



## Endoscopic Retrograde Cholangiopancreatography-Related Air Embolism in a Patient with an Unknown Biliary –Venous Fistula and Patent Foramen Ovale: A Case Report

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### Abstract

Air embolism is a rare and potentially fatal adverse event associated with endoscopy procedures. We report a case of an endoscopic cholangiopancreatography (ERCP)-related air embolism in a young patient. The diagnosis studies revealed a biliary-venous functional fistula and patent foramen ovale.

**Keywords:** Endoscopic cholangiopancreatography (ERCP)

### Introduction

Air embolism subsequent to an invasive procedure is a rare adverse event which can cause fatal cardiopulmonary compromise. It is described after endoscopy procedures, being ERCP the most frequently related one. A list of 26 reported cases of ERCP-related air embolization are summarized in a recent systematic review [1].

### Case Presentation

A 32-year-old woman with no relevant medical history was diagnosed by clinical features and magnetic resonance cholangiopancreatography of cholangitis secondary to choledocholithiasis. Therefore, elective ERCP for stone extraction was performed using air insufflation.

The patient was deeply sedated with propofol, which was administered by the endoscopy nurse and supervised by the endoscopist, according to guidelines of the American Society of Anesthesiologists (ASA) and European Society of Gastrointestinal Endoscopy [2,3]. Patient monitoring consisted of noninvasive blood pressure, pulse oximetry and clinical assessment. She received oxygen supplementation via an oxygen cannula.

After cannulating the common bile duct, a biliary sphincterotomy was done to facilitate the passage of the stone through the distal bile duct. During the procedure, the patient developed livedo reticularis on her face, right brachial area and upper-right abdominal quadrant, respiratory insufficiency (with oxygen saturation below 78%), livedo bradycardia (20 bpm) and hypotension. Both endoscopy procedure and sedation were stopped. However, the patient didn't wake up, requiring epinephrine, atropine and orotracheal intubation. She developed decerebrate posture, eye deviation and autonomic features. She was finally taken to the intensive care unit (ICU) to recover. Electrocardiogram and emergency transthoracic echocardiogram didn't show any recognizable abnormality. Brain CT scan and MR imaging showed acute ischemia of the right hemisphere and cerebellum and multiple hypodense/hypointense lesions in the sub cortical white matter, interpreted as being air emboli (Figure 1). Abdominal CT showed a biliary-venous functional fistula. Transesophageal echocardiography failed to detect a patent foramen ovale (PFO).

Hyperbaric oxygenation therapy was suggested but finally ruled out due to the impossibility of entering an intubated patient in a hyperbaric chamber. The patient died during the first 24h after the procedure. The autopsy revealed a preserved bile duct (Figure 2) and the existence of a PFO (Figure 3).

### Discussion

Different mechanisms for air embolism in ERCP have been proposed, all of them imply a direct

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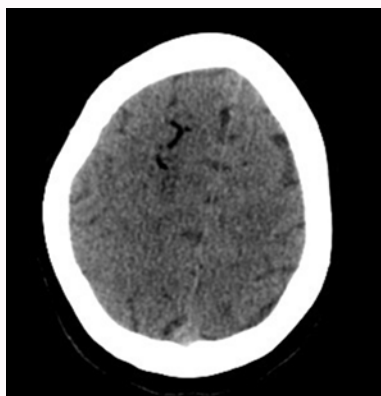


Figure 1: Brain CT showing air emboli.

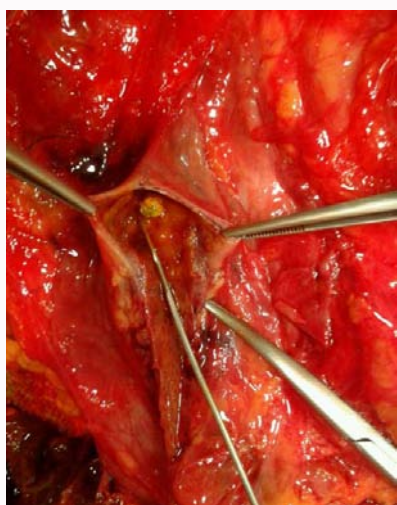


Figure 2: Anatomicpiece: Bileductwith a choledocolithiasis.

