CAUT Health and Safety Fact Sheet

Medical Gases

ISSUE 24

Medical gases are used in human and animal healthcare for anesthetics, and through surgical equipment used for incisions, vessel ligation and wound cauterization. These gases are known as surgical vapours, waste anesthetic gases, surgical smoke or smoke plumes and are a hazard to those working with and in close proximity to the machines that produce them and the patients (human or animal) who exhale their by-products.

Exposure to medical gases can impair judgment and coordination, produce adverse physical symptoms like nausea and drowsiness, and may cause liver and kidney disease, miscarriage and cancer.[1]

This fact sheet will provide you with basic information on medical gases and the currently known side-effects and hazards. Work with your Joint Health and Safety Committee to ensure that all safe practices and protocols are in place regarding this issue.

Who are exposed?

- anesthetists, dentists, physicians
- clinical instructors, researchers and their students
- veterinarians and their staff
- operating room nurses, technicians and ancillary workers
- recovery room staff
- equipment technicians working in hospitals, dental offices or veterinary clinics
- nurses working on surgical floors, emergency rooms and in ICU's, CCU's and NICU's
- operating/recovery room cleaning staff may be at risk of exposure
- equipment engineers and their students

These gases are known as surgical vapours, waste anesthetic gases, surgical smoke or smoke plumes.

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Exposure

Exposure occurs in two ways:

- direct contact by proximity to volatile anesthetic gases leaking from the anesthetic breathing circuit.
- breathing in post-anesthetic exhalations of patients (human or animal)

WAGS

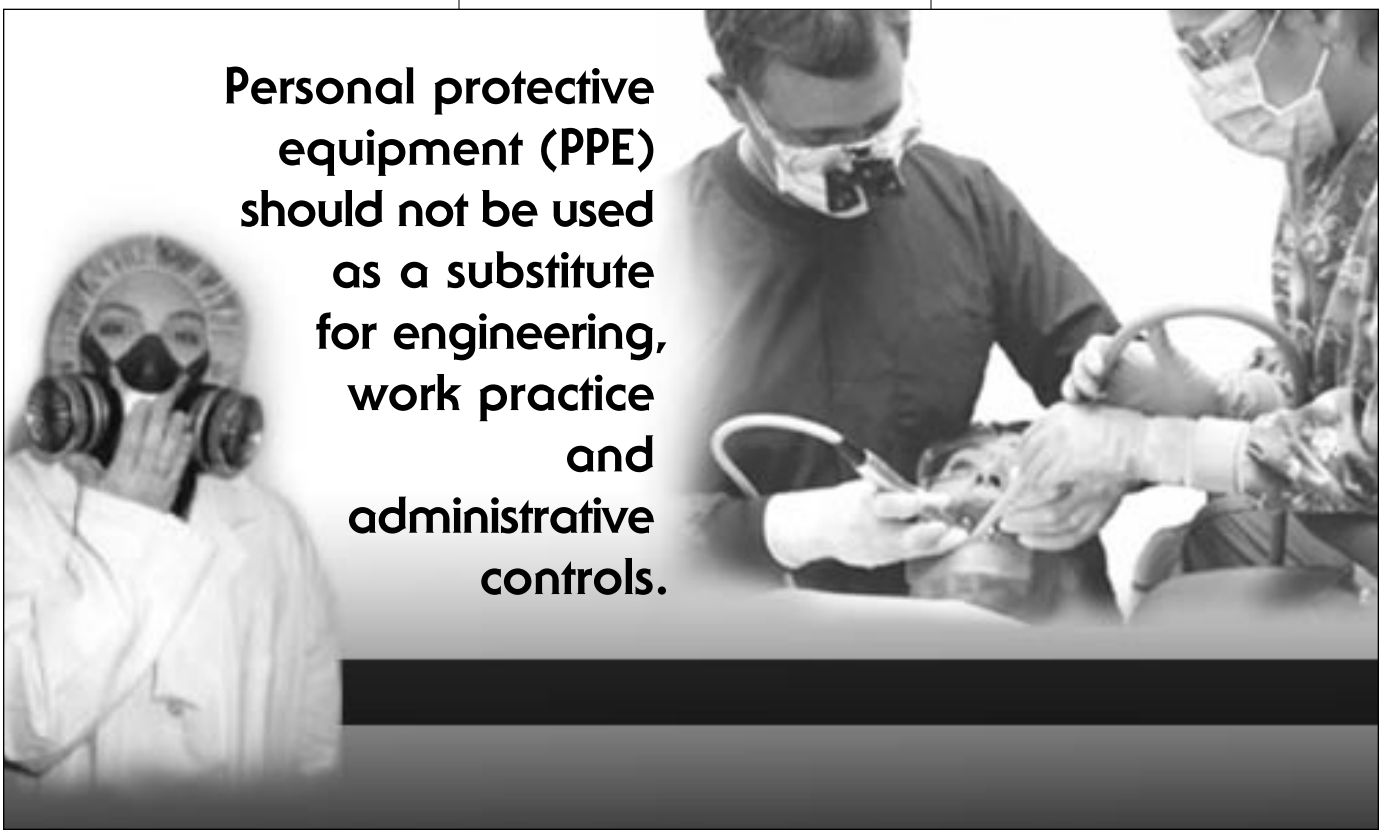
Waste anesthetic gases (WAGS) are gases or vapours that leak during medical procedures from improperly or poorly connected anesthetic equipment or patient masks, and from patient exhalation (can be for days after surgery). Patients having head, neck or throat procedures may also leak anesthetic products through surgical or other wounds.

