anesthetic procedures. Other inhalation anesthetics (isoflurane, sevoflurane, and desmoflurane) have high vapor pressures (~36%), which require the use of precision vaporizers for safe use as rodent anesthetics.

Because pharmaceutical grade methoxyflurane is no longer available, the UVa Animal Care and Use Committee has approved the use of chemical grade methoxyflurane for rodent anesthesia; however, its use must be justified in the animal protocol.

The Center for Comparative Medicine (CCM) will use and dispense chemical grade methoxyflurane to laboratories with approved protocols specifying the use of methoxyflurane for short-term rodent anesthesia. In accordance with USDA Policy #3, should pharmaceutical or veterinary grade methoxyflurane become available again, chemical grade methoxyflurane will no longer be approved for use.

**REFERENCES**


