

Patient Safety Tip of the Week

January 9, 2018

More on Fire Risk from Surgical Preps

Among our several columns on surgical fires we have discussed the role of surgical preps as fuels for such fires. Though fuels are but one leg of the “fire triad” (fuel, oxidants, heat source), there are many important interventions we can use to minimize the risks that certain fuels, like alcohol-based surgical preps, present.

A recent study used an ex vivo model to assess the risks of fires from various skin preps ([Jones 2017](#)). An electrosurgical “Bovie” pencil was activated for 2 seconds on 30 Watts coagulation mode in 21% oxygen (room air), both immediately and 3 minutes after skin preparation application. No fires occurred with nonalcohol-based preparations. Alcohol-based preparations caused flash flames at 0 minutes in 22% and at 3 minutes in 10% of tests. When examining pooling of alcohol-based preparations, fires occurred in 38% at 0 minutes and 27% at 3 minutes. The authors conclude that following manufacturer guidelines and allowing 3 minutes for drying, surgical fires were still created in 1 in 10 cases without pooling and more than one-quarter of cases with pooling. They recommend that surgeons can decrease the risk of an operating room fire by using nonalcohol-based skin preparations or avoiding pooling of the preparation solution.

Note that the fires in the above model occurred in a room air environment. It would be expected that fires might occur even more readily in the oxygen-rich environments encountered in many surgical cases.

The Canadian Medical Protective Association recently reviewed 54 closed cases of surgical fires and burns in the OR ([CMPA 2017](#)). 31% of these involved surgical fires. Incidents involving fuel sources were usually related to incorrectly applying antiseptic agents (usually alcohol-based) during skin preparation by:

- not letting the agent dry sufficiently before placing drapes
- allowing the agent to pool under the patient
- inadequately diluting or using the wrong solution

CMPA emphasizes that, when preparing the skin, avoid the pooling of antiseptic solutions and allow for sufficient drying before beginning the procedure.

While we usually think about surgical fires occurring most often in procedures around the head and neck or upper thorax, where proximity to an oxygen-rich environment is more likely, surgical fires may occur in more remote areas and in the absence of an oxygen-rich environment. In our January 2011 What's New in the Patient Safety World column “[Surgical Fires Not Just in High-Risk Cases](#)” we discussed a case that occurred in Israel during a C-section. The patient had been prepped prior to the planned surgery and

allowed to dry off. However, in the OR the surgeon requested the field again be prepped with an alcohol-based prep. This was done and then he began an incision using a diathermy needle and a spark caused the resultant fire. The fire was extinguished and a healthy baby was delivered but the patient suffered severe burns and later required skin grafting to her buttocks and thighs. The Israeli health ministry noted the risk of fire is particularly dangerous in cases where the legs are elevated, promoting pooling of the alcohol-based prep under the buttocks ([Even 2010](#)). They also noted the sheets were flammable, which further complicated the case.

Another case ([Somers-DeHaney 2008](#)) illustrated that burns may occur at great distance from the airway and in the absence of supplemental oxygen as the oxidizer. A patient underwent a femoral distal bypass graft under general endotracheal anesthesia. The skin was prepared and later re-prepared with an alcohol-based solution that may have saturated skin folds over time producing vapors under the drapes. A sterno-like fire burned the patients' leg after the vapors were exposed to the electrocautery. The authors note that a combination of 3 factors involving alcohol or alcohol prep solutions can lead to fire or burns:

- Solution may wick to the patient's hair and linens or pool on skin thus retarding drying time.
- Drapes may be applied before the solution is completely dry and alcohol vapors may become trapped under surgical drapes.
- Re-preparation of an area increases the chance that the solution may pool and not thoroughly dry.

Note that the Israeli case noted above also involved **repreparation** of the site.

