Electrosurgical Units and the Risk of Surgical Fires

Most surgical fires involve electrosurgery and begin when the electrosurgical unit (ESU) is activated in oxygen-enriched environments. Severe burns and death are associated with these types of fires, which are often preventable. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) includes reduction of surgical fires among their 2005 Patient Safety Goals for ambulatory care and office-based surgery.¹

PA-PSRS has received two reports of OR fires. In one case, a facial fire occurred involving the ESU active electrode in an oxygen-enriched environment. In the second case, inadvertent activation of the ESU ignited bone cement being used in an orthopedic procedure. Most OR fires occur during use of electrosurgery or electrocautery (i.e., hot wire) devices.

A number of other reports have been submitted by both hospitals and ambulatory surgical centers describing ESU-related electrical burns in the area of the face, neck, chest, and abdomen. While electrical burns, including “alternate site” burns, represent a fundamentally different mechanism of injury from surgical fires, both are known hazards of ESU use.

Fires require three elements (see Figure 1):

- An ignition source, such as an ESU active electrode.
- Oxidizers, such as oxygen, room air, N2O, or medical compressed air.
- Fuel, such as hair, surgical drapes, face masks, tracheal tubes, and other materials. Materials that don’t readily ignite and burn in room air (21% O2) will easily burn when the atmosphere is slightly enriched. For example, polyvinylchloride endotracheal tubes burn in 26% O2, and body hair will ignite in a flash fire and burn rapidly in oxygen-enriched atmospheres greater than approximately 50%.

Because oxygen is “heavier” than air, it collects in unexpected places, such as under surgical drapes in the head and neck area. It sometimes wells up through the drape fenestration into the surgical site. Fires in oxygen-enriched environments are easier to ignite, burn hotter and spread faster than fires do in normal air. A further complication in the OR that increases the likelihood of a fire is that different people may be managing different aspects of the elements that must come together to cause a fire. For example, surgeons may handle the ignition source, anesthesiologists may deliver the oxidizers, and nurses may handle the fuels such as OR materials and flammable skin prepping agents. Communication among OR team members about specific fire risks is vital to reducing the risk of fire.

Manufacturers have tried to make equipment and surgical drapes safer but there simply is no clear engineering solution to the surgical fire problem. For example, there are two ways to activate the ESU, using the hand piece or the foot switch. Inadvertent activation has been reported with both methods in the clinical literature.

Figure 1. The Components of OR Fires.

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Electrosurgical Units and the Risk of Surgical Fires (Continued)

Clinicians address this problem by putting the ESU pencil in a holster when it is not in active use. Mayo stands are used for laparoscopic active electrodes, as they are too big for holsters. These preventive measures rely on trained staff to keep the patient and clinical personnel safe. If the ESU is inadvertently activated, it will often cause a burn and may cause a very serious fire. Both of those unfortunate circumstances are often preventable when a holster is consistently used.

In regard to drapes, it is a common misconception that fire-retardant drapes are available. They are not. This is primarily because the technology for making a fabric that will be fire-retardant in very high oxygen concentrations does not yet exist.

Practices that may help to reduce the risk of surgical fires include:

- Educating all members of the surgical team regarding the surgical fire hazard.
- Controlling potential ignition sources.
- Managing fuels, such as flammable surgical skin prep solutions.
- Minimizing the potential for medical gases to collect under surgical drapes.

The following resources may help you learn more about this important subject.

Print Resources


Educational Videos


Medfilms. Operating room fire [video]. Tucson (AZ).


Notes

The Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error ("Mcare") Act. Consistent with Act 13, ECRI, as contractor for the PA-PSRS program, is issuing this newsletter to advise medical facilities of immediate changes that can be instituted to reduce serious events and incidents. For more information about the PA-PSRS program or the Patient Safety Authority, see the Authority’s website at www.psa.state.pa.us.

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The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP’s efforts are built on a non-punitive approach and systems-based solutions.