

Control of Smoke From Laser/Electric Surgical Procedures

HAZARD

During surgical procedures using a laser or electrosurgical unit, the thermal destruction of tissue creates a smoke byproduct. Research studies have confirmed that this smoke plume can contain toxic gases and vapors such as benzene, hydrogen cyanide, and formaldehyde, bioaerosols, dead and live cellular material (including blood fragments), and viruses. At high concentrations the smoke causes ocular and upper respiratory tract irritation in health care personnel, and creates visual problems for the surgeon. The smoke has unpleasant odors and has been shown to have mutagenic potential.

CONTROLS

NIOSH research has shown airborne contaminants generated by these surgical devices can be effectively controlled. Two methods of control are recommended:

□ VENTILATION

- Recommended ventilation techniques include a combination of general room and local exhaust ventilation (LEV). General room ventilation is not by itself sufficient to capture contaminants generated at the source. The two major LEV approaches used to reduce surgical smoke levels for health care personnel are portable smoke evacuators and room suction systems.
- Smoke evacuators contain a suction unit (vacuum pump), filter, hose, and an inlet nozzle. The smoke evacuator should have high efficiency in airborne particle reduction and should be used in accordance with the manufacturer's recommendations to achieve maximum efficiency. A capture velocity of about 100 to 150 feet per minute at the inlet nozzle is generally recommended. It is also important to choose a filter that is effective in collecting the contaminants. A High Efficiency Particulate Air (HEPA) filter or equivalent is recommended for trapping particulates. Various filtering and cleaning processes also exist which remove or inactivate airborne gases and vapors. The various filters and absorbers used in smoke evacuators require monitoring and replacement on a regular basis and are considered a possible biohazard requiring proper disposal.
- Room suction systems can pull at a much lower rate and were designed primarily to capture liquids rather than particulate or gases. If these systems are used to capture generated smoke, users must install appropriate filters in the line, insure that the line is cleared, and that filters are disposed properly. Generally speaking, the use of smoke evacuators are more effective than room suction systems to control the generated smoke from nonendoscopic laser/electric surgical procedures.

□ WORK PRACTICES

- The smoke evacuator or room suction hose nozzle inlet must be kept within 2 inches of the surgical site to effectively capture airborne contaminants generated by these surgical devices. The smoke evacuator should be ON (activated) at all times when airborne particles are produced during all surgical or other procedures. At the completion of the procedure all tubing, filters, and absorbers must be considered infectious waste and be disposed appropriately. New filters and tubing should be installed on the smoke evacuator for each procedure. While there are many commercially available smoke evacuator systems to select from, all of these LEV systems must be regularly inspected and maintained to prevent possible leaks. Users shall also utilize control measures such as "universal precautions," as required by the OSHA Blood-Borne Pathogen standard.

The following reports on this topic are available free upon request from NIOSH:

- Evaluation of a Smoke Evacuator Used for Laser Surgery, *Lasers Surg Med* 9:276 281 (1989)
- NIOSH Health Hazard Evaluation and Technical Assistance Reports, HETA 85-126-1932 (1988) and HETA 88-101-2008 (1990).

*NIOSH is the Federal agency responsible for conducting research and making recommendations for preventing work-related illness and injuries. **HAZARD CONTROLS** are based on research studies that show reduced worker exposure to hazardous agents or activities.

The principal contributor to this **HAZARD CONTROLS** is C. Eugene Moss, Division of Surveillance, Hazard Evaluations and Field Studies. Assistance was provided by the Education and Information Division, NIOSH. This document is in the public domain and may be freely copied or reprinted. NIOSH encourages all readers of this *HAZARD CONTROLS* to make it available to all interested employers and workers.