Guidelines for Safe Anesthetic Use

The University of Texas at Austin Institutional Animal Care and Use Committee

These guidelines have been written to assist faculty, staff, and students in performing vertebrate animal procedures in a humane manner and complying with pertinent regulatory requirements. Under some circumstances deviations from these procedures may be indicated but such variances must be approved in advance by the IACUC.

This document provides information to be used when planning and performing procedures using anesthesia in vertebrate animals used for research, teaching, or other purposes at The University of Texas at Austin. It is organized into five sections:

Section A – Proper Scavenging
Section B – Safe Working Practices
Section C – Requirements
Section D – Resources
Section E – Acknowledgements and References

Exposure to anesthetic gases can result in toxicity to humans. Some potential effects of exposure to waste (exhaled) anesthetic gases are nausea, dizziness, headaches, fatigue, and irritability. More serious potential sequelae of long-term exposure in those with frequent workplace use of anesthetics include liver and kidney disease, cancer, sterility, miscarriages, and birth defects in offspring. Although modern agents such as isoflurane pose less of a risk of toxicity than some of the agents used historically, it is still necessary to minimize human exposure when working with anesthetic gases. It is the Principal Investigator's responsibility to inform personnel of the hazards (health effects, signs of exposure) of working with anesthetics as part of their site-specific Hazard Communication training.

All anesthetic agents used in animals as well as description of animal recovery from an anesthetic event must be described in an approved animal use protocol. The administration of anesthesia for any purpose must only be performed by appropriately trained personnel and in all cases, animals must be monitored continuously until they have recovered

Section A – Proper Scavenging

Because there will always be anesthetic gases present in the waste air exhaled by the animal, it is absolutely necessary to use anesthetics in a setting that includes some mechanism for removing toxic components from the air stream or venting the exhaled air safely out of the room. This process is called "scavenging" and there are two main options:

1) Active scavenging

This is the preferred method, and it involves using low-pressure high-flow ventilation to create a suction that captures contaminated air and safely discharges it from the room and the building.

The simplest form of active scavenging is to actually deliver the anesthetic to the animal while it is placed within a fume hood or hard-ducted Class II B2 biosafety cabinet (BSC). Non-ducted biological Safety Cabinets (BSCs) should not be used. The fume hood or hard-ducted Class II B2 BSC will evacuate all waste gases and discharge

them from the roof of the building. Similar functionality can be obtained by working on a downdraft table approved for hazardous gas/vapor use.

Many operating rooms are designed to provide active scavenging by including small wall ports that serve as local exhaust connections for the exhaust tubing coming from an anesthetic machine. In a research lab, a similar approach can be taken by running the exhaust hoses from the anesthesia machine into a fume hood or hard-ducted Class II B2 BSC and having them discharge within the hood.

Researchers may use vapor extraction systems such as a snorkel hood. Active scavenging can be provided in areas that do not have access to a fume hood, a hard-ducted Class II B2 BSC, or to scavenger ports by installing a small specially-designed scavenging device that acts as an intermediate blower which connects the exhaust lines from the anesthesia machine to the exhaust ducts or another conduit which exits the building directly.

NOTE: When connections are made from an anesthesia machine to any active scavenging system, it is important to consult with the ARC veterinary staff and Environmental Health and Safety (EHS) to assure appropriate design. Improper use could cause impaired function of the anesthesia machine or inappropriate routing of toxic gases within the building ventilation or vacuum system.

2) Passive scavenging

This method is less foolproof than active scavenging, but when done properly it can protect personnel from gas exposure. Passive scavenging relies on the positive pressure from the anesthetic gas delivery system and/or the exhalation effort of the animal to drive contaminated exhaled air through a specially designed activated charcoal filter, which will adsorb and remove the halogenated hydrocarbon anesthetic agent before the air is discharged back into the room. As is the case with any filter cartridge, excessive flow through the filter can result in decreased performance, so gas flows should be set to the lowest rate that will allow adequate ventilation of the animal and proper function of the vaporizer. In addition, the absorptive capacity of the cartridge will eventually be exhausted, which will result in filter failure and the discharge of toxic gases into the room. To prevent this occurrence, manufacturers provide an estimate of the safe loading capacity of the filter expressed in grams. In use, the cartridge must be weighed frequently to determine the degree of loading that has occurred and discarded when the weight increase reaches the threshold (usually 50g). No makeshift induction chambers are permitted without clearance by EHS.

Section B – Safe Working Practices

Even when proper scavenging is in place, personnel exposure can occur if the equipment is not in good working condition or is not properly adjusted. Careful handling of the anesthetic in liquid form is also very important. A Lab-specific Standard Operating Procedure (SOP) should be developed in consultation with EHS for safe use of anesthetics. Lab personnel should be trained by a qualified member of the lab and it should be documented on their Procedure Specific Training form.

