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Accidental igniting of disinfectant in experimental laboratory

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EXPLOSIVE or flammable anesthetics and disinfectants are used in clinical practice as well as in the experimental laboratory. According to statistics, the incidence of fire or explosions in the operating room is rare, and such accidents are said to occur at a rate of from 1 to 4 times in 200,000 anesthetics of the approximately 13 million anesthetics administered each year in civilian hospitals.[1, 2]

The dire results of those accidents would indicate that all persons working in an operating room should exercise special caution. This report concerns an unusual accident that occurred recently in the animal experimental laboratory at the Cleveland Clinic, when benzalkonium chloride, used for sterilizing the hide of the animal, ignited.

Conditions of experiment

On March 16, 1970, preparations were being made for an experimental implantation of Hydron[3] into the right atrium of a sheep, so as to evaluate the in vivo blood compatibility of this new hydrophilic polymer. The animal was anesthetized by an intravenous injection of pentobarbital (10 mg per kilogram of body weight). The animal was placed on the operating table; endotracheal intubation was performed, and anesthesia was maintained with 99 percent oxygen and 1 percent penthrane by means of semiclosed technic.

The wool on the wall of the left side of the chest was clipped and the hide was daubed twice with benzalkonium chloride for preoperative sterilization. A surgical drape was placed over the sterilized area. A second drape with a hole cut out was placed over the first drape, and an incision was made in the chest of the sheep. Electrocautery was used. At the required voltage, a spark ignited the area sterilized with disinfectant, including the incision. A blue flame spread over the sterilized area and, to a lesser extent, under the surgical drape. The anesthetic circuit was immediately disconnected from the endotracheal tube; the oxygen supply from the tank was turned off; and the fire was extinguished with the drape pad.

After the surgical drape was removed, it was found that damage to the animal was minimal. The operation was concluded uneventfully.

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Discussion

Various methods have been used hitherto for the clinical sterilization of the operating field, and the methods vary from hospital to hospital and also from surgeon to surgeon.[4-6] Generally iodine tincture is used,[7] and not infrequently benzalkonium chloride is used.

Two types of benzalkonium chloride are in use: one type is dissolved in water, the other in alcohol. The type dissolved in alcohol is of two subtypes, one contains 70 percent alcohol, the other contains 95 percent alcohol. The results of the former disinfectant are better. The latter has a quick-drying effect on the disinfected area. In either case the alcohol evaporates, and since the specific gravity of the alcohol vapor is greater than air, the alcohol vapor hangs over the disinfected field.

In the experimental case here reported, the drape contributed to the holding of the alcohol vapor, preventing its dissipation. As a result, the spark from the electrocautery ignited the alcohol vapor hovering over the disinfected field.

An experience in the Department of Anesthesiology, Sapporo Medical College, Japan, demonstrates a different type of burn. A redistillation of petroleum ether was being conducted, when a woman technician accidentally overturned the flask containing the petroleum ether and the Bunsen burner on which it was standing. The petroleum ether spread over her upper and lower extremities and ignited; she sustained first- to second-degrees burns. Immediately after the accident the damaged skin both of forearms and shins showed diffuse hyperemia with blistering. Unfortunately the entire burned area progressed to keloid formation and scarification. The young woman underwent several skin-resection and skin-grafting operations and recovered completely. Although in the case of the experimental animal, because it was possible to quench the flame immediately, only the wool stubs were singed and the hide was not damaged, in the case of the technician, the damage sustained was catastrophic. Furthermore, when a gas mixture of adequate proportions consisting of oxygen and vapor is present, an explosion may result.

There are various reports[8-12] concerning fire and explosion incidents, together with preventive methods and the role of the anesthesiologist in such cases. Woodbridge's[13] study showed that ethylene, cyclopropane, and ether are equally dangerous from the standpoint of explosion. When explosions occur with ether, they are rarely reported.[14] Recently, Walter[15] reported that the fire accident in an oxygen-powered respirator was caused by extraneous electrical power. There are no reports of accidental ignition of flammable disinfectants. Perhaps it can be assumed that when fire accidents occur with flammable disinfectants, they are never reported. Explosions and fires occurring in the operating room with explosive anesthetics are dramatic and occasionally cause deaths; consequently, they receive much professional and lay publicity.

It is understood that *prevention* of fire and explosions is preferable to having to take steps to extinguish those that have occurred. While the case here reported was not an ignition of an explosive anesthetic agent, precautionary measures to avoid such ignition should be taken. In this case, the animal was maintained in anesthesia with oxygen and penthrane. Thus, exhausted gas from the anesthesia machine raised the concentration of oxygen in the room and increased the probability of combustion.

From present experience, it is concluded that after spraying or daubing with benzalkonium chloride disinfectants, adequate time should be allowed for the alcohol vapor to dissipate to a concentration not flammable, before the electrocautery is used. Blowing off the vapor or using mechanical suction helps to speed clearing the air of combustible fumes. Furthermore, a portable fire extinguisher should be set up in all operating rooms and, in the event of an accident, all persons working in the operating room should have been adequately trained to activate or to operate the equipment. This is applicable not only in clinical operating rooms but also in animal experimental operating rooms.

Summary and conclusion

A report is presented of the igniting of benzalkonium chloride, a disinfectant containing alcohol, by a spark arising from the electrocautery. The disinfectant had been daubed on the hide of an anesthetized sheep, and after the incision was made the disinfected area ignited. Fortunately, the animal sustained little damage.

Precautions and preventive measures required when flammable disinfectants are used are discussed. The necessity of a fire-prevention system in the operating room is stressed, and mention is made of the necessity of training all persons who assist in the operating rooms—clinical or animal—in the use of the apparatus.

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