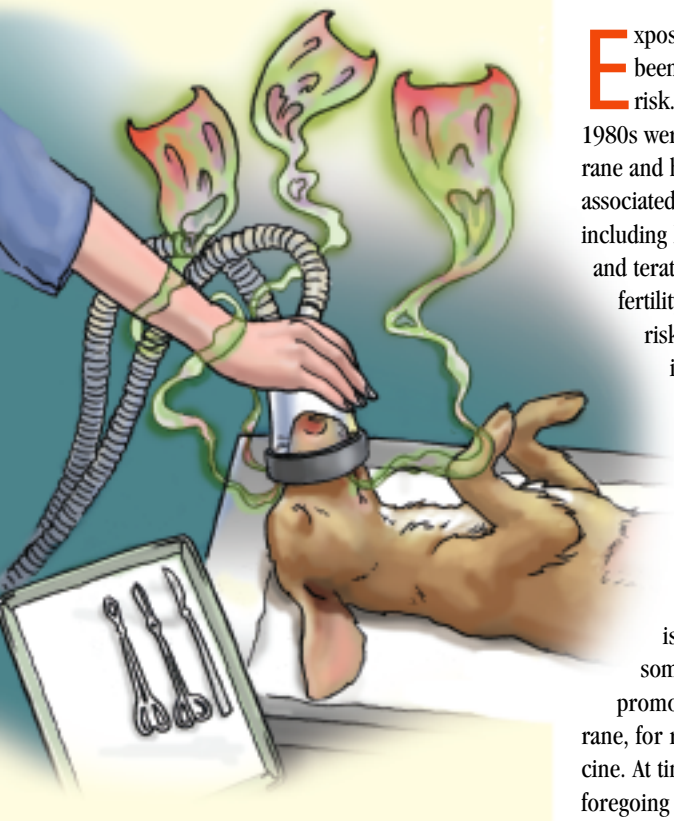
You have asked ...

How do you manage your staff's waste anesthetic gas exposure? Do you have OSHA-related concerns about staff exposure?



ACVA = American College of Veterinary Anesthesiologists; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety & Health Administration

The Expert Says ...

Waste Anesthetic Gas

Managing a Worrisome Workplace Risk

Robert Stein, DVM, Amherst Small Animal Hospital,Snyder, New York; Founder and Webmaster, Veterinary Anesthesia Support Group

Exposure to waste anesthetic gas has long been considered a worrisome workplace risk. Concerns dating back to the early 1980s were originally focused on methoxyflurane and halothane. Volatile agents have been associated with significant health concerns, including liver disease, renal disease, mutagenic and teratogenic effects,[1, 2] and reduced fertility.[3] In one human study, the health risks associated with daily trace anesthetic gas exposure were compared with smoking 11 to 20 cigarettes per day.[4]

Recent Complacency

More recently, there has been a disconcerting trend toward complacency about waste gas exposure with the newer volatile anesthetic agents, isoflurane and sevoflurane. In fact, some manufacturers have been actively promoting gas agents, particularly sevoflurane, for routine induction in veterinary medicine. At times, in-clinic seminars have suggested foregoing preanesthetic sedative and analgesic medications as a way to compensate for the higher expense of the newer agents. Ironically, effective preanesthetic medications are a key element in balanced anesthetic strategies that improve patient comfort and safety.

Sevoflurane undergoes hepatic metabolism by staff personnel to a greater degree than isoflurane—3% versus less than 0.2%—although the significance of this has yet to be determined. Although they are not considered risk free, these two agents certainly seem to be more attractive than halothane (25% metabolized) and methoxyflurane (50% metabolized).

High exposure to waste gas is most closely associated with mask and chamber inductions as well as anesthesia maintained via a mask, particularly with exotic animals. Other sources are inadequate endotracheal tube cuff seal, leaks associated with the anesthetic machine or ventilator (including the inhalation–exhalation valves, absorbent canister, reservoir bags, and pop-off valve), and failure to allow adequate patient recovery on the anesthetic machine before detachment, extubation, and recovery. While patient recovery is associated with unavoidable waste gas exposure by staff, recoveries in a well-ventilated room with a nonrecirculating ventilation system will minimize this concern.

