



## No Smoking Allowed

### Addressing the Dangers of ESU/Laser Plume and Surgical Fires in the OR

**S**urgical smoke and laser plume are byproducts that are created when tissue and cells are vaporized during electrosurgical and laser procedures. While these methods provide immeasurable benefit for the patients they treat, they and the healthcare workers (HCWs) who perform and facilitate the procedures in the operating room (OR) face possible risks to their own health from the smoke itself.

Over the last couple of decades, numerous studies have examined the possible hazards of surgical smoke. In addition to decreasing visibility in the OR and irritating the eyes and respiratory tracts of HCWs in the immediate vicinity, surgical smoke may contain toxic gases and harmful biological material such as blood fragments and viruses.<sup>1</sup>

Surgical smoke also contains a number of potentially harmful chemicals such as acetonitrile, benzene, carbon monoxide, formaldehyde, methane and phenol. The dangers of long-term contact with these and other toxins are a source of great concern for many HCWs and scientists.

In a review of the existing literature, authors recommend efforts to minimize exposure to surgical smoke and suggest that its minimal toxic capacity is similar to that of cigarette smoke.<sup>2</sup> However, studies also warn that more serious health threats may exist, particularly when laser comes in contact with tissue containing dangerous viruses.

In fact, one study has specifically demonstrated the transmission of papillomavirus via laser plume.<sup>3</sup> Authors of this study also advise HCWs to take appropriate precautions in order to minimize health risks, specifically when viral disease is present.

Another study theorizes that the infection of a laser surgeon with laryngeal papillomatosis was caused by exposure to laser plume during laser treatment of patients with anogenital condylomas.<sup>4</sup> In this case the surgeon's patients were the only known source of infection.

The presence and possible transmission of harmful material is enough to make laser plume and surgical smoke big concerns, especially for HCWs who are exposed to it on a regular basis. "I think it's a concern and a lot of other people do as well," says Carol Petersen, RN, BSN, MAOM, CNOR, perioperative nursing specialist at AORN. "Whether people are really getting sick from it is harder to prove because there are so many variables."

Although laser plume and surgical smoke are widely acknowledged to be dangerous, a specific federal standard does not exist. The Occupational Safety and Health Administration (OSHA) does recognize the threat surrounding this issue, but some feel that a more comprehensive and focused guideline is in order. "OSHA has a

general guideline that includes smoke plume, but it's not as definitive as everyone would like," says Petersen.

OSHA does state that the general duty clause, Section 5(a)(1) of the Occupational Safety and Health Act of 1970 may be cited in cases where a hazard is not specifically addressed by an OSHA standard. OSHA also issued a Hazard Information Bulletin in 1988 that urged its consultative and compliance personnel to alert HCWs of the potential hazards of laser plume when possible.<sup>5</sup>

"Part of the reason that OSHA has not made a definitive statement on surgical smoke and they've lumped it in with some other things is the research that has been done so far hasn't shown enough problems," Petersen continues. "People haven't been injured enough, although there have been reports that they have."

Given the amount of information available to the health community, Petersen thinks most OR nurses are aware of the threat surgical smoke poses. "There has been a lot of press on it and a lot of information at our (AORN) Congress," she says. "I don't think anyone thought much about it when they were in smoke from electrosurgical units (ESUs), even though that can be equally dangerous. When lasers came around and when they were also doing condyloma warts, people started to worry about viruses in those, whether they were venereal type warts or whether they were papalomas that were on vocal chords."

Once concerns began to surface about potential harm from laser plume, methods of protection for HCWs and patients started to become available. Today, concerned HCWs and facilities have several options to pick from in order to neutralize risks from smoke in the OR. One option is surgical masks. While standard masks do not offer much in the way of protection from exposure to bacteria or viruses in surgical smoke, high performance masks are available that can block out most of these tiny contaminants if worn correctly. Although this may help, masks are not designed to trap and eliminate the smoke contaminants. Another drawback to this approach is the relative difficulty in breathing that users may experience.

Some facilities may choose to make use of the existing wall suction in their ORs as a method of smoke filtration. In this case, suction would be fitted with inline filters that protect the suction system and trap particles in the smoke. While this may be adequate in some cases, it is not always realistic. For example, open procedures may require HCWs to hold suction hoses very close to the site at which the smoke originates.<sup>6</sup> This can be a difficult and inefficient mechanism in circumstances such as these.



The use of a mechanical smoke evacuation system with a highly efficient filter is widely recommended as a means of providing optimal protection from surgical smoke. This type of system should also include a device to capture smoke at its source that does not impede a surgeon's ability to perform the procedure and an effective vacuum source. Such a system is endorsed by many agencies such as the Centers for Disease Control and Prevention (CDC), the National Institute for Occupational Safety and Health (NIOSH) and the American National Standards Institute (ANSI).

For facilities that have not yet enacted a method of smoke evacuation or filtration of any kind, Petersen recommends education and action. "I would first of all do a literature search to find information on exactly what's in the smoke and the possible outcomes associated with it," she says.

Once awareness of the potential threat has been established, HCWs will often be more likely to embrace procedural changes designed to protect themselves and patients. "The transition is not much of an issue if you know it's something that you should be extremely concerned about," says Petersen. "I would make sure that everybody on the team was willing to move forward with a plan of action."

#### Only You Can Prevent OR Fires

In addition to creating dangerous smoke, lasers and ESUs have the potential to ignite fires in the OR. Although this scenario is relatively rare, with about 100 OR fires occurring each year in the United States, the results can be devastating for patients and surgical staff. <sup>7</sup> Facilities must take measures to ensure that HCWs are properly equipped and informed to prevent fires from occurring. HCWs must also be educated and prepared to take appropriate action if they do occur.

"When they're doing lasers, if it's anywhere around the face or on the trachea, the patient will be intubated and they need to have a special protective layer on them, otherwise the laser will go right through," says Petersen. "The environment is oxygen-rich and it doesn't take much to start a fire."

In "A Clinician's Guide to Surgical Fires: How They Occur, How to Prevent Them, How to Put Them Out," several specific recommendations are given in regard to both ESUs and lasers. For ESUs, they include:

- Place the electrosurgical pencil in a holster when not in active use.
- Allow the pencil to be activated only by the person wielding it.
- Deactivate the pencil before removing it from the surgical site.
- If open oxygen sources are employed, use bipolar electrosurgery whenever possible and clinically appropriate (bipolar electrosurgery creates little or no sparking or arcing).

For lasers:

- Place the laser in standby mode whenever it is not in active use.
- Activate the laser only when the tip is under the surgeon's direct vision.
- When performing laser surgery through an endoscope, pass the laser fiber through the endoscope before introducing the scope into the patient (this will minimize the risk of fiber damage). Before inserting the scope, verify the fiber's functionality.
- Use appropriate laser-resistant tracheal tubes during upper-airway surgery and follow product directions.

If a fire should break out, an immediate and decisive response is vital. Small fires on the patient can usually be extinguished by smothering with a towel or gloved hand. Larger fires on the patient require more steps such as stopping the flow of oxygen to the patient, removing and extinguishing the burning materials and swiftly caring for any injuries to the patient.

A fire in the OR can be a sudden and confusing event. For this reason, many facilities decide to institute a fire safety plan. Identifying and resolving potential issues such as evacuation routes and the logistics of evacuating anesthetized patients, for example, can give HCWs the ability to react quickly and efficiently in an actual fire emergency. As with laser and surgical plume, preparation and knowledge are the keys to safety.

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