Veterinary Clinics and Hospitals

Inhalation anesthesia in veterinary hospitals is practiced in a manner similar to that in human hospitals. Generally, animals are initially given an injectable anesthetic, followed by general anesthesia maintained by an inhalation technique. In animal anesthesia, there are five basic methods by which inhalation anesthetics are administered: open-insufflation, semiopen without nonrebreathing valves, semiopen with nonrebreathing valves, semiclosed, and closed. Figure 8 illustrates a circle breathing system. Oxygen and anesthetic are transported to the animal's lungs from the anesthesia machine through a face mask or tracheal tube. An inflatable cuff on the distal end of the tracheal tube facilitates a seal with the inner wall of the trachea.

Unidirectional valves allow flow from the vaporizer to the animal upon inspiration and route the exhaled gases through a carbon dioxide absorber during expiration. High fresh-gas flows are typically used with all techniques except closed-system breathing circuits. During expiration, excess or waste gas exits the breathing circuit at the adjustable pressure-limiting (APL) or pop-off valve and escapes into the room unless it is appropriately scavenged.

Non-rebreathing systems allow exhaled gases to be immediately expelled from the system into the room air. Because these systems do not include a carbon dioxide absorber, greater fresh-gas flows are required to ensure removal of carbon dioxide from the system. A higher fresh-gas flow may lead to an increase in ambient waste gas levels.

A. Engineering Controls

The basic principles of scavenging used to capture excess anesthetic gases in hospital surgical suites are appropriate for application in veterinary anesthesia. The APL or pop-off valve is connected to the scavenging interface valve. A waste gas reservoir bag is attached to the interface valve and collects excess anesthetic gases.

In general, the disposal pathway for waste anesthetic gases generated in a veterinary facility can be any one of those mentioned (e.g., ventilation system, central vacuum system, dedicated blower [exhaust] system, passive duct system, or adsorber) and described in detail on pages [15-17] of this document. A vacuum source, if present, is connected to the interface valve and waste gas reservoir bag, where gas is stored until the vacuum can move it to the outside air. If only halogenated compounds are used, an activated charcoal adsorption system can be used.

B. Work Practices

The following are recommended work practices for reducing gas leakage:

•Avoid turning on N2O or a vaporizer until the circuit is connected to the animal. Switch off the N2O and vaporizer when not in use. Maintain oxygen flow until the scavenging system is flushed.

•Select the optimal size tracheal tube for the animal and make sure the cuff, if present, is adequately inflated. Adequacy of cuff inflation may be evaluated by delivering a positive-pressure breath while the APL or pop-off valve is closed and listening for a leak originating from around the tracheal tube cuff.

•Occlude the Y-piece if the breathing circuit must be disconnected during surgery.

•Once anesthesia is discontinued, empty the breathing bag into the scavenging system rather than into the room. Releasing anesthetic gases into the OR could significantly increase the overall waste gas concentration within the room.

•At the end of the surgical procedure, continue to administernon-anesthetic gases/agents as long as clinically necessary, using high oxygen flow rates through the breathing circuit to wash the anesthetic gases out of the system and the animal. This allows exhaled anesthetic gases to be collected by the scavenging system.

•It is possible to close an anesthetic circle and reduce fresh-gas flow rates. In a circle system where oxygen is the only carrier gas, the amount of fresh gas flowing to the animal should be adjusted to closely match the animal's metabolic oxygen requirement.

•Select masks to suit various sizes and breeds encountered in veterinary practice. When a mask is used for induction or maintenance of anesthesia, use a mask that properly fits the contour of the animal's face to minimize gas leakage. Minimize the time of mask anesthesia to reduce waste.

•Use a box for induction of anesthesia in small, uncooperative animals. As with the mask technique, the induction box method requires high gas-flow rates, with substantial anesthetic spillage. Methods to minimize this spillage include tight seals on the box and placement of the box near the ventilation port of a well-ventilated room. The box can also be connected to an anesthetic gas-scavenging system to evacuate the gases in the box prior to removing the animal.

•Make certain that the reservoir bag, used to store excess anesthetic waste gas until the vacuum system can remove it, is adequate to contain all scavenged gas. This reservoir bag is especially designed to connect to anesthetic gas-specific fittings.

G. CLEAN-UP AND DISPOSAL OF LIQUID ANESTHETIC AGENT SPILLS

Small volumes of liquid anesthetic agents such as halothane, enflurane, isoflurane, desflurane, and sevoflurane evaporate readily at normal room temperatures, and may dissipate before any attempts to clean up or collect the liquid are initiated. However, when large spills occur, such as when one or more bottles of a liquid agent break, specific cleaning and containment procedures are necessary and appropriate disposal is required (AANA 1992). The recommendations of the chemical manufacturer's material safety data sheet (MSDS) that identify exposure reduction techniques for spills and emergencies should be followed.

