Unexplained massive pneumoperitoneum following cardiopulmonary resuscitation
心肺復甦後原因不明的大規模氣腹

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Pneumoperitoneum following cardiopulmonary resuscitation (CPR) had been described as a rare complication. Pneumoperitoneum after CPR could be due to gastric perforation or intrathoracic air tracking into the abdominal cavity via the diaphragm as a result of bag-valve-mask ventilation, external chest compression or improper intubation. In most reported cases, the specific injuries could be identified. We reported an unusual case of pneumoperitoneum following CPR in which the specific cause was not definitely established. Emergency physicians should be aware of the mechanism and clinical signs suggesting of pneumoperitoneum during or after CPR. (Hong Kong j.emerg.med. 2011;18:31-33)

心肺復甦術（CPR）後氣腹是一種罕見的併發症。心肺復甦術後氣腹可能是由於胃穿孔、胸外按壓、不當插管或袋閥面罩通氣導致胸腔內的空氣通過橫膈膜進入腹腔。在大多數的案例，具體的傷處可以查明。我們報告的這個不尋常的案例，心肺復甦術後氣腹的具體原因無法確立。急診醫師應留心注意，心肺復甦期間或之後氣腹的發病機理和臨床體徵。

Keywords: CPR, gastric rupture, stomach rupture

關鍵詞：心肺復甦術．胃破裂．胃破裂

Introduction

The term pneumoperitoneum refers to the presence of air or gas within the peritoneal cavity. Free air can originate from different sources in patients with pneumoperitoneum. The most common source is from gastric perforation. An intrathoracic source is also a commonly cited cause and generally pneumothorax or pneumomediastinum are present in these cases.

Abdominal distension not decompressed by nasogastric tube and blood-like fluid exiting the nasogastric tube can be diagnostic clues suggesting its occurrence. A chest or abdominal X-ray is useful to visualise pneumoperitoneum. The choice of surgical or nonsurgical treatment should be made on the basis of the patient’s condition and physical examination.

Case report

A 62-year-old man who was known to have delusional disorder and tuberculosis-destroyed lungs was brought to the emergency department (ED) after sudden collapsing. The patient did not receive any bystander cardiopulmonary resuscitation (CPR) at the scene. Upon arrival at the ED, the patient was unresponsive and in asystole. He was intubated, and CPR was performed. No esophageal intubation or high-
frequency bag-valve-mask ventilation had been performed. The initial arterial blood gas analysis showed respiratory acidosis with a pH of 6.9, PaCO₂ of 111.3 mmHg, and PaO₂ of 25.6 mmHg.

Approximately 10 minutes after resuscitation, spontaneous circulation was restored with the aid of an inotropic agent, resulting in a blood pressure of 100/70 mmHg. Physical examination indicated that the patient’s abdomen was markedly distended and tympanic to percussion. Bowel sounds were slightly decreased, and blood-like fluid was drained via the nasogastric tube.

Chest X-ray and abdominal computed tomography (CT) were performed to evaluate the abnormally distended abdomen. The chest radiograph showed free air between diaphragm and stomach and the CT of abdomen revealed focal gastric mucosal defect with haematoma below gastroesophageal junction and also showed dilated bowel loops with massive free air (Figures 1 & 2). On the basis of the physical and radiological findings, emergency laparotomy was performed, but the laparotomy revealed no perforated lesions. In order to detect a minimal perforation or tear, the peritoneal cavity was filled with saline, and the stomach was inflated by injecting air through the nasogastric tube. No leaking air bubbles were visible.

After emergency laparotomy, computed tomography of the chest was performed to detect any intrathoracic air leak. There was no radiological evidence of esophageal injury, pneumothorax or pneumomediastinum. The patient was transferred to the intensive care unit (ICU) and treated conservatively with antibiotics and gastric decompression via a nasogastric tube. Nutritional and haemodynamic supports were also provided. During the ICU stay, the patient’s abdomen gradually softened, and there were no complications such as fever, bowel distension, or gastrointestinal bleeding. Further evaluations including esophagoduodenoscopy and bronchoscopy were refused by patient’s family. Fifteen days after ICU admission, the patient was transferred to a rehabilitation hospital. Until discharge, the specific cause of the sudden collapse and pneumoperitoneum had not been found.

Discussion

Common complications of CPR included rib and sternal fractures, tracheal injury, and retropharyngeal bleeding. Another frequent complication was gastric mucosal injury. At autopsy, gastric mucosal laceration had been found in 10-12% of patients who received

![Figure 1. Axial contrast-enhanced CT of abdomen showed gastric mucosal defect (thick arrow) below gastroesophageal junction. Abnormal air and materials (narrow arrow) were also seen.](image1)

![Figure 2. Axial contrast-enhanced CT of abdomen showed massive pneumoperitoneum.](image2)
However, pneumoperitoneum was not considered as a frequent complication following CPR.

One possible mechanism of pneumoperitoneum could be due to gastric perforation. Gastric distension during CPR could easily occur with mouth-mouth or bag-valve mask ventilation. During cardiac massage, the pylorus and cardia would be compressed against the vertebrae, resulting in elevated intragastric pressure. Both gastric distension by positive ventilation and elevated intragastric pressure by chest compression could lead to gastric rupture. Nearly all reported cases of CPR-related gastric perforation were occurred along the lesser curvature of stomach. Unexplainable case reports on CPR-related pneumoperitoneum in the absence of pneumothorax, pneumomediastinum or gastrointestinal perforation were rare. Another proposed mechanism was intrathoracic air tracking from a pneumothorax or pneumomediastinum through diaphragmatic apertures under high intrathoracic pressure.

In our case, a definite massive pneumoperitoneum and perforated lesion were revealed by radiological investigations. Nevertheless, there was no specific lesion suggesting of gastrointestinal perforation at laparotomy. In addition, the CT of chest also revealed no evidence indicating any intrathoracic air leakage. We could still consider a sealed small gastric rupture. However, the pneumoperitoneum was massive and it would be less likely to be caused by a small lesion unnoticeable by laparotomy.

When determining which patients would need surgical exploration and which ones could be treated conservatively, some factors should be considered. In haemodynamically unstable patients, resuscitation would be required. If tension pneumoperitoneum was suspicious or present, immediate decompression technique such as needle decompression should be performed by emergency physician in ED to provide dramatic relief and restore cardiovascular stability. In stable patients, laparotomy should be considered if there were signs of peritonitis, the results of esophagogastroduodenoscopy (EGD) were not conclusive and perforation could not be ruled out.

Conclusion

Emergency physicians must be aware of the various complications during and after CPR. Gastric perforation or pneumoperitoneum is rare but should be considered in patient with a progressively distented abdomen and blood draining via a nasogastric tube after CPR. Chest or abdominal X-ray is an easy and fast method to detect intra-abdominal free air. Prudent decision for exploratory laparotomy should be made because pneumoperitoneum can be caused by a nonsurgical cause including pneumothorax or pneumomediastinum.

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References