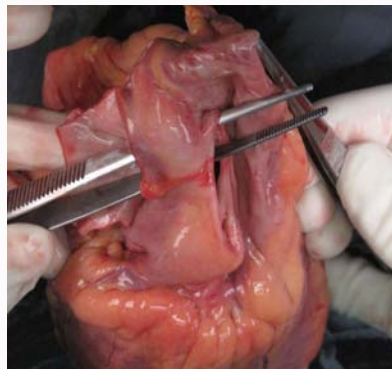


Figure 3: Anatomicpiece: patent foramen ovale.

communication between a source of air and the circulation. These include: intramural dissection by the air blown into the portal vein, transection of duodenal veins during sphincterotomy, biliary-venous fistulas and shunts, portacaval collaterals, air flow directly into the hepatic veins or inferior vena cava, retrograde flow into cerebral veins via superior vena cava, inability of the pulmonary circulation to filter out gas emboli [1,4-6].

Risk factors for the above mentioned mechanisms are previous interventions of the bile duct system, post-surgical gastrointestinal fistula, blunt or penetrating trauma to the liver, transhepatic portosystemic shunt. Other inflammatory conditions may also increase the risk of air embolism, such as pylephlebitis, hepatic abscesses, inflammatory bowel diseases or mesenteric ischemia [4-9].

Air entering the systemic venous circulation causes a major strain on the right ventricle, which can lead to cardiovascular failure. Moreover venous embolism can progress into systemic air embolism via intracardiac or intrapulmonary right to left shunts, retrograde flow to the cerebral veins through the superior vena cava or by passage into the left atrium through the pulmonary veins. The most common cause of systemic shunt is the existence of a patent foramen oval, which may be present in 30% of healthy individuals [10].

Once a systemic air embolism occurs a variety of cardiovascular, pulmonary and neurological symptoms can appear. Cardiovascular

findings include arrhythmia, hypotension, myocardial ischemia, right heart failure and cardiac arrest. Pulmonary symptoms include acute dyspnea, tachypnea, breathlessness, rales, wheezing, hypoxia, cyanosis and respiratory failure. Finally, neurological symptoms include eye deviation, dilated pupils, unconsciousness, hemiparesis, cerebral edema and coma [11].

Due to its low incidence, diagnosis of air embolism may be difficult. It is necessary to maintain a high index of suspicion and to exclude other severe pathologies.

When air embolism is suspected initial measures should be started while the definitive diagnosis is established. Such manoeuvres include: stopping the procedure if possible, administer high flux oxygen, initiate fluid therapy and place the patient in trendelenburg and left lateral position [12].

Once those are completed directed diagnosis studies should be performed to assess the final diagnosis. Bedside echocardiogram may allow the visualization of air within the right heart, brain and thorax CT scan can confirm the diagnosis [1].

Specific treatment includes air aspiration via a central venous catheter; hyperbaric oxygenation therapy has also been suggested as a possible treatment, considering its lack of availability in most of the centres.

In the case of cardiopulmonary arrest, cardiopulmonary resuscitation should be initiated in order to maintain the cardiac output.

The use of CO<sub>2</sub> insufflation has been widely compared to air insufflation. In a meta-analysis comparing CO<sub>2</sub> and air insufflation during ERCP, CO<sub>2</sub> insufflation was associated with significantly lower pain perception during the first 6 hours post procedure.

To prevent air embolism, the American Society for Gastrointestinal Endoscopy (ASGE) has recently recommended using CO<sub>2</sub> instead of air insufflation. Although air embolism has been described in procedures using CO<sub>2</sub> insufflation, overall, CO<sub>2</sub> embolism is reasonably well-tolerated and therefore, preferred insufflation gas form [13].

## Conclusion

In conclusion, establishing an early diagnosis of air embolism would improve the outcome in these cases, reducing mortality. As no specific treatment is described for air embolism detecting and avoiding, risk factors should be a priority. CO<sub>2</sub> insufflation during

endoscopic procedures is associated with less post procedural pain compared with air insufflation. As recently recommended by ASGE, CO<sub>2</sub> insufflation should be offered in patients undergoing endoscopic procedures, especially when they are associated with a higher risk of perforation or gas embolism.

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