



Pennsylvania Patient Safety Reporting System

Patient Safety Advisory

Produced by ECRI Institute & ISMP under contract to the Patient Safety Authority

Skin Burns and Fires during Electroconvulsive Therapy Treatments

PA-PSRS has received five reports of patients experiencing skin burns or injuries from a fire during electroconvulsive therapy (ECT) treatments.

The first report described sparks but no fire; the anesthesiologist and RN observed this event at the time of the ECT device activation. The patient experienced erythematous skin on one side of the forehead and behind one ear. The second report described burns to the patient's hair and skin in the temporal area in front of one ear. In the third skin burn report, a post-anesthesia care unit nurse noted burn-like lesions on the patient's earlobe and forehead; however, according to the report, clinical staff believed the lesions were pre-existing to the ECT treatment. In the fourth report, a flash was noted at the electrode sites on both sides of the patient's temples. The flash occurred at the time a staff member turned the device off then on again because the display screen was blank (i.e., no illumination). According to the facility, although an oxygen (O₂) face mask was applied to the patient, no O₂ was flowing at the time of the flash.

Finally, in the report of a fire, a bright flash and flames were noted on the right side of the patient's head at the instant that the ECT shock was given. Though the flames were quickly extinguished, the patient experienced first- and second-degree burns on one ear and first-degree burns on the forehead above one eye. According to the event description, an O₂ face mask, with O₂ flowing, was on the stretcher near the patient's face during activation of the ECT device.

A search of the U.S. Food and Drug Administration's Manufacturer and User Facility Device Experience (MAUDE) database revealed 11 similar reports of burns and 1 report of fire during ECT treatments between 1992 and 2005. Of the 11 burn reports, 7 described burns to patients' skin at the electrode site without providing further details; 2 described no conductive gel or an inadequate amount of conductive gel between the electrode and skin; 1 described a flash at the electrode site during activation of the ECT device; 1 indicated that disposable electrodes were reused on the same patient several times; and 1 indicated the use of alcohol to clean the electrode site, which was against the electrode manufacturer's recommendations. The one MAUDE report of a fire during ECT also involved O₂ delivery on the face at the time of ECT shock delivery.

An ECT device generates a therapeutic pulsed electric current used to treat various psychiatric illnesses, especially severe depression.¹ The pulsed current causes brain nerve cells to fire in unison, which produces a seizure in the patient. The action of the seizure effect in treating the illness is not fully understood. Two theories include alteration of the brain's chemical messengers—neurotransmitters—by the seizure activity and adjustment of the stress hormone regulation in the brain.²

Prior to the procedure, the patient is anesthetized intravenously and given a drug (e.g., succinylcholine) to minimize the severity of motor convulsions in the body, thereby reducing patient injury.³ The therapeutic current passes through the patient's brain between two electrodes. Electrode placement methods for administering ECT include unilateral and bilateral. In unilateral ECT, one electrode is placed above the temple of the nondominant side of the brain and the other in the middle of the forehead or crown of the head. In bilateral ECT, one electrode is placed above each temple.

Of the five reports submitted to PA-PSRS, two did not indicate potential causes for the adverse events, one indicated that the apparent lesions may have been pre-existing, and one report described no patient discomfort following the event. The one report describing O₂ in use during ECT treatment indicated that at least one change the facility will make to this procedure is to remove O₂ flow from close proximity to the patient during ECT device activation.

Regarding the potential for fire, a spark at the electrode site in an oxygen-enriched environment immediately near the electrode may ignite the patient's hair or lingering alcohol vapors from skin prepping

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Skin Burns and Fires during Electroconvulsive Therapy Treatments (Continued)

solutions. In the March 2006 issue of the *PA-PSRS Patient Safety Advisory* (see “Electrosurgery Safety Issues”), we discussed the three elements necessary for a fire: an ignition source, an oxidizer, and fuel. In the context of ECT, the ECT device is the ignition source, O₂ is the oxidizer, and fuel sources include hair, hair gel, skin, or alcohol, among others. While only one of the reports submitted to PA-PSRS described the use of O₂, O₂ was most likely in use during the other reported events. O₂ is typically administered to patients to prevent arterial desaturation during induction of general anesthesia (i.e., pre-oxygenation).⁴ The third report of those described above indicated burns to the patient’s hair and skin. Though the report does not indicate that alcohol was used to prepare the electrode site, hair can readily wick liquids such as alcohol and result in latent flammable alcohol vapors being present at the electrode area.

