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## **Acute Gastric Perforation Following Butane Ingestion**

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Although pneumoperitoneum can be caused by physiological processes in a small number of patients, the radiological manifestation of free air in the peritoneal cavity usually suggests serious intra-abdominal disease and requires urgent surgical management. The most common cause of pneumoperitoneum is gastrointestinal perforation which may be the result of penetrating foreign body, tumor, bowel obstruction or ulcerative diseases. We herein report an extremely rare case of acute gastric perforation which was caused by ingestion of butane-cooled tea sorbet followed by rapid expansion of butane gas when it turned into gaseous form in body temperature.

A 69-year-old man sprayed butane over a cup of green tea and cooled it into a lump of green tea sorbet (Fig.1). He attempted suicide by swallowing the butane-mixed tea sorbet and was sent to the emergency room (ER) after his family found what he had done. The patient was alert on arrival. He had a blood pressure of 174/102 mmHg and a regular pulse of 98 per minute. He had no difficulty on breathing (respiratory rate was 18/min) and was not febrile (body temperature was 36.7°C). He appeared lethargic, vomited several times at ER and complained of mild epigastric pain. His oropharynx was not swelled and did not show any bloody froth. The breathing sounds were clear without stridor or wheezes. His abdomen was soft showing neither rigidity nor rebound tenderness, however, it was tympanic by percussion over all of the four quadrants. Arterial blood gas analysis revealed that he did not suffer from hypoxemia ( $\text{PaO}_2$  was 244 mmHg and  $\text{SaO}_2$  was 100%). However, he had a mild leukocytosis and an increased neutrophil count (WBC: 11130/ $\mu\text{l}$ ; Neutrophil: 86.5%). Electrocardiogram only showed sinus tachycardia. The most significant pathologic findings came from radiological examinations that a plain chest X-ray revealed suspicious free air accumulation in abdominal cavity which was confirmed by a left lateral decubitus abdominal X-ray (Fig. 2).

The patient was taken to operation room as he was highly likely to have a perforated hollow viscus. A fresh hematoma was found covering the lesser curvature of the stomach which extended from cardia to antrum. After the hematoma was cleared, there was a gastric perforation about 1cm in diameter located at lesser curvature site of upper gastric body. The adjacent gastric mucosa

appeared healthy showing no signs of fibrotic or chronic inflammatory change; furthermore, there was no spillage of food residues and the peritoneal cavity was clean. The gastrointestinal tract elsewhere was unremarkable and the gastric perforation was managed by wedge resection of the perforated site followed by primary repair. The patient had an uneventful recovery and was discharged without any sequel. Pathologic examination showed merely erosion of mucosa with focal hemorrhage. There is no evidence of mucosal necrosis, formation of granulation or fibrotic tissue.

Butane is a simple aliphatic hydrocarbon with highly flammable and explosive potential. It has a melting point of  $-138.4\text{ }^{\circ}\text{C}$  and a boiling point of  $-0.5\text{ }^{\circ}\text{C}$  and is usually sold bottled as a fuel for cooking, as a refill for cigarette lighters, or as a propellant in aerosol sprays. Very pure butane can also be used as refrigerants in refrigerators and freezers. Inhalation of butane can cause euphoria, narcosis and drowsiness which make butane the most commonly misused volatile solvent<sup>1</sup>. Several reports indicated that butane inhalation resulted in a high mortality rate; furthermore, death within minutes following butane inhalation was not uncommon<sup>1</sup>. By spraying butane directly into the throat, the jet of fluid can cool tissue rapidly to  $-20\text{ }^{\circ}\text{C}$  leading to prolonged laryngospasm<sup>2</sup>. In addition, butane inhalation may also induce severe coronary artery spasm and cardiac arrhythmia<sup>3</sup>. Thus, one who inhales butane usually died from asphyxiation and ventricular fibrillation.

Though cardiac and neurological complications developed from butane intoxication were well known, to the best of our knowledge, gastrointestinal complication has never been reported. Ingestion of butane is unlikely to occur, but if it is swallowed, frostbite to the gastrointestinal tract may occur. Experiences regarding the presentation of symptoms and the management of complications associated with cryogenic ingestions are limited. One case report similar to our patient was a 13-year-old boy who developed gastric perforation after ingestion of liquid nitrogen. The boy experienced an intense burning sensation in his throat as well as severe abdominal pain. His abdomen was distended, tympanic, and diffusely tender. Two small perforations were noted in the posterior aspect of the stomach along the lesser curvature. The boy recovered well following

surgical exploration and repair of the lesions.<sup>4</sup>

As of our patient, there are several evidences that suggest his gastric perforation was not due to ulcer-related diseases. First of all, he had an extensive pneumoperitoneum without obvious signs of peritonitis. Second, the location of the perforation, located high at the lesser curvature near the cardia, was unlike that of the typical acid-related gastric ulcer. In addition, microscopic examination of the perforated gastric tissue did not show any evidence of ulcer-related pathology such as formation of necrotic debris, granulation tissue or fibrosis. Moreover, taken into consideration that his symptoms developed right after he ingested the butane-cooled tea sorbet, it suggested that the patient's gastric perforation was caused by focal full-thickness frostbite of the gastric wall and subsequent rapid volume expansion of volatile butane within the closed cavity of the stomach. Upon perforation, the intraluminal gas was released into peritoneal cavity which led to extensive pneumoperitoneum.

The patient had an uneventful recovery as his gastric perforation was recognized early and repaired urgently. Compared to patients who inhaled butane, our patient did not have those well-known life-threatening conditions such as laryngospasm, asphyxiation and cardiac arrhythmia. It appeared that ingestion of butane-cooled material posed a lesser risk of immediate death compared to butane inhalation. However, perforation of alimentary tract should be considered as a probable serious complication if cryogenic material such as butane is ingested.

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## Figure legends

Fig.1: The butane-cooled green tea sorbet.

Fig. 2: (a) Chest X-ray in upright position revealed suspicious free air accumulation in abdominal cavity; (b) left lateral decubitus abdominal X-ray revealed large amount of free air in abdominal cavity. (arrows indicated intraabdominal free air accumulation)



**Figure 1**  
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Figure 2  
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