



# NEWSLETTER (<https://www.apsf.org/apsf-newsletter>)

THE OFFICIAL JOURNAL OF THE ANESTHESIA PATIENT SAFETY FOUNDATION

Fall 2009 (<https://www.apsf.org/newsletter/fall-2009/>)

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## Reducing the Risk of Defibrillation Fires

*Lenny Wade*



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**Q** Dear Q&A,

Recently, we conducted a simulation in which a patient in the surgical ICU, who was on a ventilator at the time, needed to be defibrillated. When the students involved in the simulation defibrillated their patient, the instructor told them, “You just blew yourselves up,” ostensibly because they left the patient connected to the ventilator. I have participated in numerous code situations in the ICUs over the years, and I never witnessed anyone being “blown up,” despite being on a ventilator while they were being defibrillated. Is this instructor giving the students incorrect information?

*Lenny Wade*

*Chicago, IL*

**A** Dear Dr. Wade,

We agree that it is highly unlikely that the students or the patient would have been blown up or have been the victim of an explosion. However, it is possible for a number of factors to work together and produce a fast, large fire. In the small, crowded space of an ICU room or ambulance this can be a frightening and potentially harmful event to the patient and staff.

The ECRI Institute has learned from its 30 years of investigations that fires during defibrillation can occur when a source of high oxygen concentration (above 50% oxygen) is near the defibrillation site (within 30 cm) during defibrillation, **AND** when defibrillation produces an electric arc. Leaving the patient connected to a ventilator during defibrillation can be done safely if exhaled gases and other sources of oxygen are vented away from the patient. However, there is a small risk of a sudden, acute increase in peak airway pressure and possibly barotrauma if the ventilator should cycle during the shock, but the risk of barotrauma should be mitigated by the high pressure limit features of the ventilator. If the patient is left connected, the ventilator should likely be paused. In the event that the ventilator is paused, a person should be assigned to only operate the ventilator and restart ventilation after defibrillation. Hypoxia following lack of ventilation resulting from not remembering to turn the ventilator back on is a dangerous possibility and must be averted.

The ECRI Institute has noted cases in which the breathing circuit containing a high oxygen concentration was disconnected and laid near the patient, flooding the chest area with oxygen. Clearly this can lead to a fire if an electric arc is produced between the paddle or pad and the patient. The arc in the presence of a high concentration of oxygen with nearby combustible material such as hair and fabric fibers will cause a fire that will burn the patient.

For example (*Health Devices* Jan 2003; 32[1]: 12 with permission):

A patient went into cardiac arrest while on a ventilator and was defibrillated. Just before defibrillation, one of the responding staff disconnected the breathing system from the patient and left the open end flowing O<sub>2</sub> onto the bed near the patient's upper chest. The defibrillation discharge resulted in a visible arc, possibly because the patient was thin and had prominent ribs and the paddles were not applied with enough force to make a large low resistance contact area with the patient's skin. This arc caused a fire to flash across the patient, who had copious chest hair, and across the bed to the O<sub>2</sub> source. The breathing system caught fire and was not extinguished until the ventilator was shut off. The patient was only slightly burned, but subsequently died of cardiac arrest.

The ECRI has published numerous accounts of defibrillator fires during the past 4 decades.<sup>1,2</sup> (<https://www.apsf.org/wp-content/uploads/newsletters/2009/fall#03ref>) In many cases, defibrillation was accomplished successfully in the presence of high oxygen concentrations because the pads or paddles made good electrical contact with the skin and there was no arcing. When the pad or paddle was placed improperly, such as the pad not fully in contact with the skin, or the paddle placed on a bony prominence, an electric arc can occur during the discharge. In room air, this is not a problem. However, if the local oxygen concentration is greater than room air, then body hair and fabric fibers can be ignited by the arc and spread into a large fire. There is a little known phenomenon in which the fine body hair (vellus) or fabric fibers burn and rapidly spread the fire, which becomes established along folds, edges, and corners of the fabric. The fire then flashes back to the source of oxygen usually setting it on fire as well.

One way to potentially improve patient contact with gel pads, used by some Emergency Department physicians, is to place a pad then rip it off. This will remove the body hair and allow a second gel pad to be placed in good contact with the skin. Gel pad directions typically say shave the area in which the pad will be placed, but that might not be a timely option.

In summary, we agree with the American Heart Association 2005 Guidelines for CPR and ECC, which conclude that, “Severe fires have been reported when ventilator tubing is disconnected from the tracheal tube and then left adjacent to the patient’s head, blowing oxygen across the chest during attempted defibrillation,” and that rescuers “should . . . try to ensure that defibrillation is not attempted in an oxygen-enriched atmosphere.” Disconnecting the patient from the ventilator may be more hazardous than leaving the patient connected if the breathing circuit creates an increased oxygen concentration at the sites where the defibrillator contacts the patient. Gel pads are preferable to paddles<sup>3</sup> (<https://www.apsf.org/wp-content/uploads/newsletters/2009/fall#03ref>) due to the likelihood of better lower resistance connection with the skin, but in any case the rescuer should always ensure that paddles or pads make good contact with the patient’s skin.

***The Committee on Technology***  
***Anesthesia Patient Safety Foundation***

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(<https://www.apsf.org/wp-content/uploads/newsletters/2009/fall>)References

1. ECRI Institute. Hazard report: fires from defibrillation during oxygen administration. *Health Devices* 1994; 23:307-309.

2. ECRI Institute. Hazard report: using external defibrillators in oxygen-enriched atmospheres can cause fires. *Health Devices* 2005; 34: 423-425.
  3. American Heart Association Guidelines for CPR and ECC, 2005. *Supplement to Circulation*. 2005;112:IV-41.
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Numerous questions to the Committee on Technology are individually and quickly answered each quarter by knowledgeable committee members. Many of those responses would be of value to the general readership, but are not suitable for the Dear SIRS column. Therefore, we have created this simple column to address the needs of our readership.

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