



Fire Safety & Prevention for Surgical Nurses

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Purpose

The purpose of this course is to provide the knowledge and the tools that the perioperative nurse will need to practice effective fire safety in any surgical setting.

Learning Objectives

After successful completion of this course, the participant will be able to:

1. Identify the reasons for an increased risk related to surgical fires.
2. Describe goals of The Joint Commission Sentinel Event Policy.
3. Identify the three components in the fire triangle.
4. Identify responsibilities of each member of the surgical team in preventing fires.
5. Outline steps to treat a fire when fire exists.
6. Name the four components of the acronym "R.A.C.E."
7. Name the four components of the acronym "P.A.S.S."

Introduction

"Only YOU can prevent surgical fires" (Castro, 2017). The first formal reporting of surgical fires dates to 1850; a fire erupted during a facial procedure using both ether and hot cautery (Macdonald, 1994). Even though the causes of surgical fires are well understood, 200-240 surgical fires occur annually with devastating results to patients and staff (Castro, 2018; ECRI, 2018). The surgical team must be aware that the enriched oxygen and nitrogen atmospheres of the surgical suite increase the flammability of drapes, plastics, and hair (ECRI, 2017 & 2018).

In 1994, the Joint Commission (TJC) recognized that careful investigation and evaluation of serious adverse safety events (sentinel events) were essential to prevention of patient harm (The Joint Commission, 2014). TJC defines a sentinel event as any event that reaches the patient and results in death, permanent harm, or severe temporary harm and intervention to sustain life. Surgical fires are considered sentinel events.

Additionally, the Centers for Medicare and Medicaid Services (CMS) determined that surgical fires meet criteria to be termed "never events" because they are preventable if healthcare providers take appropriate steps to protect patients. All surgical fires can result in considerable injuries or death, and this should never occur (ECRI, 2017 & 2018).

An Unfortunate Event

In 2009 a surgical fire was reported in the Internet Journal of Anesthesiology. The unfortunate event occurred during the procurement of organs from a nineteen year old donor (Herman, Krzysztof, & Berger, 2009). The young patient was determined to be brain dead three weeks after a motor vehicle accident. The patient's family, in an effort to turn an otherwise desperate situation into something more positive, requested that the organs be donated. What unfolded next had potential consequences for not only the young patient's family, but also those now anxiously awaiting recipients.

At the start of the procedure, the surgeon cleaned the surgical site with a product commonly used in surgical procedures which includes iodine povacrylex and approximately 75% isopropyl alcohol. The patient's history

included sepsis; there was visible discharge from the tracheotomy site, causing the surgeon to wrap an alcohol soaked sponge around the tracheotomy tube which was then left in place during the procedure.

Almost immediately after the procedure began, flames erupted from the patient. The team was able to extinguish the flames with a bag of fluid and some ice chips; after having failed their initial attempt with a towel, but the damage was already done. The patient now had burn injuries extending over the face, neck, and shoulder covering an area 5 inches wide and 10 inches long.

Fortunately, the event did not prevent the donation process from moving forward, nor did the young patient suffer from injuries sustained in the fire. Unfortunately, it took this dramatic event to illustrate the need for diligence when it comes to preventing surgical fires (Herman et al., 2009).

Test Yourself

CMS designated surgical fires as never events because:

- A. They are devastating to staff and patients
- B. They are preventable**
- C. They are a serious reportable event
- D. They are a sentinel event

Rationale: Because they are preventable if healthcare providers take appropriate steps to protect patients.

The Fire Triangle

The fire triangle depicted shows the categories that must be present for a fire to erupt, heat (ignition source), fuel, and oxygen (oxidizer).



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Prevention efforts starting from each of the three categories must be reviewed and practiced routinely to ensure a safe patient environment (AORN, 2018).

Test Yourself

Match the side of the triangle to the discipline that has the most control of that category.

Ignition	Fuel	Oxidizers
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- A. Nurses
- B. Anesthesiologist
- C. Surgeon

The correct answer is:

Ignition	Fuel	Oxidizers
Surgeon	Nurses	Anesthesiologists

The Role of the Surgical Team in Fire Prevention

The entire surgical team plays an important role in fire prevention (AORN, 2018; Federal Drug Administration (FDA), 2017; Brooks, 2018) and it is imperative for each team member to understand how their role in the surgical procedure can contribute to the fire triangle.

While each member of the team performs their specific role in the operating room, their activities can interact with the activities of other team members and increase the fire risk.

Imagine a three-legged stool. If one leg is missing it cannot stand. Just like the stool, there are three parts to a surgical team that must come together in order to produce a result.

Understanding how the role and activities of the surgeon, the nurse, and the anesthesia provider interact can prevent the deadly consequences of a surgical fire (AORN, 2018; FDA, 2017; Brooks, 2018).