Common causes of inadvertent exposure include:

- Leaks from gas supply lines and connections
- Leaks within the anesthesia machine and breathing system
- Leaks between subject and facemask
- Leaks from around the tracheal tubing
- Spills of liquid anesthetics

Reduce exposure to waste anesthetic gases by:

- Working in a well-ventilated space. There should be no recirculation of exhaust air.
- Utilizing scavenging systems
- Labeling anesthetic gas appropriately
- Placing warning signage where occupational exposure can occur
- Using appropriate personal protective equipment (gloves, lab coats, safety glasses)
- Calibrating equipment
- For Anesthetic Machines:
- Leak-testing equipment
- Using properly fitting face masks
- Using appropriately sized endotracheal tubes
- Correctly inflating endotracheal tube cuffs
- Connecting tubes and fittings properly
- Using keyed filler systems or bottle adapters with spout
- Filling vaporizers when few people are around
- Using low fresh-gas flow rates
- Turning off the gas prior to removing animal from anesthetic machine
- Maintaining oxygen flow until the scavenging system is flushed

For Open Drop Systems:

- Use a chamber with a tight-fitting cover
- Use a change with the smallest diameter mouth possible
- Keep the lid on except when the animal is being placed into or removed from the chamber

For Immersion Anesthesia (common in fish and amphibians):

- Skin exposure to tricaine (MS-222) is a unique risk to persons using the compound to anesthetize or euthanize fish and/or amphibians because it can be toxic when absorbed into the body. Nitrile gloves must be worn.

Cleanup and Disposal of Liquid Anesthetic Agent Spills

Small volumes of liquid anesthetic agents such as halothane and isoflurane evaporate readily at normal room temperatures, and may dissipate before any attempts to clean up the liquid are started.

Laboratory personnel may perform the cleanup of small spills (25 mL or less) provided that they have access to appropriate personal protective equipment as directed by the Safety Data Sheet (SDS) and the agent can be absorbed with paper towels or other absorbent material at the time of release. The waste material should be placed into a sealed container, e.g., Ziploc bag or plastic jar, tagged for pickup by EHS who will then pick up for disposal.

If the spill is greater than 25 mL, laboratory personnel should vacate the room immediately and secure the room from general access by closing all doors leading to the spill area. Inform people in the area to leave. Then contact EHS by calling (512) 471-3511. Be prepared to provide contact information, location of the spill, chemical name, and approximate amount spilled. For after-hours spills call UTPD at (512) 471-4441 who will contact the EHS on-call personnel. EHS spill response personnel will respond to the scene to further evaluate the release and will determine when the area is safe for re-entry.

Pregnancy and Anesthetic Agents

Women of childbearing age should be aware that, although the risks are not completely understood, exposure to anesthetic gases such as halothane and isoflurane may pose risks to a developing fetus and therefore exposure during pregnancy is not recommended. For more information contact the HealthPoint Occupational Health Program (OHP)

for consultation and exposure concerns.

Section C – Requirements

1) All anesthetic equipment and scavenging devices must be maintained according to the manufacturer's recommendations.

2) Anesthetic vaporizers are examples of precision equipment that require routine servicing and calibration by professionally-trained service technicians to assure both human and animal safety. Unless specific manufacturer recommendations to the contrary are available, all vaporizers must be serviced on an annual basis. Recommendations for service vendors and information on group scheduling of maintenance (which may have some cost or convenience benefits) can be obtained from the Animal Resources Center (ARC) veterinary group.

3) Adequate scavenging (either active or passive) must be in place any time anesthetic gases are used.

4) When charcoal canisters are used for passive scavenging, documentation of routine weight monitoring for loading must be maintained in the laboratory.

5) All personnel must be properly trained in the safe and effective use of anesthetic gases. Careful attention must be given to eliminate leaks and spills.

6) Equipment that involves direct animal contact (anesthetic masks, nose cones, induction chambers, scales, and balance baskets) must be inspected, cleaned, and disinfected before and after use to ensure a proper fit and working condition and to prevent microbial cross-contamination.

Section D – Resources

Training in proper anesthetic and animal handling techniques and methods for pressure-testing anesthetic machines for leaks are available from the Animal Resources Center (ARC) at (512) 471-7534.

Questions or concerns about gas exposure, proper handling and disposal of anesthetic liquids, or other safety components should be directed to Environmental Health and Safety (EHS) at (512) 471-3511. Environmental monitoring to determine the concentration of anesthetic gas vapors in the workplace is available through EHS.

Anesthetic Gas Guidance and a Hazardous Chemical SOP Template is available from Environmental Health and Safety.

Consultation regarding health and exposure concerns, as well as medical care is available from the HealthPoint Occupational Health Program (OHP) at (512) 471-4OHP (4647) or Healthpoint.OHP@austin.utexas.edu.

Section E – Acknowledgements and References

This document contains content that was adapted from materials obtained from Stanford University.

Bernstein PS, Digre KB, Creel DJ. 1997. Retinal toxicity associated with occupational exposure to the fish anesthetic MS-222. Am J Ophthalmol 124(6): 843-844.

Approval Date	Change(s) Approved
02/10/2020	• Animal safety requirements added (introduction and Section D)
01/23/2023	• Removed Animal Safety requirement. Added required SOP and training.
01/31/2024	• ADMIN Update: Added clarification for use of hard-ducted Class II B2 BSC vs. non-ducted BSC to align with EHS Anesthetic Gas Guidance