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Fire in the Operating Room During Hypospadias Repair

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ABSTRACT

Fire in the operating room (OR) is a very distressful and shocking occurrence with potential dramatic consequences. Despite safety rules and rigorous recommendations, such unintentional events do occur every so often. Notably, the vast majority of cases have been reported in the adult population, with very few pediatric cases described to date. Herein, we report on a 16-month-old boy undergoing reconstructive surgery for penoscrotal hypospadias, who experienced an OR fire most likely related to the use of alcohol-based solution ignited by monopolar electrocautery.

Introduction

Fire in the operating room (OR) is a serious reportable event, which may lead to devastating consequences including death. Such a rare and untoward event is likely under-reported, with only one previous case pertaining genitourinary surgery (i.e., circumcision). Despite the adoption of training protocols for surgical fire prevention and patient safety, there has been a significant increase in the medical liability claims over the past three decades.[1] The following triad is required for initiation of a fire in the OR: fuel, an ignition source, and an oxidizer. Indeed, the OR represents an oxygen-rich environment at relatively high-risk for fire. Additionally, a variety of electrical instruments may act as an ignition source and fuel materials include antiseptic skin preparations, drapes, and even the patient's own tissues or hair.[1] The flammability of common alcohol-based antiseptic skin preparations is well recognized and also acknowledged by manufacturers themselves. Herein, we describe a case of OR fire likely related to the use of chlorhexidine–alcohol skin preparation and monopolar electrocautery that occurred during reconstructive surgery for penoscrotal hypospadias in a toddler.

Case report

A 16-month-old boy was referred to our attention for a penoscrotal hypospadias requiring reconstructive surgery. Although the urethral opening was located at the penoscrotal junction, there was a moderate penile curvature. The urethral plate appeared fairly developed, with significant deficiency of the ventral foreskin. Both testicles were in the scrotum and there were no other associated malformations of the genitourinary tract. Therefore, the patient was elected for single-stage urethroplasty. When the patient was under general anesthesia (applied F_IO_2 of 30–40%), the operating field was prepped using 2% chlorhexidine–alcohol antiseptic skin preparation, and sterile drapes were placed after few minutes according to our guidelines for safe surgery. Dissection began with a U-shaped incision around the original meatus using a #11 knife blade. Degloving of the ventral penile shaft was initially carried out by blunt and sharp dissection using fine scissors, and then continued using monopolar electrocautery. At this stage, the surgeon adjusted part of the lower drape, which did not appear to be well fixed to the perineal skin caudal to the scrotum. When the tissue dissection was started again, an unexpected spark generated from the tip of the electrocautery ignited an OR fire. The flames were instantly doused and surgical drapes promptly removed. The patient sustained first and second-degree burns on both sides of inner thighs, suprapubic region and dorsal surface of the right hand (Figs. 1 and 2). The surgical procedure was abandoned, proceeding only with tissue reapproximation and urethral catheterization.

Abbreviations: OR, operating room.

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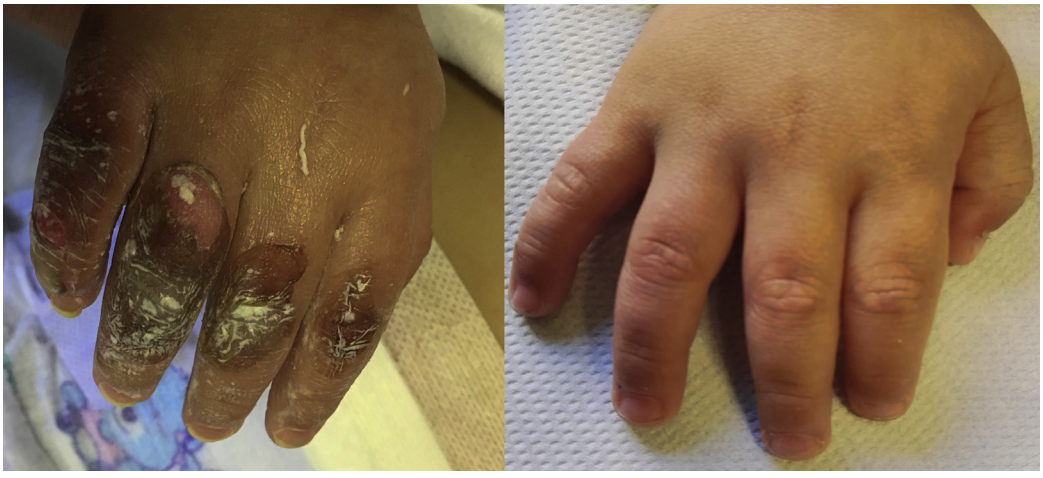

