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#### **ABOUT COVER**

Editorial Board Member of World Journal of Gastrointestinal Endoscopy, Rashid N Lui, MBChB (CUHK), MRCP (UK), FRCP (Lond), FHKCP, FHKAM (Medicine), Clinical Assistant Professor (Honorary) and Head (Clinical Service), Division of Gastroenterology and Hepatology, Department of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Hong Kong, China. rashidlui@cuhk.edu.hk

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CASE REPORT

# Systemic air embolism associated with endoscopic retrograde cholangiopancreatography: A case report

Jing-Hao Li, Zhi-Kun Luo, Yu Zhang, Ting-Ting Lu, Yue Deng, Rui-Ting Shu, Hang Yu

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Jing-Hao Li, Ting-Ting Lu, Yue Deng, Rui-Ting Shu, Hang Yu, Department of Cardiology Intensive Care Unit, The Second Affiliated Hospital of Hainan Medical University, Hainan Medical University, Haikou 570311, Hainan Province, China

Zhi-Kun Luo, Yu Zhang, Department of Kidney Transplantation, The Second Affiliated Hospital of Hainan Medical University, Hainan Medical University, Haikou 570311, Hainan Province, China

Corresponding author: Hang Yu, PhD, Chief Doctor, Department of Cardiology Intensive Care Unit, The Second Affiliated Hospital of Hainan Medical University, Hainan Medical University, No. 48 Pak Shui Tong Road, Longhua District, Haikou 570311, Hainan Province, China. 309019591@qq.com

### Abstract

#### BACKGROUND

Endoscopic retrograde cholangiopancreatography (ERCP) is a key procedure for diagnosing and treating biliary and pancreatic disorders. Although effective, it carries risks, including rare but severe complications such as air embolism.

#### CASE SUMMARY

We report a case of a 58-year-old man who developed extensive air embolism during ERCP. He previously underwent a Whipple procedure and experienced a sudden drop in vital signs and loss of consciousness. Immediate intervention with hyperbaric oxygen therapy and supportive care led to gradual recovery. Imaging confirmed widespread air embolism, which resolved with continued treatment.

#### **CONCLUSION**

Air embolism is a rare, critical complication of ERCP, especially in patients with prior surgery such as pancreaticoduodenectomy. Early detection and prompt treatment, including hyperbaric oxygen therapy, are crucial for favorable outcomes

Key Words: Endoscopic retrograde cholangiopancreatography; Air embolism; Hyperbaric oxygen therapy; Pancreaticoduodenectomy Complications; Intracardiac pneumatosis; Case report

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**Core Tip:** This case report presents a rare but severe complication of endoscopic retrograde cholangiopancreatography, where a patient with a history of pancreaticoduodenectomy developed extensive systemic air embolism. Rapid diagnosis and timely administration of hyperbaric oxygen therapy were critical in achieving a positive clinical outcome. This report underscores the importance of early recognition and intervention to prevent life-threatening consequences in similar cases.

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#### INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is a widely utilized procedure for the diagnosis and treatment of biliary and pancreatic disorders[1]. While it is an effective procedure, complications such as pancreatitis, cholangitis, bleeding, and perforation are well documented. A less common but severe complication is air embolism, which can lead to life-threatening conditions if not promptly recognized and treated[2]. This case report describes a patient who developed extensive air embolism during ERCP, emphasizing the importance of early detection and appropriate management.

#### CASE PRESENTATION

#### Chief complaints

A 58-year-old man presented with obstructive jaundice, occurring 6 months after undergoing a Whipple procedure (pancreaticoduodenectomy) for pancreatic cancer.

#### History of present illness

The patient reported progressive jaundice over the past few weeks, accompanied by generalized weakness and mild upper abdominal discomfort. These symptoms led to admission for further evaluation and management. The patient had been experiencing intermittent episodes of jaundice since his Whipple procedure, which were previously managed conservatively.

