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DURAPREP AND THE RISK OF FIRE DURING TRACHEOSTOMY

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Abstract: *Background.* DuraPrep is a widely used, alcohol-based surgical prep solution. The risk of surgical fire associated with incomplete drying of this agent in the context of electrosurgical procedures has been described previously. To date, there have been no reports of fire during tracheostomy associated with a flammable prep agent before entering the airway. We describe an operating room fire occurring during awake tracheostomy associated with the use of DuraPrep.

Methods. A 62-year-old man with copious body hair underwent tracheostomy in the operating room. The neck was prepared with DuraPrep surgical solution, and after at least 3 minutes, the operative field was draped. Activation of electrocautery ignited a fire, and the patient was burned on his neck and shoulders.

Results. The fire was extinguished, and the patient recovered from both the tracheostomy and the burns.

Conclusion. This case illustrates that DuraPrep should be avoided in the hirsute patient, because body hair interferes with drying of this solution and increases the risk of fire. © 2006 Wiley Periodicals, Inc. *Head Neck* 28: 649–652, 2006

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DuraPrep is a convenient surgical prep solution available in single use applicators. It is available in two sizes appropriate for large or small operative fields. This product contains 0.7% iodine in a

74% (weight/weight) isopropyl alcohol base. The alcohol base allows the solution to dry within 2 to 3 minutes after a single application to skin (manufacturer's package insert). Alcohol is a highly flammable agent, and any event that interferes with complete evaporation of the alcohol and drying of DuraPrep (application in hair, pooling) allows the continued generation of flammable vapors. Pleats or air pockets in the drape materials allow flammable vapors to accumulate. These vapors can unpredictably emanate into the operative field. Use of electrosurgical equipment in the presence of supplemental oxygen, an oxidizing agent, can subsequently ignite these flammable vapors, resulting in an operating room fire.¹

Operating room fires are an infrequent but catastrophic occurrence. These events have been tracked by the ECRI (formerly Emergency Care Research Institute) since 1978. It has been estimated that 100 operating room fires occur each year, with 10 to 20 of these events deemed "serious" and two directly resulting in death.² Nearly 70% of these fires are related to use of electrosurgical equipment. Furthermore, in 72% of cases, an oxygen-enriched atmosphere was shown to have contributed to the fire. The ECRI has previously published reports about the risk of fire after improper use of DuraPrep solution, although the

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FIGURE 1. Burn injury after operating room fire. (A) Anterior view of the individual demonstrating extensive hirsutism. (B) Oblique view demonstrating the 2nd degree burn. (C) Posterior view demonstrating the 2nd degree burn due to pooling. (D) This lateral view shows the extensive hirsutism and burn. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

anatomic location of these procedures was not detailed.^{3,4} Although the risks of using DuraPrep in hair-bearing skin such as scalp are well defined, this is the first report, to our knowledge, of a DuraPrep-associated fire in a hirsute patient after application of DuraPrep to the neck.

CASE REPORT

A 62-year-old man who had undergone primary radiotherapy and a right radical neck dissection for unknown primary head and neck squamous cell carcinoma returned to our head and neck oncology clinic 20 years later complaining of dysphagia and weight loss. A complete head and neck evaluation revealed a pharyngeal mass that was proven by endoscopic biopsy to be pleomorphic sarcoma. Imaging revealed prevertebral muscle involvement and C3 vertebral body erosion. After discussion at our multidisciplinary tumor board, plans were made to pursue palliative chemotherapy of this unresectable tumor. Shortly

thereafter, the patient had a sensation of air hunger develop, and flexible endoscopy revealed high-grade upper airway obstruction caused by rapid progression of this tumor.

Scheduled awake tracheostomy was subsequently performed in the operating room. The patient was positioned in the standard fashion for tracheostomy. It was noted at that time that the patient had copious body hair over the neck, shoulders, and back (Figure 1A–D). The area corresponding to the tracheostomy incision was shaved. Local anesthetic was then infiltrated in the skin and along the anterior surface and lateral aspect of the trachea. The neck was then prepared with DuraPrep surgical solution by a member of the operating room staff. At least 3 minutes elapsed before draping the operative field. The skin appeared dry at that point, and no obvious pooling of DuraPrep was observed.

