CASE REPORT

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Gastric Explosion While Using Electric Cautery During Gastrojejunostomy: A Case Report

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ABSTRACT

Gastrointestinal gases become combustible when several gases reach a certain concentration. This occurs in situations where the gastrointestinal tract is obstructed for a certain amount of time. Hence, we present this case of a gastric explosion in a patient while performing a gastrojejunostomy. The reason underlying this combustion involved concomitant chronic pyloric stenosis. Operative procedures should include this information to enhance the safety of the patient and the surgical team.

For an explosion event to occur, three prerequisite elements must occur simultaneously—nonrenewable fuel, oxygen, and an ignition source. Standard operative precautions for surgical procedures are effective in preventing this phenomenon, despite the variety of energy sources used during surgery.[1] However, exceptions can occur. We report a case of a gastric explosion while performing gastrojejunostomy in a patient with duodenal perforation and concomitant pyloric stenosis. In this case, the unanticipated fuel was the static intragastric gas.

CASE REPORT

A 42-year-old man presented to the emergency department with a history of sudden onset and severe right upper quadrant abdominal pain for a duration of six hours. The pain started a few hours after consuming barbequed meat and two pints of beer at dinner time. Soon after, the colicky pain became generalized and associated with difficulty breathing, nausea, and vomiting. The vomitus was nonbilious, non-bloody, and contained partially digested food. Seven months previously, this patient had presented to the emergency department with a perforated duodenal ulcer and underwent emergency laparoscopic repair of anterior duodenal ulcer perforation with Graham's patch followed by uneventful postoperative recovery. He was an active light smoker (13 pack/year) who consumed alcohol occasionally. There was no history of consumption of nonsteroidal anti-inflammatory medications, and he did not suffer from any other medical comorbidities.

On examination, the patient looked ill, dehydrated, and in pain. He had a pulse rate of 122 beats/minute, blood pressure of 114/81 mm Hg, temperature of 36.7 °C, respiratory rate of 22 breaths/minute, and oxygen saturation of 95% on room air. Abdominal examination demonstrated generalized tenderness, distention, guarding, and 'board-like' rigidity, as well as decreased bowel sounds, intact hernial orifices, and normal genitalia. Rectal examination and remainder of the systemic checks were unremarkable.

A provisional diagnosis of acute peritonitis secondary to hollow viscus perforation was made. He was resuscitated with 2 L of normal saline and administered oxygen by mask. Laboratory investigations yielded the following results: hemoglobin 13.4 g/dL, white blood cells 14.3 $\times 10^9$/L, neutrophils 11.7 $\times 10^9$/L, urea 6.5 mmol/L, serum creatinine 89 µmol/L, albumin 48 g/L, international normalized ratio 1.53, and activated partial thromboplastin time 49.0 seconds. Liver enzyme results were unremarkable. Furthermore, his erect chest X-ray and two-view abdominal X-ray showed free air under the diaphragm [Figure 1]. A diagnosis of peritonitis secondary to recurrent duodenal ulcer perforation was made. An exploratory laparotomy was planned, and informed consent

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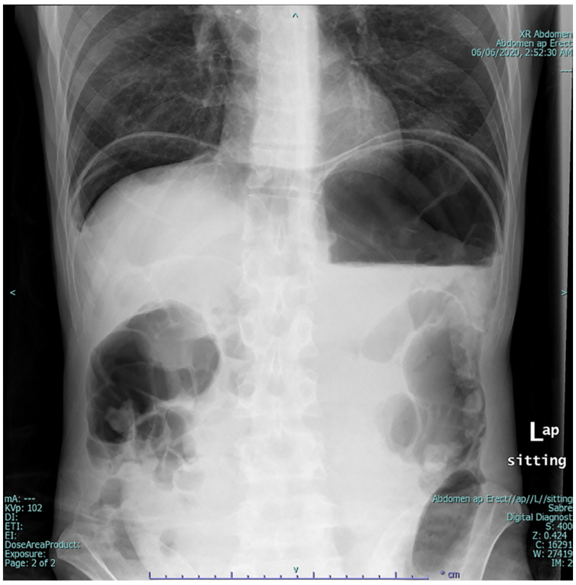

Figure 1: An erect abdominal X-ray showing air under the diaphragm with a huge gastric bubble.

was obtained after arranging for cross-matched blood products and administering a proton pump inhibitor (esomeprazole IV 80 mg) and antibiotics (cefuroxime IV 1.5 g and metronidazole IV 500 mg).