Somers-DeHaney and Christie went on to describe ECRI Institute recommendations for the use of alcohol-based prep solutions in the operating room:

- The manufacturer's instructions should be read and followed. Only skin preps and kits with clear and explicit instructions and prominent warnings should be purchased.
- Surgical, emergency department, and all appropriate personnel should be alerted and made aware of the problem.
- Alcohol based prep solution should be applied like paint; it should not be laid on in a thick, drippy, runny coating that could lead to excessive drying times.
- The drapes should not be applied until after the prep has fully dried as shown by loss of shine of the film. This may take several minutes.
- Liquid prep that has dripped away from the surgical site should be blotted with gauze sponges before it can soak into any absorbent material. Pooled prep solution should be wicked with gauze sponges instead of blotted or wiped so that the antimicrobial film is maintained on the skin.
- If prep solution wicks into a material, staff must replace the material or allow sufficient time (possibly longer than 10 minutes) for the solution to dry before the drapes are applied.
- If alcohol-based preps are used, ensure that solution does not soak into hair or linens. Sterile towels should be placed to absorb drips and runs and they should be

- removed before draping. Daubing of prep pooled on skin (e.g., umbilicus, cricoid notch) may be necessary.
- Use incise drapes if possible. If the incise material does not adhere to the patient, the prep is likely still wet and the patient should be redraped once the prep is fully dry.
 - During surgery be aware of any sudden flash of heat. Such a flash of heat may indicate an occult alcohol fire. Search for smoldering materials and remove them.

That last point is a pearl. In the case described by Somers-DeHaney and Christie the surgeon at some point during the procedure reported a heat sensation briefly but ascribed it to something else. It was only while later that the surgical drapes ignited into visible flames.

In emergency situations time pressures may lead to failure to wait an adequate time for skin preps to dry. In our October 1, 2013 Patient Safety Tip of the Week “[Fuels and Oxygen in OR Fires](#)” we even noted that, after a patient suffered burns to the neck and shoulders from a fire during an emergency surgical procedure, one hospital ([Natt 2013](#)) implemented a policy prohibiting alcohol-based skin preps in any emergency surgery that does not allow sufficient drying time (usually 3 minutes or longer). Instead they went back to non-alcohol-based preps like Betadine for such emergency cases.

In our December 16, 2014 Patient Safety Tip of the Week “[More on Each Element of the Surgical Fire Triad](#)” we discussed the Anesthesia Patient Safety Foundation (APSF) article about flammable surgical preps ([Cowles 2014](#)). That APSF article has some nice tables listing the alcohol content of commonly used skin preps and alcohol-based hand rubs. It has good advice about the importance of communication in the OR as it pertains to ensuring adequate drying time for surgical preps and assessment for alcohol pooling near the surgical field. It emphasizes that adequate drying time is still important in emergency cases.

Allowing adequate time for skin preps to dry and avoiding pooling of these preps are critical in preventing surgical fires. We know of many hospitals that use timers to ensure that the recommended drying time has elapsed. But that may not be enough. The other “pearl” in the Cowles APSF article about alcohol-based surgical preps is that, whereas the drying time for most such preps is typically at least 3 minutes, drying time of up to 1 hour may be needed when applied to hairy areas, body folds, or body creases. The Jones study in today’s column emphasizes the manufacturer’s suggested drying times of 3 minutes may not be enough in many cases.

And lastly, don’t forget the issue of the “too big” applicator. In our January 10, 2017 Patient Safety Tip of the Week “[The 26-ml Applicator Strikes Again!](#)” we described two cases in which surgical fires occurred after use of the 26 ml Chloraprep applicator instead of the 10.5 ml Chloraprep applicator. The smaller applicator did not have the warning to avoid use in head and neck surgery, whereas the 26 ml applicator did have the warning. It is actually quite predictable that staff would assume the new supplies were the same as the old (because the active ingredients and percent of alcohol are the same) and not “read

the fine print”. In that column we suggested the most logical way to avoid this mistake is to deliver a **real-time message** to prevent use of the bigger applicator. How would we do this? We’d add it to the checklists used for the pre-op huddle or the surgical timeout or both. 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. In our January 2011 What's New in the Patient Safety World column “[Surgical Fires Not Just in High-Risk Cases](#)” we noted the San Francisco VA checklist “[The Surgical Fire Assessment Protocol](#)” ([Murphy 2010](#)), 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 in preventing a fire and what to do if a fire occurred. One of the checkbox items for the circulating nurse on that checklist is “Assess that enough time has been allowed for fumes of alcohol-based skin preps to dissipate (minimum of 3 minutes)”. It is there that we would propose adding the warning in bold, colored print that **the 26-ml applicator of Chloraprep should not be used in head/neck surgery**.

