POLICY

To reduce risk of anesthetic gas exposure to animals and personnel, proper maintenance of anesthesia equipment, appropriate waste scavenging systems, and safe administration techniques must be employed. Anesthesia machines, vaporizers, ventilators, breathing systems and scavenging systems should be inspected using Comparative Medicine SOP 980, Anesthesia Machine Safety Checklist and Use Instructions, before each use. Anesthesia machines and vaporizers must be checked annually by an authorized service center and maintained in good working condition to ensure a safe working environment. Administration of inhalant anesthetics must be carried out with a certified vaporizer or in a vented fume hood using a technique that prevents the animal from coming into direct contact with the anesthetic and minimizes personnel exposure to waste anesthetic gases (WAG).

BACKGROUND

Inhalant anesthetic gases (i.e. isoflurane, sevoflurane) are commonly used for anesthesia and euthanasia. Exposure measurements indicate that WAG can be found in the room air during and after the administration of anesthetic gases. The National Institute for Occupational Safety and Health (NIOSH) recommendations for exposure limits to halogenated gases were established in 1977, prior to the introduction of isoflurane onto the market. Recommended exposure limits for isoflurane, desflurane and sevoflurane do not exist. Without further updated guidance from NIOSH, UNMC users should strive to follow the general recommended exposure limit for halogenated gases: 2 ppm/ 1 hour. Potential sources of exposure to WAG may include tank valves, machine connections, breathing circuit connections, defects in plastic and rubber tubing and connectors, reservoir bags, and ventilator bellows. Filling the vaporizer, improper anesthesia delivery techniques and unsafe practices may also lead to unwanted exposure to WAG. Patients recovering from anesthesia are also a potential source of exposure for postoperative care staff, especially with larger species. Scientific literature contains conflicting evidence about the damaging effects of personnel exposure to WAG but the most serious potential risks surround reproductive health, such as spontaneous abortions. Genetic mutation, cancer, hepatic and renal disease, immunological effects, and psychomotor changes also have possible links to WAG exposure. Exposure to WAG should be controlled with a combination of engineering, work practice and administrative controls as outlined below.

REFERENCES

Anesthetic Gases: Guidelines for Workplace Exposure, OSHA, May 18, 2000

Current AVMA Guidelines on Euthanasia

Commentary and recommendations on control of waste anesthetic gases in the workplace, American College of Veterinary Anesthesia and Analgesia, November 18, 2013

Criteria for a Recommended Standard: Occupational Exposure to Waste Anesthetic Gases and Vapors. DHHS (NIOSH) Publication No 77-140, 1977

PROCEDURES

1.0 Equipment Maintenance/Calibration
1.1 The primary standard for vaporizer calibration/certification is the manufacturer’s recommendations. If the manufacturer’s recommendation for service is implemented, then a copy of the manufacturer’s manual or instructions should be available for review.
1.2 If no manufacturer recommendation is available, the machine must be serviced annually or any time the vaporizer has not been in use for more than a year. Annual service consists of certification (inspection of all the mechanics associated with the vaporizer and anesthesia machine) and calibration (analysis of the emitted gas to insure the accuracy of the concentration settings).
1.3 Anesthesia machines and vaporizers are to be serviced by qualified personnel (authorized service center). Documentation of service must be kept in the lab and readily accessible for inspection by the IACUC at any time.
1.4 Indicators of the need for service by an authorized service center include cracked or damaged hoses, sticking valves or knobs, animals not responding to the level of anesthesia provided, and/or discoloration (yellowish-brown) in the “fill” sight glass of a vaporizer.

2.0 Acceptable Waste Gas Scavenging Systems
2.1 Dedicated Exhaust System: An exhaust system such as a central vacuum system provides a source of negative pressure to remove the waste anesthetic gases. This is the preferred system of scavenging waste anesthetic gases. When possible, situate the anesthetic event as close to a room exhaust vent as possible. Personnel should not stand between the animal and the exhaust flow.
2.2 Fume Hoods/Cabinets: A vented chemical fume hood or vented biosafety cabinet may be used to capture waste gases. The unit must be certified by UNMC (or any authorized contractor) every 12 months. Contact Comparative Medicine for additional information on the certification process.
2.3 Charcoal Canisters: Canisters containing activated charcoal can be used to absorb waste gas. These canisters are not effective for capture of nitrous oxide. The canister must be weighed PRIOR to its initial use and again at each use thereafter. Manufacturer’s recommendations are to be followed in regards to replacement of canisters. Most canisters are to be replaced upon 50-100gm increase in the initial weight. Canisters must be positioned so that the exhaust vents are not blocked.