Taking Sides

As shown in the Fire Triangle, the surgeon is most frequently responsible for the ignition sources such as electrocautery, direct lasers, and fiber optic light sources.

Anesthesia providers supply the oxidizers including oxygen, nitrous oxide, and medical compressed air. As the final side of the triangle, nurses are often responsible for the fuels; including prepping agents, drapes, sponges, and gowns (AORN, 2018; FDA, 2017). Communication is an essential part of surgical fire prevention.

Taking Ownership

While it is the responsibility of each of these key team members to manage their side of the triangle, the individual must also to articulate the potential interactions their product or device has with the rest of the team.

Heat and Ignition Sources

Heat serves as a catalyst to increase the oxidation rate of the fuel/oxygen mixture until a state of combustion is achieved.

The following are a few ignition/heat catalysts:

- Electrosurgical units (ESU)
- Fiber optic light sources and cables
- Lasers
- Drills and burrs
- Argon beam coagulators
- Overhead lights

Oxidizers

Oxidizers are the gases that can support combustion. The operating room suite is rich with these gases.

- Oxygen
- Nitrous oxide

Fuels

Virtually everything that comes into contact with the patient (including the patient's own hair) is flammable and may become fuel for the fire.

- Bone cement generates flammable fumes while mixing
- Dressings, sponges, drapes, plastics
- Chlorhexidine
- Alcohol
- Hair

Test Yourself

The operating room is equipped with items that may contribute to a surgical fire. Which of the following is designated as a fuel?

- A. Oxygen
- B. Bone Cement**
- C. Drills
- D. Lasers

Rationale: Virtually everything that comes into contact with the patient (including the patient's own hair) is flammable and may become fuel for the fire.

- Bone cement generates flammable fumes while mixing
- Dressings, sponges, drapes, plastics
- Chlorhexidine
- Alcohol
- Hair

Prevention

Prevention is the most important puzzle piece. It is important that the surgical team does not become complacent about fire safety.

IT CAN HAPPEN TO YOU!

Each team member must be vigilant to processes that will prevent surgical fires. In addition to correctly managing the fire triangle, the team should have a plan in place to ensure the team is competency validated in surgical fire risk prevention and management.

Controlling Ignition/Heat Sources

The electrosurgical unit (ESU) is discussed in this example. It is essential that the patient is positioned and draped to avoid sparking. The first intervention takes place before the patient is draped. Place the patient return electrode on a large muscle mass close to the surgical site. This placement provides for the least amount of resistance in the electrical circuit created as does keeping the active electrode cords from coiling. These actions decrease the heat produced and the amount of power required to accomplish cauterization.

Storing the ESU pencil in a safety holster when not in use helps to keep the ignition source and the fuel separated and decrease the potential for accidental activation of the active electrode.

Keeping the surgical drapes or linens away from activated ESU also keeps the ignition source and the fuel separated. Moistened drapes or absorbent towels and sponges will be in close proximity to the ESU active electrode.

You should use only active electrodes or return electrodes that are manufacturer approved for the type and model of ESU being used because others may not fit correctly requiring a higher energy level or even create sparks at the connection. The active electrode should be activated only when in close proximity to the target tissue and away from other metal objects that could conduct heat or cause arcing therefore providing the spark to cause a fire.

All devices with a heat source must be handled in such a way as to reduce the risk of fire. The person who is controlling the heat source should be the only one who activates it. This can help to avoid accidental activation which may result in a fire away from the surgical site. The team should ensure that the correct type of fire extinguisher is readily available in the event of a fire.

Did You Know?



The tip of the ESU pencil maintains heat event after it is turned off?



The ESU unit is controlled by a foot pedal and that foot pedal can be activated by anyone in close contact?



Sparks occur when the ESU pencil inadvertently touches another instrument, such as the clamp near the vessel that is to be cauterized?

Controlling Oxidizers

It is important to note that ambient air, 21% oxygen, is not flammable. However, as the concentration of the oxygen content increases, the temperature that is required to ignite the oxygen decreases. An oxygen enriched atmosphere – greater than 21% oxygen – is easily created when concentrations of 30% or greater oxygen are administered via an open delivery system and in a confined area. This is important because many items will not burn in ambient air, but need as little as 26% oxygen to ignite, for example the endotracheal tube commonly used in surgeries. According to the ECRI Institute and the Anesthesia Patient Safety Foundation, fires in oxygen enriched atmospheres ignite more easily, burn hotter, and spread faster than fires in other areas (ECRI, 2017 & 2018).

Interventions include administering the lowest amount of oxygen via mask or nasal prongs to the patient who is not intubated that will support the patient's physiological needs. Next, drape the patient so that the surgical drapes allow sufficient venting of oxygen delivered to the patient. Additionally, use a separate administration system to deliver 5 to 10 L/min of air under the surgical drape. This will help flush out the excess oxygen.

