Patient Safety Tip of the Week

June 25, 2013 Update on Surgical Fires

Just about every year we find ourselves doing a column on surgical fires. Despite all the efforts at prevention of these disastrous events they continue to occur.

The most recent case in the news involved a 55 y.o. woman who was undergoing a procedure in her temporal region (the report says temporal lobe biopsy but we wonder if it was a temporal artery biopsy) in whom electrocautery ignited a fire in the presence of oxygen, resulting in third degree facial burns to the patient (Breslow 2013a, Breslow 2013b). Details were not provided in the articles but the patient refers to "oxygen in my nose, and then a big sound and they met, right in my face and it set my face on fire".

A recent review by the Pennsylvania Patient Safety Authority (Clarke 2012) found rates of surgical/OR fires to range from 0.90 per 100,000 patients to 0.33 per 100,000 patients. Though there has been a downward trend in the incidence of these over the last few years in the Pennsylvania database, this did not reach statistical significance.

An analysis of closed malpractice claims involving surgical fires provides a considerable amount of insight (Mehta 2013). Though data from a closed claims database significantly underestimates the total occurrence of OR/surgical fires, it does provide insight into trends and contributing factors. Claims more often involved older outpatients, compared to other types of claims. 99% involved procedures known to be high risk for fires (head, neck, or upper chest surgery). Electrocautery was the ignition source in 90% of claims and oxygen was the oxidizer in 95% of claims. Alchohol-containing prep solutions and volatile compounds were identified in only 15% of OR fires during monitored anesthesia care. Importantly, the vast majority of claims were for fires that occurred during monitored anesthesia care rather than general anesthesia. That highlights the importance of oxygen. **In the vast majority of claims involving monitored anesthesia care the oxygen was delivered by an open delivery system**.

On the other hand, the OR fires during general anesthesia more often the airway and leaks surrounding endotracheal tubes were a major factor.

So it certainly seems that there has been a trend for surgical/OR fires to be seen more often in relatively minor surgery (eg. plastic procedures removal of skin lesions, temporal

artery biopsies, etc.), done under sedation or monitored anesthesia care where there is open delivery of oxygen.

The first component of the "**fire triad**" is an oxidizer. In most cases that is **oxygen** (nitrous oxide is the other potential oxidizer). In our November 2009 What's New in the Patient Safety World column "ECRI: Update to Surgical Fire Prevention" we discussed the 2009 ECRI update of its "New Clinical Guide to Surgical Fire Prevention". The 2009 key change in clinical practice is **discontinuing the open delivery of 100% oxygen during procedures done during sedation** and where high concentrations of oxygen are needed the airway should be secured. They discuss ways to minimize the concentration of oxygen being used in a variety of scenarios. The APSF recently highlighted the importance of this in their Winter 2012 newsletter (Stoelting 2012) and provide an algorithm regarding use of oxygen. Perhaps the most important question to ask is: does the patient need supplemental oxygen? Most probably do not, in which case room air should be used. But if greater than 30% oxygen concentration is needed to maintain oxygenation, the **airway should be secured** with an endotracheal tube or supraglottic device. In cases where supplemental oxygen at less than 30% is medically necessary they recommend use of a delivery device such as a blender or common gas outlet to maintain concentration below 30%.

However, just as important is **timely communication between the surgeon and the anesthesiologist**. As the surgeon plans to use the Bovie (or other potential heat source) he/she needs to let the anesthesiologist know and then the oxygen flow may be reduced or stopped temporarily. A period of time for allowing dispersal of oxygen should then pass before the surgeon uses the Bovie.

The second component of the "fire triad" is the **heat source** and, as in the closed claims study (Mehta 2013), electrocautery is the most common heat source for surgery/OR fires. While electrocautery was still the most common igniting mechanism in the PPSA study (Clarke 2012), they also noted fiberoptic light cords and lasers as responsible in some cases.

The third component is **the fuel**. While that can be anything that burns (clothing, drapes, cotton balls or sponges, gauze, skin, etc.) we have focused most often on alcohol-based skin preps or other volatile substances. In our April 24, 2012 Patient Safety Tip of the Week "Fire Hazard of Skin Preps Oxygen" we discussed a UK National Patient Safety Agency (NPSA) "signal" regarding the **risk of alcohol-based skin preps** in contributing to surgical fires (NPSA 2012). This Signal addresses the risk of a patient being burned when diathermy is used in the presence of alcohol-based skin preparation solutions. They identified 23 incidents of fire in which the involvement of skin prep was clearly stated and another ten incidents where diathermy was used and the involvement of skin prep was likely but not stated. Four of these incidents were reported as resulting in death or severe harm to the patient. Key contributing factors found include:

- **insufficient time for drying** of the skin prep solutions before commencement of surgery
- **pooling** of the skin preparations

In two cases, the **volume of skin prep used** was an issue. Common to several of the reports of fires (including an example given in the UK NPSA "signal"), additional skin prep was applied after the initial prep. The volume is important because the amount of run-off is important. It is the run-off that often saturates drapes, etc. and ultimately serves as the fuel for the fire.

