Clinical Case Report

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Cerebral air embolism following an endoscopic variceal ligation

A case report

Xue-song Bai, MD, Bo Yang, MD*, Yi-jun Yu, MD, Hong-lan Liu, MD, Zi Yin, MD

Abstract

Background: Cerebral air embolism (CAE) is a rare but potentially devastating complication of endoscopic procedures. Only 3 cases, to our knowledge, have been reported.

Case presentation: A 50-year-old female patient presented with hepatitis C virus-related hepatic cirrhosis, emergency endoscopy and endoscopic variceal ligation was performed in an awakened state. CAE occurred during procedure, the patient passed away the next day in the intensive care unit.

Conclusions: CAE is a rare but potentially devastating complication in endoscopic procedures. We need more preventive tools and treatments.

Abbreviations: CAE = cerebral air embolism, EVL = endoscopic variceal ligation.

Keywords: cerebral air embolism, endoscopic variceal ligation, esophageal varices, hyperbaric oxygen, liver cirrhosis

1. Introduction

Air embolism is a rare but potentially devastating complication of endoscopic procedures. This complication has been observed during various types of endoscopic procedures, like endoscopic retrograde cholangiopancreatography,[1–6] endoscopic stricture dilatation,[6–9] per-oral endoscopic cardiomyotomy, endoscopic variceal ligation (EVL),[10–12] endoscopic esophageal stenting,[7] Esophagogastroduodenoscopy,[6] and endoscopic evaluation of rectal stump.[13] Cerebral air embolism (CAE) following an EVL is extremely rare. Only 3 cases, to our knowledge, have been reported. Here, with the informed consent of patient's husband, we reported a case of CAE that occurred during an EVL procedure in liver cirrhosis, which led to the death of the patient.

2. Case presentation

A 50-year-old female patient, presented with hepatitis C virus-related hepatic cirrhosis, was brought to our hospital due to hematemesis by ambulance. The medical history included Sheehan syndrome of oral taking of Prednisone and Euthyrox. It was the first bleeding. Upon arrival, the patient was conscious. Her blood pressure was 98/69 mm Hg, sinus tachycardia was presented at 95 beats per minute, and the respiratory rate was 20 per minute. The conjunctiva and lips were pale. The results of laboratory tests obtained emergently were: white blood cell count, 4070/l L (normal:4000–10,000/l L); hemoglobin, 5.1 g/dL (11–15 g/dL); hematocrit, 16.8% (33.0–45.0%); platelet count, 3.2/l L (10–30/l L); total protein, 5.5 g/dL (6.4–8.3 g/dL); albumin, 2.9 g/dL (3.4–4.8 g/dL); total bilirubin, aspartate aminotransferase, and alanine aminotransferase were normal; prothrombin time, 15 S (9–14 S), prothrombin activity, 48.4% (86–160%), fibrinogen 1.15 g/L (2.0–4.0 g/L); serum tests for antibodies against hepatitis C virus was positive.

A drip infusion of an electrolyte solution and compatible red blood cell solution was started under atmospheric pressure. In the operating room, monitoring devices, including a pulse oximeter, were applied. Emergency endoscopy was performed in an awakened state. To evaluate the source of hematemesis, upper endoscopy was performed, which revealed multiple esophageal varices grade II without gastric varices. A rupture located at 30 cm from the incisor teeth was found (Fig. 1). The endoscope was removed and then reinserted with Shooter Universal Saeed Multi-Band Ligator (Wilson-Cook Medical Incorporated, Indiana, America). When we were preparing for the rupture banding (Fig. 2), the patient had a generalized convulsion and became unconscious, with a sudden decline in blood oxygen saturation and heart rate. The endoscope was removed immediately. The total elapsed time from initial insertion of the endoscope to final removal of the instrument was 21 minutes. We performed cardiopulmonary cerebral resuscitation and endotracheal intubation and, stopped cardiopulmonary resuscitation after 15 minutes. Her sinus tachycardia was increased to 121 beats per minute, but the degree of blood oxygen saturation stayed at a range from 65% to 80%. Therefore, a simple respirator was used to keep a normal degree. Head computed tomography scan indicated sulcus pneumatosis in the right parietal lobe (Fig. 3). Although mechanical ventilation and other supportive measures were continued, the patient passed away the next day in the intensive care unit.

Editor: N/A.

The authors have no conflicts of interest to disclose.

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Medicine (2018) 97:23(e10965)

Received: 11 March 2018 / Accepted: 10 May 2018

http://dx.doi.org/10.1097/MD.0000000000010965

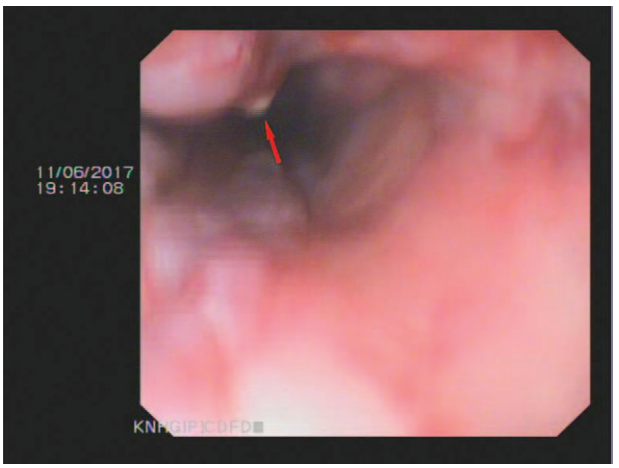

Figure 1. Initial gastroscopy showing esophageal varices, red arrow indicating the varices rupture.

