

## CASE REPORTS

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## Intravenous Erythromycin Promotes Gastric Emptying Prior to Emergency Anesthesia

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Emergency anesthesia in a patient with full stomach presents a risk of pulmonary aspiration of gastric contents, and many strategies have been developed to minimize the risk of this life-threatening complication before emergency anesthesia.<sup>1</sup> We report a case of endoscopically confirmed total gastric emptying after intravenous administration of erythromycin lactobionate before induction of general anesthesia for emergency esophagogastroduodenoscopy (EGD).

### Case Report

A 15-yr-old, 50-kg, American Society of Anesthesiologists' (ASA) IV-E boy with cystic fibrosis, hepatobiliary cirrhosis, portal hypertension, abdominal ascites, hypersplenism, anemia, thrombocytopenia,

and hydronephrosis presented to our institution in hypovolemic shock as a result of bleeding esophageal varices. After hemodynamic stabilization and volume resuscitation with packed erythrocytes, platelets, and fresh frozen plasma, he underwent emergency EGD in the pediatric intensive care unit. Five bleeding esophageal varices proximal to the gastroesophageal junction were identified, and endoscopic variceal band ligation was performed. On the second hospital day, he was transferred to the ward and resumed a regular diet and oral medications.

On the fourth hospital day, he developed signs and symptoms of recurrent gastrointestinal bleeding, principally hematemesis, hematochezia, and melena. Although hemodynamically stable, his hemoglobin and platelet counts decreased, his prothrombin and partial thromboplastin times increased, and his fibrinogen level remained stable. The decision was made to perform EGD emergently to identify and manage new or recurrent sites of bleeding. General anesthesia in the operating room was requested.

Before the decision to perform emergency EGD, the patient took oral medications and ate a meal. Six hours before the EGD, oral intake included multivitamin, vitamin K and E preparations, and pancrease tablets. Medical management of bleeding included one oral dose of particulate antacid and one intravenous dose of ranitidine 3.5 h and 2.5 h before induction, respectively. Within 2.5 h of induction, he ate a meal of meat broth, potatoes, corn kernels, and whole milk. After the decision was made to perform EGD, the patient received one intravenous dose of erythromycin lactobionate (100 mg) 80 min before induction as a gastric prokinetic agent. Particulate antacid was repeated 30 min before induction independent of anesthesiology staff instructions. Finally, immediately before induction, 30 ml of sodium citrate solution was orally administered.

Induction of anesthesia and oral endotracheal intubation were accomplished with propofol (2.0 mg/kg) and succinylcholine (1.0 mg/kg). Cricoid pressure was applied until the endotracheal tube cuff was inflated and until mid-tracheal position was confirmed. Mainte-

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## CASE REPORTS

nance of anesthesia consisted of propofol by infusion supplemented with isoflurane in air and oxygen. Ondansetron (4 mg) was given after induction.

Findings during EGD included no evidence of new esophageal varices, ulcerations, or active bleeding. Four of five previously placed bands remained intact. The fifth band had sloughed, leaving a varix that appeared to be thrombosed. This was thought to be the site of the patient's hemorrhage. Passage of the endoscope into the stomach revealed a total absence of solid or liquid material; specifically there was no clotted blood, food, or particulate matter. Inspection of the stomach revealed no additional bleeding source or stigmata of recent hemorrhage. Passage through the duodenal bulb was easily accomplished. No solid or liquid material was seen. The procedure ended without complications, and the patient emerged from anesthesia without nausea or vomiting.

### Discussion

This case illustrates the use of intravenous erythromycin lactobionate as a prokinetic agent before emergency anesthesia in a patient with multiple risk factors for pulmonary aspiration. However, the conclusion that erythromycin administration resulted in complete gastric emptying needs close inspection. Complete gastric emptying is variable and influenced by many factors. In one double-blind randomized study of normal healthy human volunteers given either normal saline or erythromycin infusions before ingestion of a radiolabeled mixed minced solid and liquid meal containing alcohol (a substance that can delay gastric emptying), 60% solid meal retention and 30% liquid meal retention were measured by scintigraphy at 180 min in the placebo group *versus* 40% solid and 20% liquid meal retention in the erythromycin group.<sup>2</sup> More dramatic differences exist in a chronic duodenal fistula dog model wherein solid particle size was controlled, and no alcohol was administered.<sup>3</sup> Given this patient's risk factors for a full stomach, complete spontaneous gastric emptying seems unlikely in the 2.5-h period between food ingestion and endoscopically documented gastric emptying. Vomiting did not occur after eating and thus did not play a role in gastric emptying. Ranitidine, particulate antacids, and sodium citrate increase intragastric pH but do not promote gastric emptying.<sup>1</sup> No anticholinergic drugs were administered, so gastric fluid secretion rates and gastric volumes were not pharmacologically decreased. No other prokinetic drug, such as metoclopramide or cisapride, was administered. The only intervention in this patient associated with enhanced gastric emptying was intravenous erythromycin lactobionate administration.