The importance of **the applicator** becomes apparent when we discuss the volume issue. In one case the hospital had switched from using a forceps to the sponge applicator because the latter allowed for speedier application of the skin prep. But the amount of run-off is considerably higher with the sponge applicator. We've seen a similar case occur shortly after a hospital changed from a 10.5 ml sponge applicator to the same prep with a 26 ml applicator.

Allowing **sufficient time for the skin prep to dry and any alcohol vapors to disperse** is critical. We know of some hospitals that use a timer to ensure that sufficient time is allowed for that drying to occur. Search for the ideal skin disinfectant that prevents surgical site infections but is not flammable is still ongoing. Several studies now seem to show that chlorhexadine/alcohol is a better disinfectant than providone-iodine (see our April 2013 What's New in the Patient Safety World column "Chlorhexidine in the News"). Unfortunately, the fire risk is much higher for the chlorhexadine/alcohol preparation. So careful attention to the drying time remains most important.

And while we haven't yet seen a surgery/OR fire where it has contributed, **hand sanitizers** may also be flammable (see our April 2013 What's New in the Patient Safety World column "Reminder: Hand Sanitizers Are Flammable").

Take note of other potentially flammable fuels, too. The recently updated ASA Practice Advisory for the Prevention and Management of Operating Room Fires (Apfelbaum 2013) notes that the flammability of sponges, cottonoids, or packing material is reduced when wet rather than dry or partially dry. So it is recommended **such materials be moistened** when they will be in close proximity to heat sources.

We have long advocated that the **surgical fire risk be discussed as part of the pre-op huddle (or pre-op briefing)** and, if the case is considered high-risk, respective roles of all OR participants are called out during the surgical timeout. As part of an effort to promote fire safety in the OR (Murphy 2010), the San Francisco VA has developed a checklist "The Surgical Fire Assessment Protocol". This checklist/protocol is actually printed on the reverse side of their larger preoperative checklist. This is really a very good tool! The fire risk is assessed by a simple numerical scale. If the score is 3 (high risk) the rest of the form is filled out, which basically delineates the respective roles of all those participants. That's a really good way to remind all about their responsibilities if a fire occurred. We've also seen several hospitals incorporate questions about the fire risk into their modifications of the Surgical Safety Checklist. The Christiana Care Health

System also has some good examples of incorporating the fire risk into Universal Protocol plus many other great tools in their Surgical Fire Risk Assessment resources.

While head, neck and upper chest surgeries have been considered to be at greatest risk for surgical fires, don't forget that they can occur in almost any surgery. Our January 2011 What's New in the Patient Safety World column "Surgical Fires Not Just in High-Risk Cases" pooling of the alcohol-based skin prep under the buttocks of a patient having a C-section in Israel was a key element in producing a surgical fire. And our April 24, 2012 Patient Safety Tip of the Week "Fire Hazard of Skin Preps Oxygen" described another ob/gyn case with a fire.

As you'll recall, some great resources on surgical/OR fires have been made available in recent years, through organizations like ECRI Institute, the Anesthesia Patient Safety Foundation (APSF), the American Society of Anesthesiologists (ASA), AORN, the VA medical system, Christiana Care Health System, and the FDA. Links to those resources can be found in our many previous columns on surgery/OR fires listed below. The FDA collaborative initiative began in late 2011 and provides a whole host of valuable resources on surgical/OR fires. The APSF recently updated its algorithm into poster formats that can be downloaded (APSF poster). We previously mentioned the excellent APSF Fire Safety video (see our March 2011 What's New in the Patient Safety World column "APSF Fire Safety Video"). And the ASA just recently updated its Practice Advisory for the Prevention and Management of Operating Room Fires (Apfelbaum 2013).

The ASA Practice Advisory for the Prevention and Management of Operating Room Fires (Apfelbaum 2013) has a good discussion of the steps and responsibilities of each OR team member if a fire does occur. As we've noted often in the past, there are some rare events that arise so suddenly that you can't go to any resources to see how to handle them. The only way to know how to respond to a surgery/OR fire is to do **drills or simulations** so everyone knows what to do.

Our prior columns on surgical fires:

Patient Safety Tips of the Week:

- December 4, 2007 "Surgical Fires"
- April 29, 2008 "ASA Practice Advisory on Operating Room Fires"
- December 13, 2011 "Surgical Fires Again"
- April 24, 2012 "Fire Hazard of Skin Preps Oxygen"

What's New in the Patient Safety World columns:

- November 2009 "ECRI: Update to Surgical Fire Prevention"
- January 2011 "Surgical Fires Not Just in High-Risk Cases"
- March 2011 "APSF Fire Safety Video"

- November 2011 "FDA Initiative on Preventing Surgical Fires"
- April 2013 "Reminder: Hand Sanitizers Are Flammable"

Update: See our Patient Safety Tips of the Week for October 1, 2013 "Fuels and Oxygen in OR Fires", August 12, 2014 "Surgical Fires Back in the News", and December 16, 2014 "More on Each Element of the Surgical Fire Triad".

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