3. Discussion

Air embolism as a complication of medical procedure is uncommon. Reported here is a case of CAE following an EVL. Until now, only 3 cases have been reported of CAE as a complication of EVL: In 2004, Takeuchi et al[10] described a case of a 59-year-old female patient who had a generalized convulsion and became unconscious, with a sudden decline in blood oxygen saturation. Computed tomography of the brain revealed intracranial air that was distributed mainly in the area supplied by the right middle cerebral artery. The patient died later the same day. In 2016, Kim et al[11] reported a patient with cerebral infarction due to air embolism during EVL in liver cirrhosis. The patient was later confirmed to have patent foramen ovale. Kobari[12] in 2017 reported an another case of CAE. A 77-year-old man with liver cirrhosis was admitted in 2015. The patient was unconscious caused by hemorrhagic shock. Even though received a successful EVL of 2 varices, the patient became unresponsive shortly after returning to the emergency room. Head computed tomography showed pneumocephalus and a suspected air embolism of the right hemisphere. As CAE can lead to a fatal result, understanding of the mechanism of air embolism after EVL is very important. CAE could result due to the following mechanisms: The mucosal barrier damage leads to a more probable environment for the absorption of gas.[12,14–17] CAE can occur if air either directly enters the arterial system or is shunted across after entering the venous system through the disrupted mucosa. Retrograde movement of air into the jugular vein[8]; when the volume of embolus exceeds the capacity of pulmonary filter[8]; if there is right to left intra cardiac shunting[11]; insufflation for better visualization undergoing endoscopy creates pressure gradients that have been cited as a factor in creating gas embolisms.[14,18,19] In the present case, transthoracic echocardiography did not show any evidence of a patent foramen ovale. The variceal rupture, like mucosal barrier damage, and rapid insufflation of air during the procedure were thought to be major causes of the CAE.

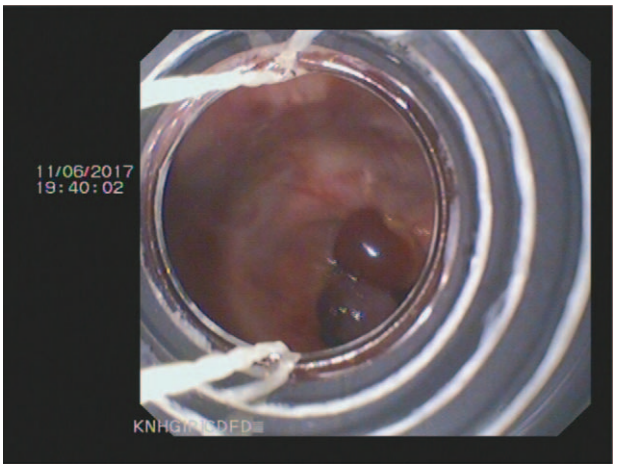

Figure 2. The rupture of esophageal varices undergoing EVL. EVL = endoscopic variceal ligation.

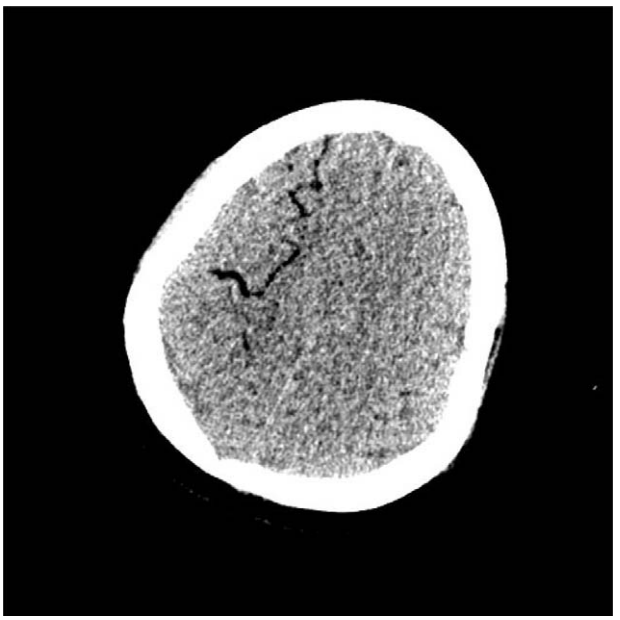

Figure 3. Sulcus pneumatosis in the right parietal lobe.

There are some steps to prevent air embolism when undergoing endoscopic procedures: Using CO_2 for insufflation instead of air, because CO_2 can be easily absorbed and should not cause an occlusion in the vasculature[20,21]; a precordial Doppler probe monitor during the procedure can quickly detect air within the heart and pulmonary vasculature before clinical symptoms may appear[22,23]; slow infusion for better visualization avoids forming a pressure gradient quickly.[18,19] Until now, there is no standard treatment for CAEs. Hyperbaric oxygen therapy is widely accepted as the most beneficial therapy of CAEs. As it can reduce bubble volume, platelet aggregation, activation of the coagulation cascade due to bubble induced endothelial trauma and, endothelial binding of leukocytes which can prevent oxygen-free radical releasing. Meanwhile it can increase diffusion gradient out of the bubbles, oxygenation of hypoxemic tissues, and amelioration of cerebral edema. Start hyperbaric oxygen therapy as soon as the patient's condition allows it.[6,14,24,25] Sadly, our patient did not get hyperbaric oxygen therapy because she must use a respiratory machine.

CAE is a rare complication in endoscopic procedures. Although there are a few adjunctive treatments, hyperbaric oxygen is the only prompt definitive therapy.

Author contributions

Formal analysis: Bo Yang.
Resources: Xue-song Bai, Hong-lan Liu, Yi-jun Yu, Zi Yin.
Software: Bo Yang.
Writing – original draft: Bo Yang.

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