Figure 1. Close up view of burn injuries on the dorsal aspect of the right hand immediately after the OR fire (*left*), and complete healing of the burn injuries documented two months postoperatively (*right*).

After appropriate treatment of burn injuries, the patient was awakened from anesthesia. The burns healed completely within 2 months and, thus, the patient uneventfully underwent one-stage repair of penoscrotal hypospadias using the tubularized incised-plate urethroplasty technique (Fig. 2). Three weeks after surgery, the patient underwent elective urethral calibration and dilatation

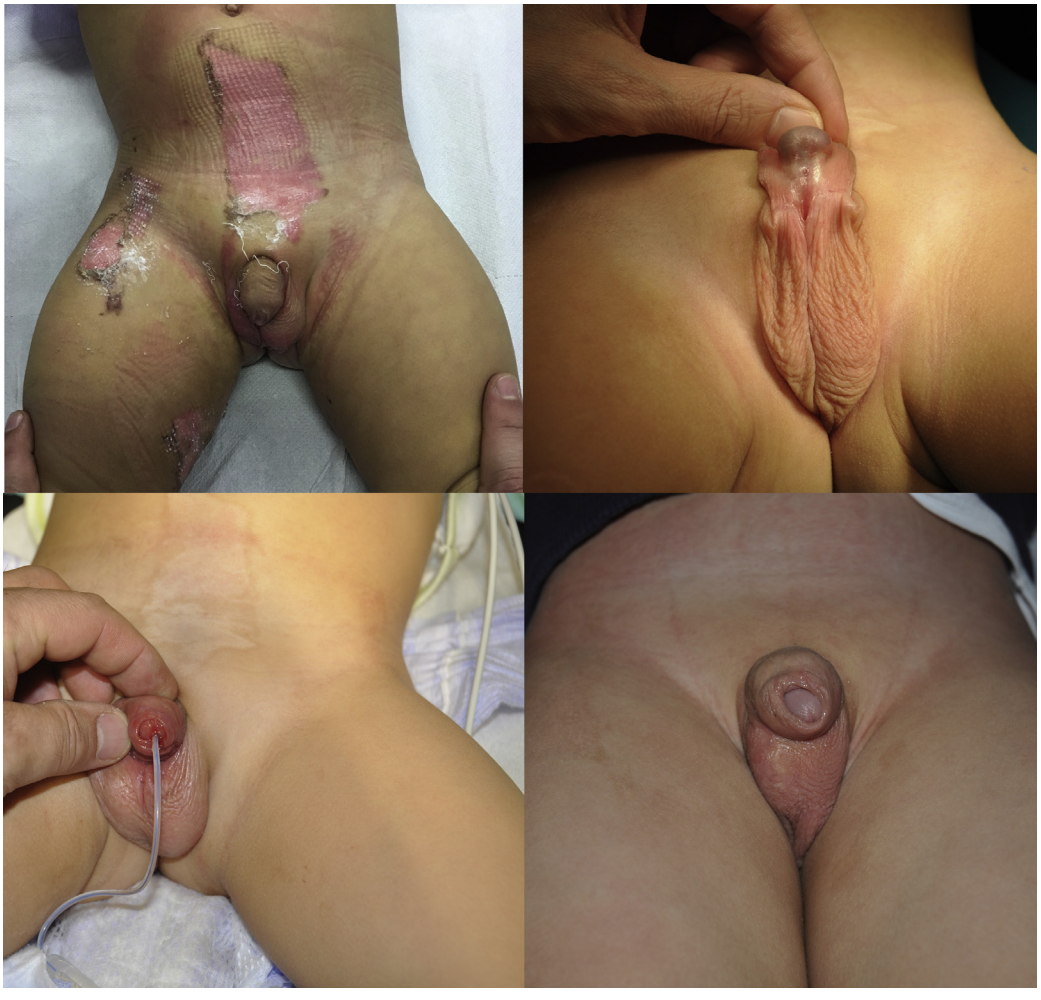

Figure 2. Gross appearance of first and second-degree burn injuries involving suprapubic region and inner thighs documented at first intervention (*top left*); considerable spontaneous healing of the burn injuries documented at the beginning of urethroplasty, carried out two months after initial surgery (*top right*); gross appearance of burn injuries two weeks after the second surgical procedure (*bottom left*). Note some skin discoloration still visible in the healed area of the suprapubic region, which had returned to its natural color at last clinical follow-up one year after urethroplasty (*bottom right*).

up to 12 Fr performed under general anesthesia. The child is now almost 3 years old, and has started potty training with a normal-looking penis and a good urinary stream within 1 year of surgery.

Discussion

Fire in the OR rarely happens, but it can have awful consequences for the patient as well as for the OR staff. Recently, the US Food and Drug Administration revealed that there are 550–650 surgical fires per year in the United States, reflecting a 2-fold increase in the past 12 years.[2] It is renowned that the confluence of the aforementioned three factors is responsible for surgical fires in the OR. Indeed, alcohol-based antiseptic skin preparations are most often involved in this fire triangle. However, the currently widespread utilization of these products is secondary to the well-documented superiority in preventing surgical-site infections as compared with povidone–iodine solutions.[3] Notably, in a multicenter randomized trial recruiting into each treatment arm more than 400 patients undergoing clean-contaminated operations, the chlorhexidine–alcohol skin preparation (2% chlorhexidine gluconate and 70% isopropyl alcohol) was twice and three times as effective as aqueous solution of 10% povidone–iodine in preventing superficial incisional infections and deep wound infections, respectively.