The skin was incised, retractors inserted, and subcutaneous tissues exposed. Bovie electrocautery was then brought to the field and activated.

There was an immediate audible “whoosh,” but no smoke or flame was visualized. The surgical team immediately peeled back the drapes, patted down the patient, and applied saline to the neck and shoulders (Figure 1A–D). The area was closely inspected, and it was confirmed that the fire was extinguished. The drapes were replaced, and the tracheostomy was completed without further event. The area of burn was subsequently dressed with Silvadene cream, and a burn consult was immediately obtained. During the patient’s hospital stay, his recovery from both the tracheostomy and second- and third-degree burns was uneventful.

DISCUSSION

The “fire triangle” is a useful construct describing the three elements necessary for initiation of a fire: heat, fuel, and an oxidizer.⁵ In the case of operating room fires, an electrosurgical unit most often provides heat to ignite the flammable substance, although lasers as well as fiberoptic light sources are potent heat sources as well. Fuels are abundant in the operative field and include prep solutions, drapes, sponges and endotracheal tubes, petrolatum-based ointments, tinctures, as well as many others. In the presence of a high oxygen environment, all of these substances can burst into flame and burn intensely. During head and neck surgical procedures, in particular, all elements of the fire triangle exist in close proximity. Further complicating the risk of operating room fire is the fact that control of electrosurgical equipment, sponges, and prep solutions, as well as management of oxygen delivery, are controlled, to some degree, by different members of the operating room team. This requires the surgeon to closely monitor all three elements of the fire triangle and communicate effectively with the rest of the team to minimize the risk of fire.

Fires occurring during tracheostomy have been described after ignition of the endotracheal tube by electrosurgical equipment.^{6–9} In addition, a previous report documented an operating room fire after ignition of an oxygen-delivery mask during awake tracheostomy.¹ However, this represents the first case report to our knowledge in which the application of DuraPrep to the neck of a hirsute patient has been associated with an operating room fire. In this case, the application of DuraPrep to the neck of a very hirsute patient allowed collection of DuraPrep within neck, chest, and back hair that interfered with proper drying. As a result, on activating Bovie electrocautery, a

high concentration of flammable vapor was present within a hairy operative field.

Operating room fires are fortunately a rare occurrence.² To prevent the risk of operating room fires, one element of the fire triangle must be removed. In the case described herein, removal of the fuel is the most reasonable and efficacious approach. Options include shaving the entire neck and shoulder regions of excess body hair. This would accomplish removal of hair and enable adequate drying of DuraPrep, both of which represent ample fuel sources. In all cases, significant attention must be paid to effectively draping the patient to prevent collection of flammable vapors beneath the drape material. In this instance, both shaving the patient or allowing adequate time for DuraPrep sequestered in hair to dry would exceed the time requirement for a traditional iodine prep. Thus, we would recommend avoiding DuraPrep in the hirsute patient, because it is associated with an increased risk of operating room fire and does not offer any time savings in this patient population.

Another risk factor in this case relates to oxygen delivery. Previous reports have detailed the risk of oxygen delivery by face mask.¹ In this case, high flow oxygen was provided by facemask despite the fact that the patient had adequate oxygenation in the immediate preoperative period based on oxygen saturation levels and clinical evaluation. We would recommend, if tolerated, the delivery of oxygen by nasal canula either into the nasal or oral cavity. This would result in a significantly lesser amount of oxygen delivery to the operative field. In addition, oxygen delivery should be titrated to the patient’s oxygenation status, and the unnecessary use of high flow oxygen would be avoided. Barriers composed of drape material or surgical towels can provide an additional barrier preventing oxygen delivery to the site of electrosurgery. In the rare case that time does not allow the removal of fuels from the operative field or oxygen delivery into the operative field is unavoidable, electrocautery could be avoided in favor of blunt dissection.

Prevention of operating room fires is of paramount importance. This requires vigilance and control of all three elements of the fire triangle. Furthermore, oxygen delivery should be maintained at the minimum level providing adequate oxygenation and delivered by either nasal or oral canula, preventing oxygen enrichment on the operative field. Last, we would recommend that DuraPrep not be used in the hirsute patient,

because collection in hair-bearing skin can impede drying of DuraPrep solution.

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