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Endotracheal Tube Ignition during Laryngeal Surgery with Resectoscope

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The urethral resectoscope is being used in our hospital to remove tracheal granulomas formed at the tracheostomy site. We describe a case in which the endotracheal tube ignited when the urethral resectoscope was being used.

REPORT OF A CASE

A 2-year-old male weighing 8 kg was scheduled for bronchoscopy and tracheal dilatation for subglottic stenosis. The child was born spontaneously without complications at 32 weeks' gestation, weighing 1.3 kg. After birth, he experienced severe respiratory distress syndrome. His trachea was intubated and ventilation controlled for several months. Later he experienced bronchopulmonary dysplasia. Patent ductus arteriosus was ligated at age 2 weeks. Ileostomy was done at age 3 weeks for severe necrotizing enterocolitis with bowel perforation. The ileostomy was closed at age 8 months. The child has a seizure disorder for which he was being treated with phenobarbital. Tracheostomy was performed at age 3 months and the child was finally weaned from the respirator at age 18 months. Currently with a tracheal collar at a $F_{I_{O_2}}$ of 0.35, a Pa_{O_2} of 64 mmHg was maintained.

Bronchoscopy and tracheal dilatations had been done periodically under general anesthesia. The same technique has always been employed without complications, namely, passing an endotracheal tube through the tracheostomy. Anesthesia was induced and maintained by inhalation of halothane and 50 per cent nitrous oxide. The last four procedures included removal of granulation tissue found at the tracheostomy site which was resected with the urethral resectoscope. No complications had occurred.

This time, the same procedure was followed. Atropine, 0.2 mg, was administered intramuscularly 1 h before inducing anesthesia with halothane and 50 per cent nitrous oxide through the tracheostomy tube. When adequate anesthetic depth was attained, the epiglottis, arytenoids, vocal cord, and trachea were sprayed with 1 per cent lidocaine. The tracheostomy tube was removed and a plastic endotracheal tube was passed through the tracheostomy. During bronchoscopy, granulation tissue was found at the tracheostomy site in the area above the endotracheal tube. While resecting it with the urethral resectoscope, smoke suddenly came out of the child's mouth and we saw a flash at the tracheostomy site. The endotracheal tube was immediately withdrawn. It was on fire which rapidly ceased spontaneously. Bronchoscopy showed burns on the lower trachea and right bronchus, with minimal involvement of the left bronchus. On auscultation the lungs were clear, except for occasional rhonchi in the right lung fields. Halothane was discontinued, 100 per cent oxygen administered through the tracheostomy tube and dexamethasone 4 mg administered intravenously. In the recovery room, the child was placed on CPAP +5 and $F_{I_{O_2}}$ of 0.5. The pH_a was 7.34, Pa_{CO_2} 37 mmHg, and Pa_{O_2} 84 mmHg. The child made an uneventful recovery. Bronchoscopy done two weeks later revealed normal trachea and bronchi.

DISCUSSION

Some children with tracheostomies are found to have granulation tissue at the tracheostomy site by bronchoscopic examination. The presence of granulation tissue may cause airway obstruction and prevent decannulation. The granulation tissue had been resected with laryngeal biting forceps until a year ago when our otolaryngologist decided to use the urethral resectoscope coupled with a fiberoptic telescope. In the past year, we have done 67 cases under general anesthesia without complications using halothane, 50 per cent nitrous oxide, and an endotracheal tube inserted through the tracheostomy. This time, ignition of an endotracheal tube occurred during resection of tracheal granuloma using a urethral resectoscope.

Johnson and Stewart,[1] and Downing and Johnson[2] have reported cases where subglottic stenosis was resected with urethral resectoscope and the tracheas were successfully decannulated, or in some cases, tracheostomy entirely avoided. Our surgeon prefers to have the tracheostomy tube removed so he has better visibility and accessibility to the lesion. We have been using vinyl plastic endotracheal tube passed through the tracheostomy because Hirshman and Smith have demonstrated that red rubber and latex rubber endotracheal tubes also can ignite.[3]

Andrews[4] and Konchigeri[5] found that red rubber endotracheal tubes are less easily punctured by laser beams than plastic tubes. We experimented *in vitro* with Rusch red rubber tubes that were grounded and connected to an anesthetic machine delivering 50 per cent oxygen and air. The resectoscope touched the endotracheal tube five times repeatedly in the same area. There was no burn on the tube. We chose 50 per cent oxygen because according to Burgess and, Le Jeune[6] the inspired oxygen should ideally be between 30 and 50 per cent.