NIOSH Recommendations

NIOSH recommends that no worker be exposed to halogenated anesthetic agent concentrations greater than 2 ppm on a time-weighted average.[5] The human sense of smell cannot detect the odor of an anesthetic agent until concentrations reach 30 to 40 ppm—levels 15 to 20 times the NIOSH-recommended exposure level. Although these guidelines were initially written before the introduction of isoflurane, sevoflurane, and desflurane, it is clear that NIOSH and OSHA intend for these guidelines to apply to all agents.

The General Duty Clause contained in the Occupational Safety and Health Act of 1970[6] states that the employer "shall furnish to each of his employees employment and a place of

continues

employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." OSHA's *Anesthetic Gases: Guidelines for Workplace Exposures*[5] warns that "Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take steps to prevent or abate the hazard." This suggests that an employer is at significant risk for an OSHA citation if he or she routinely uses high-exposure practices like mask and chamber inductions without monitoring waste gas exposure by staff.

Minimizing Exposure

The ACVA has taken the clear position that exposure to inhalant agents should be minimized for all staff members, not just women of child-bearing age.[7] It recommends minimizing the delivery of inhalant anesthetic by mask and chamber. If used, such delivery methods should take place in a well-ventilated room with an effective nonrecirculating ventilation system or under a fume hood—neither of which is commonly available in private practice today.

Whether to allow pregnant staff in the anesthetic arena is a difficult decision. There is clearly an overall sense of concern regarding staff exposure to halogenated waste gases during pregnancy. Just as clearly, there is a lack of meaningful information about the magnitude of the risk as well as a lack of helpful information on how to eliminate the risk, leaving the following questions unanswered: Is there a cut-off point below which there is no risk? Do employers have liability exposure if they allow pregnant staff to continue working in the anesthetic arena? Should the employer have a pregnant staff member sign a liability waiver if the employee chooses to continue working with anesthetics?

Certainly, pregnant women who continue to work in the anesthetic arena should have their waste gas exposure monitored (details below). In addition to the management steps outlined below, organic vapor respirators may be worn to further reduce pregnant staff exposure. The 7500 series half facepiece respirator with 6001 organic vapor chemical cartridges (3M Corporation—St. Paul, MN) is listed for controlling halogenated agent exposure. It is available in three sizes, allowing for a comfortable individual fit. The cost of the facepiece and 2 replaceable cartridges is approximately $30.00.

Simple Preventive Steps

By following these simple rules, taken directly from the ACVA position paper[7] on the control of waste anesthetic gases in the workplace, you can easily minimize exposure to waste gas by your staff:

1. **Follow a regular maintenance schedule** for anesthesia machines, ventilators, breathing systems, and waste-gas scavenging systems.

2. **Refrain from using the following habits or techniques**—this will decrease anesthetic gas pollution when inhalant anesthetics are used:

- *Administering inhalant anesthetics by open drop or insufflation.* If used, such techniques should be conducted in a fume hood.
- *Turning on flowmeters and vaporizers before attaching the breathing system to the patient.*
- *Allowing flowmeters and vaporizers to remain on after the patient is disconnected from the breathing system.*
- *Using uncuffed endotracheal tubes that do not create a completely sealed airway* or using cuffed tubes without inflating the cuff.
- *Disconnecting a patient from a breathing system without eliminating as much of the residual gases as reasonably possible through the scavenging system.* The patient should remain attached to the breathing system until extubation occurs.
- *Spilling liquid anesthetic during the filling of vaporizers, especially during an anesthetic procedure.* Ideally, properly functioning, agent-specific, keyed filler systems should be used. At a minimum, a bottle adapter with a spout to prevent excessive spillage should be used.

3. **Minimize the use of masks and closed containers for delivery of inhalant anesthetics.** If used, these techniques should be done in well-ventilated rooms with nonrecirculating ventilation systems or under a fume hood.

4. **Use scavenging systems with all inhalant anesthesia delivery systems to which they are adaptable.** Unscavenged delivery systems should not be used except as described previously.

5. **Use the lowest fresh-gas flow rates (as opposed to very high fresh-gas flows), consistent with the proper function of flowmeters, vaporizers, and breathing systems and with regard to patient safety.** Although scavenging systems should function effectively for both high and low fresh-gas flows, low flows produce less waste gas.