Erythromycin is a motilin receptor agonist with cholinergic stimulatory properties.<sup>4</sup> It increases LES pres-

sure,<sup>4,5</sup> enhances antroduodenal coordination, and promotes gastric emptying of solids and liquids.<sup>2,3,6</sup> Erythromycin overcomes sieving actions during gastric emptying in animals<sup>3</sup> and humans,<sup>6</sup> and promotes solid meal emptying in patients with scleroderma<sup>7</sup> and diabetic gastroparesis<sup>8</sup> by allowing expulsion of large food particles from the stomach without retarding liquid emptying. Studies in premature infants,<sup>9</sup> mechanically ventilated patients,<sup>10</sup> and postesophagectomy patients<sup>11</sup> also confirm erythromycin's prokinetic effects.

To the best of our knowledge, there are no published reports of the use of erythromycin as a prokinetic agent in patients undergoing anesthesia. This is surprising given its history of successful use by gastroenterologists, surgeons, and intensivists. In light of this case and others' reports, anesthesiologists should assess the role of macrolides in pulmonary aspiration prevention research. Gastroenterologists have had success using erythromycin to achieve gastric emptying before EGD and to advance nasoenteral feeding tubes. The most commonly used dose range in adults is 200–250 mg, or about 2.0–3.0 mg/kg. In this case, a 50-kg patient received an intravenous dose of 100 mg, or 2.0 mg/kg. Investigation of erythromycin and related macrolides as prokinetic drugs in anesthesia patients at risk for pulmonary aspiration seems warranted. Although its use is not without risk, erythromycin lactobionate is readily available, inexpensive (our institutional acquisition cost is \$1.13 per 500 mg vial), has a low dose-dependent side effect profile, is compatible with most drugs, and is an infrequent cause of allergic reactions. It has none of the side effects of metoclopramide and possesses a different mechanism of action. Nevertheless, before routine use of macrolide gastric prokinetic drugs in patients with full stomachs can be recommended, studies should be performed to determine the role they might play in reducing the risk of pulmonary aspiration in patients during general anesthesia.

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## Generalized Seizures Associated with Nitrous Oxide in an Infant

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Despite evidence showing cerebral excitatory actions of nitrous oxide and the increased motor activity associated with its use,<sup>1-4</sup> electroencephalographic (EEG)-documented electrical seizure activity after N<sub>2</sub>O administration have been lacking.

We present a case of tonic clonic seizures after exposure to nitrous oxide in oxygen occurring in an otherwise healthy child coming for an elective orthopedic procedure.

### Case Report

A 7-month-old, 9.6-kg, girl was admitted for reduction of hip dysplasia during general anesthesia. History was unremarkable; develop-

mental milestones were appropriate for her age, and the family history was negative for epilepsy. Results of the physical evaluation were normal. Preoperative hemoglobin was 114 g/l.

The infant had been breast fed 6 h before coming to the operating room. After monitoring of heart rate and oxygen saturation was established, the patient was given 50% and then 70% N<sub>2</sub>O in oxygen by mask while intravenous cannulation was attempted. The patient was calm, had her eyes open, and was breathing smoothly; SaO<sub>2</sub> was 100%. While the hand was being examined for possible intravenous placement sites, the patient started to seize; first she exhibited quivering of the lips, then eye-rolling, and finally tonic clonic movements, starting at the upper limbs and then generalizing to include the whole body. Inspired oxygen concentration was immediately increased to 100%, and ventilation was assisted by mask.

Just as the patient started to seize, intravenous access was achieved. Blood glucose by chemstrip was between 2 and 4 mmol/l (36-72 mg/dl). A bolus dose of dextrose in water was given (total dose, 1.75 g) followed by a continuous infusion of 10% dextrose in water at 40 ml/h. Within approximately 1 min, the seizures stopped, and the patient began crying. Oxygen saturation had dropped to the mid-80s when the patient started seizing, but was 100% as soon as the abnormal movements ceased.

The surgical procedure was canceled, and the patient was transferred to the postanesthesia care unit (PACU). She slept for 45 min and was sent to the ward when fully awake. In the PACU, serum glucose and serum electrolytes levels were normal. The neurologic examination and a diagnostic 16-channel EEG done the same day showed no abnormalities. The neurology consultant believed that the most likely diagnoses were either a "convulsive syncope from pain or a generalized seizure secondary to hypoglycemia."

The patient was brought back to the operating room 1 week later for the same procedure. The child was given breast milk 5 h and dextrose in water 2 h before the scheduled time of surgery. No

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