In addition, OSHA Standard for Hazardous Waste Operations and Emergency Response (29 CFR 1910.120) would apply if emergency response efforts are performed by employees. The employer must determine the potential for an emergency in a reasonably predictable worst-case scenario, and plan response procedures accordingly. Only adequately trained and equipped workers may respond to spills. When the situation is unclear or data are lacking on the exposure level, the response needs to be the same as for high levels of exposure. Responses to incidental releases of liquid anesthetic agents where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel do not fall within the scope of this standard.

Because of the volatility of liquid anesthetics, rapid removal by suctioning in the OR is the preferred method for cleaning up spills. Spills of large volumes in poorly ventilated areas or in storage areas should be absorbed using an absorbent material, sometimes called a sorbent, that is designed for clean-up of organic chemicals. "Spill pillows" commonly used in hospital laboratories, vermiculite, and carbon-based sorbents are some of the materials commercially available and regularly used for this purpose. Caution should be exercised if broken glass bottles pose a hazard.

Both enflurane and desflurane are considered hazardous wastes under the EPA regulations because these chemicals contain trace amounts of chloroform (a hazardous substance), a by-product of the manufacturing process. Consequently, sorbents that have been saturated with enflurane or desflurane should be managed as an EPA hazardous waste material due to the trace concentrations of chloroform present. Isoflurane and halothane do not contain trace amounts of chloroform or any other regulated substance and are therefore not considered hazardous wastes by EPA.

To minimize exposure to all liquid anesthetic agents during clean-up and to limit exposure during disposal procedures, the following general guidelines are recommended. The waste material should be placed in a container, tightly sealed, properly labeled, and disposed of with other chemical wastes sent to a facility's incinerator or removed by a chemical waste contractor. After a large spill has occurred and the appropriate response action taken, airborne monitoring should be conducted to determine if the spill was effectively contained and cleaned up.

Determination of appropriate disposal procedures for each facility is the sole responsibility of that facility. Empty anesthetic bottles are not considered regulated waste and may be discarded with ordinary trash or recycled. Furthermore, the facility as well as the waste handling contractor must comply with all applicable federal, state, and local regulations.

To minimize exposure to waste liquid anesthetic agents during clean-up and disposal, the following general guidelines are recommended by the manufacturers of liquid anesthetic agents: Wear appropriate personal protective equipment. (Refer to section E4 on personal protective equipment).

Where possible, ventilate area of spill or leak. Appropriate respirators should be worn.

Restrict persons not wearing protective equipment from areas of spills or leaks until clean-up is complete.

Collect the liquid spilled and the absorbent materials used to contain a spill in a glass or plastic container. Tightly cap and seal the container and remove it from the anesthetizing location. Label the container clearly to indicate its contents.

Transfer the sealed containers to the waste disposal company that handles and hauls waste materials. Health-care facilities that own or operate medical waste incinerators may dispose of waste anesthetics by using an appropriate incineration method after verifying that individual incineration operating permits allow burning of anesthetic agents at each site.

H. AIR MONITORING

Air monitoring is one of the fundamental tools used to evaluate workplace exposures. Accordingly, this section presents some of the appropriate methods that can be used to detect and measure the concentration of anesthetic gases that may be present in the health-care environment. The data provided by monitoring are necessary to establish proper engineering, work practice, and administrative controls to ensure the lowest reasonably achievable gas levels in the operatory and PACU room air.

OSHA recommends that air sampling for anesthetic gases be conducted every 6 months to measure worker exposures and to check the effectiveness of control measures. Furthermore, OSHA recommends that only the agent(s) most frequently used needs to be monitored, since proper engineering controls, work practices and control procedures should reduce all agents proportionately. However, the decision to monitor only selected agents could depend not only on the frequency of their use, but on the availability of an appropriate analytical method and the cost of instrumentation. [**ASA emphasizes regular maintenance of equipment and scavenging systems, daily check-out procedures for anesthesia equipment, and education to ensure use of appropriate work practices. It does not believe that a routine monitoring program is necessary when these actions are being carried out.** ASA prefers to use monitoring when indicated such as in the event of known or suspected equipment malfunction. The Academy of General Dentistry also emphasizes properly installed and maintained analgesia delivery systems.]

Three fundamental types of air samples can be taken in order to evaluate the workplace: personal, area, and source samples. Personal samples give the best estimate of a worker’s exposure level since they represent the actual airborne contaminant concentration in the worker’s breathing zone during the sampling period. This is the preferred method for determining a worker’s time-weighted average (TWA) exposure and should be used to assess personal exposures during anesthetic administration and in the PACU. Where several health-care workers perform the same job, on the same shift, and in the same work area, and the length, duration, and level of waste gas exposures are similar, an employer may sample a representative fraction of the employees instead of all employees.

Area sampling is useful for evaluating overall air contaminant levels in a work area and for investigating cross-contamination with other areas in the health-care facility. Source sampling can be used to detect leaks in the anesthesia delivery and scavenging systems as well as ineffective capture by the scavenging system. Thus, how samples are taken is a critical point in any safety program.

The OSHA Chemical Information Manual contains current sampling technology for several of the anesthetic gases that may be present in anesthetizing locations and PACUs.