#### History of past illness

Six months ago, the patient underwent a Whipple procedure (pancreaticoduodenectomy) for pancreatic cancer, which involved removal of the head of the pancreas, part of the duodenum, gallbladder, and a portion of the bile duct to treat the cancer. The surgery was successful without immediate complications, but his postoperative course was complicated by intermittent jaundice and episodes of biliary obstruction, which were managed conservatively with supportive care, including fluid management and monitoring of liver function tests. Preoperatively, the patient presented with symptoms such as jaundice, weight loss, and abdominal pain, and imaging confirmed a mass at the head of the pancreas. Despite his diagnosis, his baseline health was good, with no history of chronic liver disease, cardiovascular conditions, diabetes, or significant comorbidities. Despite his balanced diet, the patient reported decreased appetite and significant weight loss in the months leading up to his cancer diagnosis.

#### Personal and family history

The patient denied any history of similar conditions in his family, and no known genetic predispositions were reported.

#### Physical examination

The patient presented with jaundice but remained hemodynamically stable, exhibiting a blood pressure of 135/85 mmHg, a heart rate of 78 beats per minute, a respiratory rate of 18 breaths per minute, and an oxygen saturation of 98% on room air. The abdominal examination demonstrated mild tenderness in the right upper quadrant, with no palpable masses or signs of ascites detected. There were no signs of acute distress, hepatosplenomegaly, or peripheral edema. Neurological and cardiovascular examinations were unremarkable.

#### Laboratory examinations

Initial laboratory investigations showed elevated levels of total bilirubin (5.2 mg/dL) and direct bilirubin (4.0 mg/dL), along with raised alkaline phosphatase (230 U/L). Mild elevations were noted in alanine aminotransferase (78 U/L) and aspartate aminotransferase (65 U/L). Serum amylase, lipase levels, complete blood count, coagulation profile, and renal function were normal.



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Table 1 Timeline of medication administration following symptom onset			
Time	Drug	Dosages	
Immediate	Adrenaline	1 mg	
Immediate	Dopamine	3 mg	
Immediate	Norepinephrine	18 µg	
5 hours later	Norepinephrine	18 µg	
5.5 hours later	Meropenem	1 g q8h	
5.5 hours later	Metronidazole	0.4 g q8h	
5.5 hours later	Glutathione	1.2 g qd	
5.5 hours later	Ademetionine	1 g qd	

#### Imaging examinations

A contrast-enhanced CT scan of the abdomen revealed dilated intrahepatic bile ducts, indicating biliary obstruction. There was no evidence of an obvious mass, stone, or new metastatic lesions. The pancreaticojejunal and hepaticojejunal anastomoses were patent, and mild dilation of the pancreatic duct was noted.

#### FINAL DIAGNOSIS

During ERCP, the patient was diagnosed with an extensive systemic air embolism.

#### TREATMENT

During ERCP, the patient suddenly became unconscious, with a precipitous drop in blood pressure to 60/40 mmHg and a heart rate decrease to 42 beats/min. Additionally, oxygen saturation dropped significantly to 54%. Immediate resuscitation measures were initiated, including intubation and manual bag ventilation. Intravenous medications were administered *via* cannulation of the right internal jugular vein (refer to Table 1). These interventions stabilized the patient's condition, with blood pressure rising to 100/40 mmHg, heart rate to 90 beats/min, and oxygen saturation to 92%. A contrast-enhanced CT angiography (Figure 1B) further demonstrated multiple air collections in the right thoracic, abdominal wall, mediastinum, right pleural cavity, liver, alongside the inferior vena cava, retroperitoneal abdominal cavity, around the right kidney, right inguinal and scrotal areas, and proximal right thigh.

Transthoracic echocardiography revealed the presence of air within the heart chambers (Figure 1A). The original video at the time of examination is provided as Video 1, Video 2, and Video 3. Prompt treatment with hyperbaric oxygen therapy was initiated, starting with 2.8 atmospheres absolute (ATA) (atmospheres absolute) for 2.5 hours, followed by continued therapy at 2.2 ATA for 3 hours. The goal was to promote reabsorption of the air embolism, reduce the volume of air, minimize cerebral edema, and enhance tissue oxygenation. Broad-spectrum antibiotics (meropenem 1 g q8h, metronidazole 0.4 g q8h) were administered to prevent infection, and hepatoprotective agents (glutathione 1.2 g qd, ademetionine 1 g qd) were provided to support liver function.