Also, don’t forget that skin disinfectants are not the only substances that are flammable. In our April 2013 What's New in the Patient Safety World column “[Reminder: Hand Sanitizers Are Flammable](#)” we reported on a case in which an alcohol-based hand sanitizer contributed to a fire in a young girl. Recently, in the UK, the London Fire Brigade urged doctors to be aware of the risks of prescribing flammable emollient creams for skin conditions such as eczema and psoriasis ([Bird 2017](#)). Many moisturizing creams used for common skin conditions such as eczema are based on flammable components, such as paraffin and petroleum. The risks are especially great for smokers, the elderly, those who are less mobile, and patients on oxygen therapy. They note that these creams are especially dangerous if they leach into bedding and clothing, allowing flames to spread rapidly. And because many sufferers use these creams on large areas of their body, there is a high risk of severe burns. This often happens when patients are smoking and drop a cigarette. In fact, at least 37 deaths had been noted in the UK related to such creams since 2010. They offer the following advice regarding such substances:

- Ideally, patients should switch to a non-flammable alternative.
- Advise patients not to smoke or use naked flames (e.g. gas fires, hobs, candles) when using paraffin-containing creams.
- Patients who require 100g or more of emollient should use a water-based product (e.g. cream or lotion) rather than a paraffin based one (e.g. ointment).
- Never smoke in bed.
- Use fire retardant bedding and clothing.
- Change clothing and bedding regularly, and wash with biological washing powder.

We hope you’ll look at the many useful recommendations in our previous columns (listed below). And, of course, we again refer you to the valuable resources on surgical fires

provided by [ECRI Institute](#), [AORN](#), the [FDA](#), [Christiana Care Health System](#) and the [APSF](#).

Our prior columns on surgical fires:

- December 4, 2007 [“Surgical Fires”](#)
- April 29, 2008 [“ASA Practice Advisory on Operating Room Fires”](#)
- 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”](#)
- December 13, 2011 [“Surgical Fires Again”](#)
- April 24, 2012 [“Fire Hazard of Skin Preps Oxygen”](#)
- April 2013 [“Reminder: Hand Sanitizers Are Flammable”](#)
- June 25, 2013 [“Update on Surgical Fires”](#)
- October 1, 2013 [“Fuels and Oxygen in OR Fires”](#)
- August 12, 2014 [“Surgical Fires Back in the News”](#)
- December 16, 2014 [“More on Each Element of the Surgical Fire Triad”](#)
- December 2015 [“Unique Ignition Sources in Surgical/OR Fires”](#)
- January 10, 2017 [“The 26-ml Applicator Strikes Again!”](#)

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SF VAMC Surgical Fire Risk Assessment Protocol

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<http://www.pulsetoday.co.uk/clinical/prescribing/gps-warned-about-risks-of-flammable-skin-creams/20034579.article>

Christiana Care Health System. Surgical Fire Risk Assessment.

<http://www.christianacare.org/FireRiskAssessment>

ECRI Institute. Surgical Fire Prevention.

https://www.ecri.org/surgical_fires

AORN (Association of periOperative Registered Nurses). Fire Safety Tool Kit.

<https://www.aorn.org/guidelines/clinical-resources/tool-kits/fire-safety-tool-kit>

FDA. Preventing Surgical Fires.

<http://www.fda.gov/Drugs/DrugSafety/SafeUseInitiative/PreventingSurgicalFires/default.htm>

APSF (Anesthesia Patient Safety Foundation). Resources. Fire Safety Video. Prevention And Management Of Operating Room Fires.

<http://www.apsf.org/resources/fire-safety/>

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