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Intraoperative Explosion: Methane Gas and Diet

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Since the advent of nonflammable anesthetics, the frequency of intra-operative explosions has been reduced markedly. The following case illustrates that explosions can still occur in the operating room and are not always within the control of the anesthesiologist.

REPORT OF A CASE

A 60-year-old, 55-kg man was brought to surgery for an esophageal-colon interposition. He had a long history of unsuccessful treatment of esophageal reflux with esophageal reflux stricture with repeated bouts of aspiration pneumonitis. Severe COPD and ischemic cardiovascular disease were additional medical problems. Preoperative preparation had included extensive oral nutritional supplementation with ENSURÉ.[®] This is a liquid which provides a balanced diet for patients who are unable to digest solid foods. The routine monitors were established and arterial and Swan-Ganz catheters inserted. Anesthesia was induced with the intravenous administration of 21 mg morphine sulfate, 10 mg diazepam, and 6 mg pancuronium bromide, in divided doses. Intubation of the trachea was performed without difficulty. Anesthesia was maintained with 2 l oxygen and 3 l nitrous oxide. Surgery proceeded smoothly until the construction of the ileotransverse colon anastomosis. As the stapled colon was opened by electrocautery, a loud explosion occurred, producing a 10-cm rent in the serosa of the colon. The involved colon was resected, and the remainder of the case completed uneventfully.

On the sixth postoperative day, the patient developed metabolic signs of intra-abdominal sepsis. Exploratory laparotomy was performed. Leak of the ileotransverse colon anastomosis and associated left pelvic abscess were found. The abscess was drained and the anastomosis exteriorized. There were no anesthetic related problems. The patient made a satisfactory recovery and was discharged home on the eighteenth postoperative day.

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DISCUSSION

When adequately grounded and maintained, electro-surgery is a safe tool and contributes greatly to the facility and speed of the surgical procedure. In this case, the electrosurgery provided the energy for the explosion. The major problems of this case related to the enteral feedings and inadequate bowel preparation.

The normal colon has a gas composition in volume per cent of carbon dioxide 4-9 per cent, oxygen 15-16 per cent, and nitrogen 74-79 per cent, along with trace amounts of hydrogen and methane. This composition is non-explosive.¹ However, during fasting and when diets high in protein and carbohydrates are consumed, the colonic gas composition can change to include explosive concentrations of hydrogen and methane (up to 30-70 volumes per cent).¹

This patient was nourished enterally on ENSURÉ,[®] a liquid diet containing 14 per cent protein and 50 per cent carbohydrate by volume. Therefore, while on this diet, explosive concentrations of hydrogen and methane can accumulate in the large bowel. Recently, attention has been drawn to the explosive hazards of cautery use during colonoscopy when the bowel is prepared with oral mannitol.^{3,4} Since oral mannitol is absorbed poorly in the gastrointestinal tract, it is metabolized primarily by colonic bacteria. This fermentation process leads to an explosive concentration of methane in the large bowel.

Colon explosion is a well-known event requiring specific preventative measures. Adequate preparation of the colon, with a primary requisite that it be empty and well-vented are the cornerstones of explosion prevention.³ In this case, the patient was not only on a diet producing high colonic concentrations of methane and hydrogen, but also had an inadequately prepared colon prior to surgery. The patient had not had a sufficient enema preparation and his feeding had not been stopped early enough to let the colon empty naturally. During surgery, the colon was entered directly by the cautery without prior venting. This resulted in an extensive colon injury requiring further resection and eventually in intra-abdominal sepsis secondary to peritoneal soiling from the explosion. Fortunately, this patient finally made a satisfactory recovery.

Since the decline of ether and cyclopropane, reports of intraoperative explosions have generally become an-

tiques. However, in current medical practice, increasing numbers of elderly and debilitated patients will be receiving this type of enteral nutritional supplementation before bowel surgery. Therefore, the bowel should be empty before surgery and if electrosurgery is anticipated, the bowel should be vented. These simple steps will eliminate the contact of an explosive mixture with a hot surface and prevent further intraoperative explosions.

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Epiglottitis in the Adult

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Epiglottitis in children is a frequently lethal upper airway problem because of edema of the supraglottic larynx. Although epiglottitis in adults is less common, over 100 cases are in the otolaryngology literature.¹⁻⁵ Five postpubertal patients in one year with this diagnosis have been seen in our hospital. The emphasis was on early endotracheal intubation in contrast to observation and performing tracheostomy if respiratory obstruction developed.^{2-4,6}

REPORTS OF FIVE CASES

Patient 1. A 22-year-old man complained of sore throat, dysphagia for three days, and mild respiratory distress. Indirect laryngoscopy revealed an edematous, erythematous epiglottis but normal vocal cords. There was no posterior pharyngeal swelling. Because of the relatively clear airway, the patient was observed in the Intensive Care Unit but the trachea not intubated. After two days of intravenous ampicillin, a lateral neck roentgenogram showed a decrease in epiglottic swelling. The patient was transferred to the ward with subsequent resolution of all symptoms.

Patient 2. A 34-year-old schizophrenic man complained of a sore throat and dysphagia for 24 hours. The patient had respiratory distress when supine. Physical examination showed marked swelling of the neck and a lateral neck roentgenogram showed massive epiglottic swelling with air present in the epiglottis. After the patient inhaled oxygen and halothane followed by tracheal intubation, the otolaryngologist

performed a tracheostomy. Multiple organisms were cultured from the epiglottis. The patient proceeded to develop mediastinitis and required two months of hospitalization.

Patient 3. A 33-year-old man was seen in the emergency room complaining of a sore throat and dysphagia. A lateral neck roentgenogram was originally read as normal and penicillin therapy initiated. Another review of the roentgenogram 12 hours later revealed epiglottic swelling and retropharyngeal air. The patient returned to the hospital in mild respiratory distress. Indirect laryngoscopy showed marked epiglottic inflammation and normal vocal cords. The trachea was intubated following intravenously administered thiopental and succinylcholine. Direct laryngoscopy showed several small collections of pus in the epiglottis. Ampicillin was given intravenously and the trachea remained intubated for two days. Blood and epiglottic cultures grew *Hemophilus influenzae*.

Patient 4. A 14-year-old male adolescent presented with 8 hours of sore throat and drooling but no respiratory distress. A lateral neck roentgenogram revealed epiglottic swelling. After inhalation of halothane and oxygen, the trachea was intubated and ampicillin was given intravenously. No epiglottic cultures were taken but blood cultures were negative. The patient was reexamined at 48 hours and the trachea extubated after marked improvement was noted.

Patient 5. A 28-year-old man complained of 36 hours of sore throat and dysphagia. Lateral neck roentgenograms revealed a markedly swollen epiglottis. After inhalation of halothane and oxygen, the trachea was intubated with some difficulty. Direct laryngoscopy revealed an epiglottic abscess which was drained and cultured. Normal mouth flora were recovered. Ampicillin was given intravenously and the trachea extubated two days later in the operating room after direct laryngoscopy revealed marked improvement.

DISCUSSION

Morgenstein and Abramson⁷ believe that adults are equally prone as children to suffer obstruction. Other authors argue that adults are less likely to acutely obstruct their airways.^{6,8,9} Because of this disagreement, management of the disease remains controversial. However, there can be no doubt that acute obstruction of the

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