3.0 Safe Work Practices
3.1 Inspecting Equipment: All anesthesia delivery and scavenging equipment must be inspected prior to each use. Hoses and tubing should be checked for cracks or holes and that fittings and connectors are secure. Induction chambers should be checked for cracks and that the lid seals properly when closed. Induction chambers should only be large enough to allow for normal posturing of the animal that you are working with. Excess space in chambers wastes gases and increases the potential for personnel to be exposed to anesthetic. All induction masks and nose cones must include a diaphragm that seals around the animal’s nose and, if possible, the mouth. Face mask seals should be checked for structural stability and replaced often. Endotracheal tubes and cuffs must be checked for structural stability and staff must check that they are properly inflated during use.
3.2 Working with anesthetic gases: Distance your face and, when possible, your body from anesthetic gas sources. These include the animal’s breathing zone and as you open induction and/or imaging chambers. Flush oxygen through tubing prior to opening chambers or disconnecting an animal from a breathing circuit. Ensure that vaporizers and fresh gas supplies are turned off and gas flow control valves are closed when not in use. Vaporizers should be filled in a well-ventilated area and anesthetic agents should be poured carefully, using an anti-spill device. Filling vaporizers should be done with the least amount of personnel present and in a well ventilated area. Small spills will likely evaporate before they can be effectively cleaned. In case of a large spill, evacuate
the area and limit personnel entry. Contact Security and Chemical Safety and provide the product MSDS for specific clean-up instructions.

3.3 Medical Surveillance: As a general rule, discuss any changes in health status with Employee Health and/ or your healthcare provider. In certain situations, additional safety measures may be implemented, such as the use of a chemical respirator during possible exposures to WAG. Any overt exposures to anesthetic gasses should be reported to your manager and Employee Health.

3.4 Monitoring: Air sample monitoring may be performed for procedures where active scavenging is not available or, as requested. The IACUC emphasizes regular maintenance of machines and equipment, safety checklist procedures before anesthesia is used, and education to ensure safe work practices.

4.0 Documentation of Equipment Service
4.1 Vaporizers must have documentation of calibration/service. Information that must be affixed to the vaporizer includes:
   A. Date of last service
   B. Initials of service technician

4.2 Documentation of service must be kept in the lab and readily accessible for inspection by the IACUC at any time.

5.0 Special Consideration-The Open Drop System. The open drop system is the most basic type of anesthetic delivery system. It involves the application of the anesthetic gas to an absorbent material that is then placed in the bottom of an anesthetic chamber or nose cone device. The advantage of this system includes low cost of equipment and minimal rebreathing to expired gases by the patient. The disadvantages include personnel exposure due to difficulty in scavenging waste gas and patient concerns due to difficulty in controlling anesthetic concentration and risk of mucus membrane, skin or eye irritation due to contact with the liquid. To minimize the risks, the following must be implemented:

5.1 A vented chemical fume hood or vented biosafety cabinet must be used during the procedure. The anesthetic must be added to the absorbent material only inside the hood/cabinet. Researchers who use this method in open air field studies must stay upwind of the anesthetic and chamber.

5.2 A chamber with a tight-fitting cover must be used. The cover must stay on the chamber except when the animals is being placed into or removed from the chamber.

5.3 Prior to placement into a jar, a barrier such as a mesh grid must be placed into the jar to prevent local skin and eye irritation of the animal by direct contact with the liquid anesthetic.

LINKS TO RELATED FORMS, RECORD LOGS, AND SOPS

Comparative Medicine SOP 980, Anesthesia Machine Safety Checklist and Use Instructions, July 2016
Contact Information for Vaporizer Certification