[3] Additionally, the use of alcohol-based antiseptic skin preparations is not generally recommended on mucous membrane surfaces. However, some recent studies have demonstrated that 2–4% chlorhexidine–alcohol skin preparations are safe and effective for off-label use in genitourinary surgery, including both male and female genitalia. Therefore, given the lack of urethral and genital skin irritation, and in consideration of the persistent antimicrobial activity and superior cost profile, alcohol-based antiseptic skin preparations can be considered as a safe alternative to iodine-based preparations also in genitourinary surgery.[4,5] In our pediatric OR, we switched from iodine-based to an alcohol-based antiseptic skin preparation (2% chlorhexidine concentration) almost 10 years ago, irrespective of the type of surgery to be performed. The reported event is the only one ever occurred in our pediatric OR in the past 50 years of activity, with an average of 700 surgical procedures under general anesthesia per year.

Notably, an experimental study using an ex-vivo model of porcine skin has confirmed that alcohol-based skin preparations may fuel OR fires, even when the waiting time (3 minutes) according to the manufacturer's guidelines is respected.[1] Pooling of alcohol-based skin preparations was the primary causative factor involved in large spreading fires. That is what we believe happened in our present case: some of the prep solution likely pooled beneath the patient, thus residual alcohol vapors and oxygen built up, escaping through the partially detached drape and causing ignition when the cautery was used.

In conclusion, despite the potentially significant event we experienced, we believe that chlorhexidine–alcohol solution for preoperative surgical site preparation can be safely used in children, including genitourinary procedures. However, it is desirable that all health care professionals involved in the OR pursue continuing education on safe surgery, including guidelines for prevention of surgical fires. Strict adherence and implementation of surgical safety checklists, which should also address drying times of used prep solutions, may prevent similar critical incidents.

Submission declaration

This work has not been published previously and is not under consideration for publication elsewhere. It has been approved by all authors.

Conflicts of interest

None.

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