6. **Fill vaporizers in a well-ventilated area with as few people in the room as possible.** Filling vaporizers under a ceiling-mounted hood with an active evacuation system is ideal.

ACVA = American College of Veterinary Anesthesiologists; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety & Health Administration

Anesthetic scavenging systems have become a common fixture in private practice. A properly constructed passive or active scavenging system can significantly reduce staff exposure to waste gas. Charcoal-absorbent systems (F/Air canisters—A. M. Bickford Company, Wales Center, NY) have limitations that reduce their practicality in the clinic setting. The manufacturer suggests replacing the canisters after 10 to 12 hours of use or, more accurately, after a canister weight gain of 50 grams. The likelihood of clinic personnel accurately monitoring time in use or canister weight change is not great. In addition, studies have shown that inhalant agent is detectable in as many as 88% of these canisters by the time they have reached only 50% of their expected lifespan.[8] In a parallel study, 31% of the canisters were emitting isoflurane levels exceeding 5 ppm before they had reached their maximum life as defined by the manufacturer.[8] Waste gas flow rates are not a direct issue affecting the canister performance but higher waste gas flows along with higher anesthetic concentrations will shorten the canister's useful life.

Staff exposure can be monitored through one of the many anesthetic exposure badges available

on the market today (listed in Aids & Resources). They range in prices from $39.00 to $75.00 each with the lab analysis included. Each kit contains specific directions from the manufacturer detailing where the badge should be worn and for what time period. ■

See Aids & Resources, back page, for references, contacts, and appendices.

our authors

JULY 2005

Ralph E. Barrett, DVM, Diplomate ACVIM, is the director of the NAVC Veterinary Postgraduate Institute. Prior to his current position, he was veterinary internist/chief medical officer of National PetCare Centers and also cofounded the Sacramento Animal Medical Group, a practice comprising board-certified specialists and 12 associated veterinary hospitals. Dr. Barrett's interests are in gastroenterology/liver/pancreas, endoscopy, and ultrasonography. He is a past president of the NAVC and has been active at both the local and national levels in various continuing education and organizational roles in the profession.

Adam Birkenheuer, DVM, PhD, Diplomate ACVIM (Small Animal Internal Medicine), is an assistant professor of internal medicine at North Carolina State University College of Veterinary Medicine. Dr. Birkenheuer received his DVM from University of Florida and then completed a small animal internship and residency at North Carolina State University. He also completed a PhD in immunology, studying canine babesiosis. Dr. Birkenheuer's current research is focused on the diagnosis, treatment, and epidemiology of vector-borne diseases of dogs and cats.

Marion Haber, DVM, is a small animal internal medicine resident at North Carolina State University College of Veterinary Medicine. She received her DVM from Tufts University School of Veterinary Medicine and completed a small animal rotating internship at the Veterinary Referral and Emergency Center, Norwalk, Connecticut. Dr. Haber's areas of interest include infectious disease and hepatic diseases. Her current research is based on molecular diagnostic test development for *Cytauxzoon felis* and the role of feral cats in *Cytauxzoon felis* infections.

Debra F. Horwitz, DVM, Diplomate ACVB, has a behavior referral practice in St. Louis, Missouri, and is an adjunct faculty member at University of Missouri. She received her DVM from Michigan State University College of Veterinary Medicine. Dr. Horwitz writes and speaks for professional and lay audiences on behavior topics and is coeditor of the *BSAVA Manual of Canine and Feline Behavioral Medicine*. She received the 1999 AAHA Friskies PetCare award for excellence in companion animal behavior.

Matthew S. Johnston, VMD, Diplomate ABVP (Avian), is an assistant professor of exotic animal medicine at Colorado State University. He received his veterinary degree from University of Pennsylvania and then completed a small animal rotating internship at University of Georgia. Dr. Johnston returned to University of Pennsylvania to complete a residency in special species medicine and then remained as a staff veterinarian before taking his current position. He has been a speaker and lab instructor at NAVC since 2002 and was the NAVC "Exotics Speaker of the Year" in 2004.

Robert Stein, DVM, is the owner of Amherst Small Animal Hospital, Snyder, New York. He

continues on page 55