ECT Stimulus Electrodes

Various types of stimulus electrodes are available for use with ECT devices including stainless steel electrodes with holders, paddle electrodes and adhesive gel-pad electrodes. Stainless steel and paddle electrodes are held in place on the patient’s skin by a clinician during ECT device activation. Adhesive-backed disposable gel-pad electrodes, when properly applied, stick to the patient’s skin without being held in place. Poor electrode/skin contact during ECT procedures can lead to patient skin burns or fire. The electrode/skin interface beneath hand-held electrode types may be susceptible to gaps from clinician or patient movement during ECT activation. Conductive gels are used to minimize potential gaps between the electrode and skin and help to maintain an adequate conductive pathway for the therapeutic electric current.

Although it is less common than with hand-held electrodes, gaps may also occur with adhesive gel-pad electrodes. Creases created during placement of the adhesive electrodes or the pad lifting up from the skin during treatment can cause gaps between the electrode-skin interface. Those gaps may be sufficient to create electrical sparks, which in the presence of O₂ and a flammable substance may lead to burn or fire.

Electrode Site Preparation

Under the right conditions, skin burns during ECT treatment may occur readily due to poor electrode contact with the skin. Electrode site preparation is an important step in ensuring adequate electrode-to-skin contact. Hair, dead skin, and even cosmetic products between the electrode and skin could

result in poor contact. Reducing the surface area contact between the electrode and skin disperses more therapeutic current over a smaller contact surface area. Concentrating the current in a smaller area generates greater heat dissipation from that area, which raises the skin temperature and could lead to a burn.

Isopropyl alcohol is often used to clean the skin of debris. Wiping the skin with a saline applicator is also sometimes used to clean the site.⁵ If alcohol or alcohol-based solution is used and not given enough time to dry and the alcohol vapors are not given enough time to dissipate, a flash fire is possible in the presence of a spark.⁶

Understanding the potential risks associated with ECT procedures will help to promote a positive and safe treatment outcome. The mechanisms of action for the risks of patient skin burns include poor electrode site preparation, insufficient conductive gel between the electrode and skin, and reuse of single-use electrodes. Sparking from electrodes to the skin from poor site preparation can also cause fires due to alcohol vapor ignition from insufficient drying time for alcohol or alcohol-based solutions, from oxygen-enriched ignition of hair from O₂ delivery on the patient’s face, or from an O₂ delivery device (e.g., nasal cannula or face mask) on the treatment bed during delivery of the ECT shock.

Minimizing patient or staff movement when using hand-held electrodes can reduce gaps between the electrode and skin, thereby, reducing the potential for sparks at the site. Adequate conductive gel also helps reduce or eliminate gaps and maintain good electrical conductivity between the electrode and skin.⁷ However, too much gel may make the electrode slippery and prone to movement. Assessing the need for O₂ delivery to the patient during ECT device activation may help reduce the risks of burns or fires during ECT treatments. Off-label use of products (e.g., reuse of single-use accessories) may contribute to a negative patient outcome. Following manufacturer guidelines can greatly enhance the safety of the patient and lessen the chance of skin burns. However, no manufacturers caution about the risk of oxygen-enriched fire during ECT treatment. Fire prevention during ECT treatment may be guided by the information presented herein.

Notes

1. ECRI Institute. Electroconvulsive therapy. *Health Risk Control* 2005 May;4:Mental health 5:1-9.
2. University of Michigan Health System. Electroconvulsive therapy (ECT) [online] [cited 2006 Jun 13]. Available from Internet: <http://www.med.umich.edu/depression/ectedpm.htm>.

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3. Werawatganon T, Kyokong O, Charuluxananan S, et al. Muscular injury after succinylcholine and electroconvulsive therapy. *Anesth Analg* 2004 Jun;98(6):1676-9.
4. Hirsh J, Fuhrer I, Kuhly P, et al. Preoxygenation: a comparison of three different breathing systems. *Br J Anaesth* 2001 Dec;87(6):928-31.
5. Somatics LLC. Thymatron System IV Instruction Manual. Eighth edition. 2003 Aug 15.
6. ECRI Institute. Improper use of alcohol-based skin preps can cause surgical fires [hazard report]. *Health Devices* 2003 Nov;32(11):441-3.
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