Several plastic tubes were coated with dental acrylic and the same experiment was repeated. The tubes did not burn. Nevertheless, the disadvantage of this technique is that the dental acrylic coat renders the endotracheal tube rigid and hard. It also takes a long time to coat and dry it and dental acrylic has a pungent odor.

Another solution to this problem would be to remove the endotracheal tube whenever the surgeon is resecting the granuloma. Since the endotracheal tube is to be reinserted whenever the resectoscope is removed, some degree

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of trauma to the tracheostomy as well as to the trachea is almost inevitable. Our present technique is to insert a red rubber tube through the tracheostomy and anesthetize the patient with halothane and 50 per cent oxygen and air.

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Development of Bronchial Obstruction with Secondary Lobar Emphysema during Anesthesia

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Lobar emphysema secondary to a functioning one-way valve that permits gas to pass in the tracheobronchial tree during inspiration but not during expiration may result in compression atelectasis, a shift of the mediastinum, impairment of venous return, and precipitous hypoxia, hypotension, and cardiac instability.[1] Preoperative awareness of this condition allows for avoidance of anesthetic techniques (*e.g.*, nitrous oxide and positive pressure breathing) that might exacerbate the hyperinflation. In the following case report, we describe a patient who preoperatively had an unrecognized functioning one-way valve which manifested itself as an intraoperative respiratory emergency.

Report of a Case

A 4-month-old, 5.5-kg girl was scheduled for cystoscopy and possible right ureteral reimplantation. Her past medical history was unremarkable except for a history of urinary tract infections and the presence of a dilated right ureter and dilated right calices. The preoperative physical and laboratory evaluations were normal; a chest roentgenogram (fig. 1) was initially interpreted as normal.

One hour after the patient received 5 mg hydroxyzine and 15 mg pentobarbital, intramuscularly, anesthesia was induced with halothane and 60 per cent nitrous oxide in oxygen. Succinylcholine was then administered to facilitate insertion of a 3.5-mm tube in the trachea; immediately thereafter, auscultation of the chest revealed decreased breath sounds over the left upper hemithorax. Because we suspected that a right-sided endobronchial intubation had occurred, the endotracheal tube was pulled back, but no change in breath sounds occurred. As the muscle paralysis disappeared, breathing became spontaneous. Repeat auscultory examination of the chest revealed no change. Therefore, an emergency chest roentgenogram was obtained which showed a marked mediastinal shift to the right, hyperlucency of the left lung, and flattening of the left hemi-diaphragm (fig. 2); the endotracheal tube appeared to be correctly positioned. In addition, when the preoperative chest roentgenogram was compared with the intraoperative roentgenogram, a slight mediastinal shift, which was not originally appreciated by the radiologists, appeared to be present on the initial roentgenogram (fig. 1). Because of these findings, further operative procedures were cancelled, and the trachea was extubated after the child manifested vigorous activity. During the anesthetic, nitrous oxide (60 per cent) had been given for approximately 45 minutes and positive pressure breathing for approximately 15 minutes.

In the recovery room, the patient appeared in no acute distress and a pediatric pulmonary consultant recommended not to immediately investigate the pulmonary problem. However, about two hours later, tachypnea, tachycardia, and sternal retractions were noted. An emergency chest roentgenogram (fig. 3) now showed massive air trapping, herniation of the left lung across the anterior mediastinum, and a further shift of the mediastinum to the right. Therefore, an emergency bronchoscopy was scheduled. Anesthesia was induced and maintained with halothane and oxygen with spontaneous ventilation. A rigid bronchoscope with a side-arm adaptor for ventilation was used. Because bronchoscopy revealed a slit-like left main stem bronchus, a potentially lethal bronchial ball-valve obstruction was thought to exist. Therefore, after substituting an oral endotracheal tube for the bronchoscope, a left thoracotomy was undertaken.

During the thoracotomy, halothane and oxygen were administered via spontaneous respiration until the pleural cavity was entered, and then controlled ventilation was instituted. At this time, the involved

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