Endotracheal intubation was performed with Sellick's maneuver to reduce the risk of regurgitation because a preoperative Ryle's tube insertion was unsuccessful due to poor patient cooperation. A midline laparotomy was then performed. However, while opening the peritoneum with electrosurgery, abnormal sparking was noticed. Therefore, the electrosurgical unit's output power was reduced to 25 W.

Intraoperative findings revealed gross contamination of the peritoneal cavity with purulent bilious fluid, gastric content, and fibrinous flakes. The stomach was hugely distended below the level of the umbilicus with a deformed, stenosed pylorus secondary to a cicatrized duodenal ulcer. There was a 6 mm perforation of the posterior duodenal wall in the first part of the duodenum.

The peritoneal cavity was thoroughly irrigated with warm normal saline. As the stomach was hugely distended, a nasogastric tube was inserted under guidance. Despite aspirating gastric contents via a nasogastric tube, the stomach remained hugely dilated. When considering the chronic pyloric stenosis and recurrent duodenal ulcer perforation, truncal vagotomy with gastrojejunostomy was planned, along with the closure of the duodenal ulcer perforation with Graham's patch. Following the closure of the duodenal ulcer perforation and the truncal vagotomy, a 6 cm gastrotomy incision was made by using monopolar electrocautery. Upon the opening of the gastric mucosa, there was a loud explosion from inside of the stomach and a blue flame spread in the operative area. The flame was spontaneously extinguished in seconds once the gastric gases were consumed and did not harm the patient or the surgeon. The gastric mucosal rent extended to the entire length of the seromuscular incision. Following the completion of the gastrojejunostomy, the abdomen was closed in a single layer by using nonabsorbable sutures. The skin was closed with skin clips.

The patient was kept in a high-dependency unit under close supervision. His postoperative recovery was uneventful, and he was discharged on day five. Histopathology specimens from the duodenal ulcer base were negative for dysplasia and malignancy.

DISCUSSION

Gastrointestinal (GI) gases originate from either air ingestion or metabolic reaction byproducts. These metabolic reactions include human cellular activity or gut microbiota activity. In the literature, the GI gases are measured and estimated to range 30–200 mL in healthy individuals. These gases are largely composed of hydrogen, methane, oxygen, and hydrogen sulfide (known as flammable gases), in addition to nitrogen, carbon dioxide, ammonia, indole, and skatole. Methane and hydrogen are produced by microbial fermentation of undigested carbohydrates within the gut. These reactions usually occur in the colon, but exceptions are noted in pathological events. Environmental and pathological factors determine the relative concentrations of the combustible gases.[2–4]

For these gases to be combustible, they need to reach specific concentrations. For example, methane's ignitable concentration is 4.4–16.3% in the presence of an oxygen concentration of $\geq$ 10.7%, whereas hydrogen is ignitable at concentrations of 4–75% in the presence of $\geq$ 4% oxygen.[5] To attain such concentrations in the stomach, environmental or pathological changes are needed. Reddymasu et al,[6] reported increased small intestinal bacterial overgrowth in gastroparesis patients.

Endoscopic and surgical explosions are attributable to flammable GI gases.[7–10] All gastricrelated explosions have also demonstrated an element of obstruction pathology.[7,11–14] This strengthens the hypothesis of bacterial overgrowth secondary to obstruction, stagnation, or contamination, leading to increased production and concentration of explosive gases.

Our patient had multiple factors that eventually led to the undesirable event. First, high oxygen concentration administration during his resuscitation and prior to intubation led to some oxygen ingestion. Second, pyloric stenosis secondary to peptic ulcer disease led to bacterial overgrowth and increased methane and hydrogen concentrations in the stomach. Third, part of the ethyl alcohol ingested prior to presentation may have retained without being absorbed, given the usual cycle of alcohol metabolism.[15] Fourth, the gastric contents could not be completely aspirated prior to the procedure. Fifth, electric cautery was used to perform the gastrotomy.

Historically, intra-surgical explosions were not an issue because all equipment were manual. With the ubiquitousness of modern surgical energy devices, reports of explosions have been emerging, albeit without significant injuries. Where there is a high probability of an explosive event, manual surgical equipment may be preferred.

CONCLUSION

Modern standard precautions are generally adequate to prevent explosive events in the operation theater. However, extra precautions should be taken when an energy device is used in a site containing potentially flammable GI gases, especially if the GI tract has been obstructed. In such cases, manual equipment may be preferable to energy devices.

Disclosure

The authors declared no conflicts of interest. A written consent was obtained from the pateint for publication.

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