Dr. Doris Dyson[2], a professor of anesthesiology at the Ontario Veterinary College (OVM) notes that "In the past, when methoxyflurane was used, its distinct odour could be smelled on the breath of patients [animals] for hours, sometimes even overnight." The OVM has taken a proactive approach in reducing and eliminating exposures to WAGS and has comprehensive protocols on their website.

Health effects: dizziness, nausea, fatigue, headache, irritability, depression, compromised cognitive, perception and motor skills, sterility, miscarriage, birth defects, cancer, and liver and kidney disease

Safety Measures: "Anesthetic Gases: Guidelines for Workplace Exposures, Revised May 18, 2000"[3] provides comprehensive and detailed information on safety processes and controls when working with or in the vicinity of anesthetic gases. General measures include:

- Hazard communication programs
- Worker training
- Engineering controls – scavenging systems and general or dilution ventilation
- Work practices – pre-operative equipment checks, masks to fit patient, airway devices positioned correctly and cuffs inflated adequately, vaporizers filled in well-ventilated areas, liquid anesthetic agent spills cleaned promptly, administer non-anesthetic gases/agents pre-extubation to allow scavenging system to capture washed-out gases



- Biomedical engineers and technicians should monitor airborne concentrations, assist in identifying sources of waste/leaking gases and implement corrective action, determine if the scavenging system is designed and functioning properly, and ensure that operatory and PACU ventilation systems have adequate air exchange to reduce ambient waste gas levels
- Administrative controls – routine inspection and regular maintenance of equipment, monitoring program of airborne levels of waste gases in the breathing zone or immediate work area, use scavenging systems where inhaled agents are used, reduce worker exposure, medical surveillance programs, use personal protective equipment for clean-up and containment of major spills, proper disposal of spills, and comply with any legislation or regulations
- Personal protective equipment (PPE) should not be used as a substitute for engineering, work practice and administrative controls
- Pregnant workers are at risk of miscarriage and the teratogenic effects of WAGS and should work in non-exposed areas

Anesthetic breathing circuit

The anesthetic breathing circuit includes the mask, endotracheal tube, anesthetic gas machine, ventilator, pumps, scavenging devices, all connecting tubing, and other elements, depending on the type of anesthesia delivery system.

