

A Surgical Field Flash Fire during the Separation of Dicephalus Dipus Conjoined Twins

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Despite the prevalent use of nonflammable anesthetics, reports of perioperative fires still appear in the anesthesia literature.¹⁻³ The following case report relates an experience with surgical field fire during separation of dicephalus dipus conjoined twins.

REPORT OF A CASE

Dicephalus dipus conjoined twins were referred to our hospital after Cesarean section delivery at another hospital. Cardiac catheterization revealed that the left twin (twin B) had a normal heart except for a small patent ductus arteriosus and a right atrial connection with the large, single-chambered atrium of the right twin (twin A). Other cardiac anomalies in twin A included pulmonary valvular atresia, hypoplasia of the right ventricle from which arose the aorta, a left ventricle whose only outlet was a ventricular septal defect and a large patent ductus arteriosus which maintained circulation to the lungs.

The conclusion was that surgical separation could not result in the survival of both infants. At 13 days of age twin A began experiencing severe bradycardia and cyanosis secondary to ductal closure. This was soon followed by a concomitant decrease in the heart rate of twin B. In an effort to save twin B, the patients were prepared for surgical separation.

A team approach was used to provide anesthesia for the procedure. Each infant received anesthesia delivered by a separate anesthesiologist. A third supervised the administration of drugs, blood loss replacement and fluid administration and record keeping. Separate but similar machines and breathing circuits were used for each twin, the latter consisting of the Jackson-Rees modification of the Ayre's T-piece.

Twin A arrived in the operating room with the trachea previously intubated with 3-mm endotracheal tube and ventilation controlled with an $F_{I_{O_2}}$ of 1. Her cardiopulmonary status was tenuous with $P_{a_{O_2}}$ 28 torr and a systolic arterial blood pressure of 82 torr. Twin B arrived clinically stable and while awake, her trachea was intubated and anesthesia was achieved with intravenously administered morphine. The twins were placed in the left lateral decubitus position and the surgical site was prepared with Povidone Iodine, a water soluble, nonflammable

antiseptic solution. The patients were then draped with cotton cloth drapery and a plastic occlusive surgical drape. The plastic drape encircled the head and neck of twin A with its adhesive edge affixed to the extraoral portion of the endotracheal tube. A cone-shaped air space was thus formed with the apex at the endotracheal tube.

Forty-five minutes into the surgical procedure, a blue flame was noted on the operative field surrounding the electrocautery device. Simultaneously, the nonbreathing circuit connected to twin A began expelling smoke and became extremely hot. The flames were quickly smothered with surgical sponges. The esophageal stethoscope, the endotracheal tube and the right subclavian intravenous line in twin A had been burned. Ventilation was resumed after a new 15-mm connector was attached to the intraoral remains of the endotracheal tube in twin A. The clinical condition of twin A did not significantly change after the fire; $P_{a_{O_2}}$ and $P_{a_{CO_2}}$ continued to be in the 23-28 torr and 26-36 torr range, respectively. Systolic arterial blood pressure remained constant at 70-75 torr. Likewise, no change was noted in the clinical course of twin B prior to completion of the amputation.

The amputation of twin A from twin B was completed two hours postfire. The head, neck, right arm and majority of the thorax above T10 level of twin A were presented to pathology. Full thickness thermal injuries were noted on the face and head and also in the oral cavity and carbon deposits were found in the trachea. Hemorrhagic fluid was present in the alveoli, but could not be conclusively attributed to the fire.

Initially, the surviving twin suffered severe pulmonary hypertension, acute tubular necrosis and severe hypoxemia. Twin B was never weaned from ventilatory support. Partial thickness burns were present on her head and along the incision line. On postoperative day four, she developed a Klebsiella wound infection. The subsequent month's course was characterized by wound dehiscence, septicemia, and superior vena cava thrombosis. The twin suffered a cardiac arrest and died on postoperative day 46.

DISCUSSION

Because of the complexity of the surgical separation and of the anatomy involved in this anomaly, we were quite concerned about three areas in the anesthetic management: 1) the cross-over effect of a drug or anesthetic given to one twin on the other infant; 2) the ability to accurately estimate blood loss and replacement fluids for each twin; and 3) the ability to maintain normothermia considering the length of the procedure. Bloch and Karis⁴ consider these and other problems in their detailed report of the anesthetic management of twins with conjoined hearts. One problem which neither they nor we anticipated, however, was the possibility of an operative field flash fire.

Two of the three necessary ingredients for combustion, oxygen and an ignition source, are always present in the operating room. Despite the near exclusive use of non-explosive anesthetic agents, the third ingredient, a com-

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bustible material, also is present in the form of alcohol-based prep solutions and alcohol-based adhesive sprays,⁵ alcohol-packaged suture,¹ drapery, gauze pads, sponges, adhesive tape (especially the plastic type), eye patches, disposable plastics, and paper products.⁶

Both experimental and clinical evidence support the potential hazard these combustible items pose. Plumlee² tested the combustibility of tincture of Benzoin spray and found that after a 5-s burst, the area sprayed could be ignited by cautery up to four minutes later; even after a 1-s burst, ignition was possible up to 90 s later. Hot wire cautery has been shown to generate enough heat to ignite any alcohol-based antiseptic which contains as little as 20 per cent alcohol. Therefore, any substance containing greater than 10 per cent alcohol must be considered potentially flammable.⁷ Also, cotton drapes ignite within 3-s duration of contact with cautery if the oxygen concentration under the draping is 40 per cent or greater.⁸

We feel that the twin-fire can be explained by the combination of a highly enriched oxygen environment, combustible drapery, and electrocautery. Twin A was quite hypoxemic (P_{aO_2} 28 torr); therefore, ventilation was with an FI_{O_2} of 100 per cent. The plastic occlusive drape completely enveloped the baby's head, encircling and being attached to the endotracheal tube. An audible leak around the endotracheal tube resulted in the creation of an enriched oxygen atmosphere under this drapery. When the dissection became immediately subjacent to the oxygen rich atmosphere, a flash fire in the operative field resulted. Analogous experiences were cited by Gupte,³ who reported ignition of a pharyngeal gauze

pack during intraoral diathermy which he attributed to leakage of oxygen and nitrous oxide around the endotracheal tube, and by Cameron and Ingram,⁸ who reported ignition of surgical drapes when oxygen enriched gases were vented beneath them.

This case report serves to emphasize that the potential for fire still exists, despite the use of nonflammable anesthetics. The hazard may be decreased by: 1) using water-based prep solutions,⁷ or if alcohol-based preps must be used, delaying draping until vapor dissipation has occurred⁹; and 2) preventing the accumulation of oxygen enriched anesthetic gases beneath the drapery.

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Posttetanic Count (PTC): A New Method of Evaluating an Intense Nondepolarizing Neuromuscular Blockade

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The methods commonly used for monitoring neuromuscular transmission do not allow evaluation of an in-

tense neuromuscular blockade. Thus the doses of nondepolarizing relaxant used for endotracheal intubation cause disappearance of the response to single, tetanic, and train-of-four (TOF) nerve stimulation for a variable

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