If greater than 30% oxygen is required, consider intubating with a cuffed endotracheal tube. The cuff helps restrict the flow of the oxygen into the throat or into the surgical field. The supplemental oxygen or nitrous oxide should be stopped for one minute before using an ignition source or for head, neck, or upper chest procedures as the patient's condition allows. This will also help to decrease the oxygen concentration in the air under the drapes. Nitrous Oxide is another commonly used oxidizer. This gas, often called "laughing gas" is administered via a face mask and can infiltrate the air around the patient. It is just as important to monitor this gas as the other anesthesia gases and oxygen levels within the surgical suite.

Controlling Fuel Sources

Anything in the surgical suite may become fuel for a fire under the correct circumstances. Utilizing damp towels and dressings increase the ignition threshold and decrease the risk that they will burn. When utilizing chemical agents such as alcohol-based skin prep agents or tinctures ensure they are completely dry. This allows the fumes to dissipate before draping the patient and using an ignition source such as an electrosurgical unit or laser. The fumes are the actual fuel which burns with some chemicals and any product which contains alcohol.

Conducting a skin prep "time out" to validate that the prepping agent is dry before draping the patient is another way to decrease fire risk. CMS has regulatory guidelines surrounding the use of alcohol-based skin prep and hand hygiene products.

Guidelines

- Policies and procedures must be in place to reduce risk of fire
- Personnel must be aware of these policies
- Products are packaged for controlled delivery with clear directions that must be followed
- Documentation of implementation of fire prevention practices must be present in the patient's medical record
- Personnel must demonstrate practice of the policies & procedures (CMS, 2017)

Test Yourself

Which national agency regulates the use of hand hygiene products?

- A. TJC
- B. CMS**
- C. OSHA
- D. CDC

Rationale: The Center for Medicare and Medicaid Services (CMS) has regulatory guidelines surrounding the use of alcohol-based skin prep and hand hygiene products.

Managing the Process

Have a plan to fight the fire if one occurs. The time it takes to put the disaster plan into action can determine the extent of the harm to the patient.

Communication is key. Knowing how to remove the patient from harm needs to be at the fore front of each team members mind during a fire. The use of the following acronym will help team members remember their immediate responsibilities in the event of a fire.

Immediately move the patient to the far side of a fire door, this will protect the patient from the immediate danger from the fire. Calling for help is essential to prevent the spread of the fire. If the fire is small and can be contained, such as a fire in a trash can, contain and extinguish it. However, if you perceive the fire too big for you to extinguish, evacuate the team to safety.

Knowing how to use the rescue equipment is essential. When the need exists to deploy a fire extinguisher; the acronym P.A.S.S. is useful to help the team member how to operate the extinguisher.

R.A.C.E.

R.A.C.E. stands for the following:

Rescue the individual that is involved in the fire.

Alarm should be sounded as soon as possible.

Confine the fire.

Extinguish the fire and evacuate if required.

P.A.S.S.

P.A.S.S. stands for the following:

Pull the pin

Aim the nozzle at the base of the fire

Squeeze the handle

Sweep the stream over the base of the fire

CO₂ Extinguishers

In the operating room, ECRI recommends a CO₂ extinguisher. CO₂ extinguishers expel a fog of cold gas and snow that leaves no residue as it cools the fire. CO₂ extinguishers are Class BC and are effective in flammable liquids and electrical fires and have been shown to function well in Class A fires. Not all fires require an extinguisher; use the most appropriate material to extinguish the fire, e.g. water or smothering (ECRI, 2017 & 2018 & 2018).

Practice Makes Perfect

Practice makes perfect. Because surgical fires are rare, the opportunity to learn how to react efficiently and effectively to a fire is also rare. Therefore, the recommendation of AORN is to have your team participate in regularly scheduled fire drills. A well-planned simulation of a fire in an operating suite will afford the operating room staff an opportunity to practice and to see the results of their actions.

Knowing where the safe zone is before the fire occurs will help eliminate confusion. Where is the closest fire door? Does the patient(s) need to move out of the operating rooms to the post-operative or pre-operative areas? Where is the safest place? Do you have the right fire extinguisher? Does your staff know how to use them? Does your staff know where the closest one is? Who does what? Does the nurse need to wait for direction from the surgeon? From the anesthesiologist? The correct answer is: define your practice, develop an action plan, and rehearse the plan.

In the event of a fire, follow your institution's disaster plan.

Conclusion

The Joint Commission and Centers for Medicare Services have regulations and guidelines to help hospitals and surgery centers prevent patient harm. It is up to you to make sure you are doing all you can to protect your patients.

Many safety hazards are present during surgical procedures and OR nurses must be diligent in protecting patients from harm. Fire safety is a priority and nurses must act as leaders to ensure proactive fire safety programs are established and practiced by the entire surgical team. With proper training and staff vigilance virtually, all surgical fires can be avoided.

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