Exposure to waste anesthetic gas has long been considered a worrisome workplace risk. Concerns dating back to the early 1980s were originally focused on methoxyfluorane and halothane. Volatile agents have been associated with significant health concerns, including liver disease, renal disease, mutagenic and teratogenic effects, and reduced fertility. 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 methoxyfluorane (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 19706 states that the employer “shall furnish to each of his employees employment and a place of...”
administering inhalant anesthetics by
spilling liquid anesthetic during the fill-
If used, such
disconnecting a patient from a breathing
allowing flowmeters and vaporizers to
turning on flowmeters and vaporizers
using uncuffed endotracheal tubes that do

- use scavenging systems with all
- use the lowest fresh-gas flow rates (as
- fill vaporizers in a well-ventilated

- spilling liquid anesthetic during the fill-
ing of vaporizers, especially during an
esthetic 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 anes-
ethetics. If used, these techniques should be
done in well-ventilated rooms with nonrecirc-
ulating 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 safe-
ty. Although scavenging systems should func-
tion 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 sys-
tem is ideal.

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 Corpor-
ation—St. Paul, MN) is listed for controlling
degenerated 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 on the control
of waste anesthetic gases in the workplace,
you can easily minimize exposure to waste
gas by your staff:

■ Follow a regular maintenance sche-
dule for anesthesia machines, ventilators,
breathing systems, and waste-gas scavenging
systems.

■ Refrain from using the following
habits or techniques—this will decrease
anesthetic gas pollution when inhalant anes-
ethetics 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 disconnect-
ed 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 sys-
tem until extubation occurs.

■ Spilling liquid anesthetic during the fill-
ing of vaporizers, especially during an
esthetic 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.

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 monitor-
ing waste gas exposure by staff.

Minimizing Exposure

The ACVA has taken the clear position that expo-
sure to inhalant agents should be minimized for
all staff members, not just women of child-bear-
ing age. 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 non-
recirculating 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 expo-
sure 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 ques-
tions unanswered: Is there a cut-off point below
which there is no risk? Do employers have lia-
ability exposure if they allow pregnant staff to
continue working in the anesthetic arena?
Should the employer have a pregnant staff mem-
er sign a liability waiver if the employee choos-
es to continue working with anesthetics?

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

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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. 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. 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.