CDC/NIOSH Waste Anesthetic Gases, Occupational Hazards in Hospitals

Table 1: Anesthetic Gases

Generic or Chemical Name	Commercial. Name	Year Introduced
Nitrous Oxide	Nitrous oxide	1844
Halothane	Fluothane™	1954
Methoxyflurane	Penthrane™	1960
Enflurane	Ethrane™	1974
Isolurane	Forane™	1980
Desflurane	Suprane™	1992
Sevoflurane	Ultane™	1995

SOURCE: Canadian Centre for Occupational Health and Safety

Nitrous oxide (N_2O)

Commonly known as "laughing gas", it is often the anesthetic of choice in dental procedures requiring sedation. This WAG is in a liquid state before application and produces frostbite effects to skin and eyes on contact. Exposure by inhalation can produce dyspnea, drowsiness, headache, asphyxia, reproductive effects and frostbite. It targets the respiratory, central nervous and reproductive systems.[4]

Surgical Smoke/ Smoke Plume

Surgical smoke or smoke plume occurs during procedures where lasers or electrosurgical units are used. This equipment causes thermal tissue destruction and "smoke" or "plume."

The smoke or plume can contain: benzene, hydrogen cyanide, formaldehyde, bioaerosols, dead and live cellular material (blood and tissue), bacteria, blood borne pathogens and viruses. These toxic gases can be carcinogenic or mutagenic.

Visualizing the surgical field can become compromised, resulting in unsafe operating conditions.

Reducing Exposure

It is important that anyone with the potential for exposure should be properly trained on how to safety work around and with these machines and understand the hazards of exposure.

The workplace should comply with any applicable legislation, regulation or standard regarding the safe use of the equipment.

MSDS sheets on any hazardous products used in conjunction with lasers or electrosurgical units should be easily accessible to workers.

The need for care and caution

John Snow, a founding father of anesthesiology[5], gave this discipline scientific credence by showing how the human body responded to different doses of anesthetic drugs and their affects. In one of his papers on the subject, "On narcotism by the inhalation of vapours", Snow noted that care had to taken when using chloroform or ether (the anesthetics of the day) not only because the wrong dosage could be fatal, but that the after-effects, including vomiting, depressed respirations and "vacancy in a patient's manner", could last for days afterwards. He was adamant that it "…ought not to be used except by medical men who have studied its effects." Although modern anesthetic was in its infancy and little was known about these substances, Snow clearly recognized the need for care and caution when applying them.

Ventilation: a combination of general room and local exhaust is recommended

Scavenging systems: should have high efficiency airborne particle reduction, capture velocity of about 100 to 150 feet per minute, and a HEPA filter or equivalent

Masks: all workers in an area where smoke or plume may be produced should wear facemasks of 0.1-micron filtration levels. They should not be used as the first line of defense, but in concert with proper ventilation and scavenging systems.

Toolkit

Canadian Standards Association, CSA Z305. 13-09
Plume Scavenging Standard

International Federation of Perioperative Nurses, IFPN Guideline on Smoke Plume

NIOSH, Hazard Controls, Control of Smoke from Laser/ Electric Surgical Procedures

United States Department of Labour OSHA: Waste Anesthetic Gases – Possible Solutions, Hazard Recognition, Fact Sheet No. OHSA 91-38; Anesthetic Gases: Guidelines for Workplaces Exposures

Sources

British Occupational Hygiene Society, COSHH Guidance, Surgical Smoke

Canadian Centre for Occupational Health and Safety www.ccohs.ca

CDC, MMWR Leading Work-Related Diseases and Injuries – United States, Disorders of Reproduction www.cdc.gov

CDC NIOSH
www.cdc.gov

Ontario Veterinary College, University of Guelph
www.ovc.uoguelph.ca

Operating Room Nurses Association of Canada
www.ornac.ca

Notes

1 CDC/NIOSH Waste Anesthetic Gases, Occupational Hazards in Hospitals www.cdc.gov/niosh

CCOHS OSH Answers, Waste Anesthetic Gases, Hazards of www.ccohs.ca

2 Dr. Doris Dyson, DVM, DVSc, DACVA, Clinical Studies, Ontario Veterinary College, University of Guelph

3 United States Department of Labor, OSHA www.osha.gov/dts/osta/anestheticgases

4 NIOSH Pocket Guide to Chemical Hazards, Nitrous Oxide www.cdc.gov/niosh/npg/npgd0465.html

5 The John Snow Archive and Research Companion, About John Snow

Photos:
CDC, MMWR 2003;52 (No. RR-17); NIOSH (page 2), © Jupiterimages Corporation (page 1)