#### OUTCOME AND FOLLOW-UP

Following initial treatment, the patient's condition gradually stabilized. He regained consciousness and began responding to verbal commands. Over the next few days, repeat imaging showed a significant reduction in air embolism within the cardiac, cerebral and abdominal cavities (Figure 1C and D). The patient was successfully extubated and transferred out of the intensive care unit in stable condition.

Two days after ERCP, repeat contrast-enhanced computed tomography angiography indicated further reduction in air embolism, with no new complications noted. After ruling out contraindications, percutaneous transhepatic cholangiography drainage was performed to address biliary obstruction, and the patient continued to recover without complications.

The patient was discharged in stable condition, with follow-up imaging showing continued improvement. At the 2month follow-up, he reported no specific complaints, and repeat imaging confirmed the absence of residual air embolism or biliary obstruction (Figure 1E).

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Figure 1 Imaging evolution of systemic pneumatosis in air embolism post-endoscopic retrograde cholangiopancreatography. A: Esophageal echocardiography suggests intracardiac pneumatosis; B: Pneumatosis is present in the right chest, back and abdominal wall, mediastinum, right pleural cavity, liver parenchyma, adjacent to the inferior vena cava, retroperitoneum, around the right kidney, right groin and scrotum, and proximal right thigh; C: Magnetic resonance imaging of the head indicates ischemic-hypoxic brain injury; D: Echocardiography suggests a reduction in intracardiac pneumatosis compared to previous; E: Pneumatosis in the original areas of the right chest, back and abdominal wall, mediastinum, right pleural cavity, adjacent to the inferior vena cava, retroperitoneum, and around the right kidney has essentially disappeared, while pneumatosis in the right groin and scrotum has decreased compared to previous.

#### DISCUSSION

The occurrence of air embolism in this patient was likely multifactorial, with significant contributions from surgical history and the procedural aspects of ERCP. The patient had previously undergone a Whipple procedure (pancreaticoduodenectomy), which typically involves extensive manipulation of the retroperitoneal space. This surgical intervention can lead to adhesions between the intestines and surrounding tissues, placing them in close proximity to major vascular structures such as the inferior vena cava. These adhesions may have created a conduit for air to enter the venous system during the ERCP procedure[3].

Additionally, the patient's history of pancreatic malignancy with multiple liver metastases could have exacerbated the risk of air embolism. Tumor invasion or metastatic deposits near the inferior vena cava might compromise the integrity of the vascular wall, although direct invasion of the tumor into the vena cava, as theorized, would likely present with significant bleeding, which was not observed in this case.

During ERCP, the introduction of positive pressure air to improve visibility and cleanse the ducts is a routine practice. However, in patients with altered anatomy due to previous surgery, such as the Whipple procedure, there is an increased risk that air could inadvertently enter the venous system[4]. In this case, it is hypothesized that air entered through incomplete anastomoses between the pancreatic and bile ducts or through abnormal channels created by surgical adhesions. Once in the biliary system, the air could have traveled through the hepatic veins into the inferior vena cava, subsequently reaching the right side of the heart.

Ultrasonography confirmed the presence of air predominantly in the right side of the heart, supporting the theory of venous air embolism originating from the inferior vena cava. The accumulation of air in the retroperitoneal and right abdominal areas further supports this pathway.



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In the echocardiogram (Figure 1D), an echogenic area was observed posterior to the heart, which may correspond to the presence of air in the pericardial or surrounding thoracic structures. This finding is consistent with the spread of air embolism through the venous system and its subsequent accumulation in both cardiac and extracardiac compartments. The presence of air in these areas suggests that the embolism was extensive, involving not only the intracardiac chambers but also the pericardium and possibly adjacent mediastinal structures. This observation corroborates the hypothesis that air entered through the inferior vena cava and dispersed throughout the thoracic cavity, including pericardial and mediastinal spaces.

#### CONCLUSION

Post-ERCP air embolism is a rare but well-known adverse event, with an incidence rate of 3.32 cases per 100000 procedures [5-7]. Hyperbaric oxygen therapy is an effective treatment for such air embolisms, promoting gas reabsorption to reduce the volume of air embolisms, thereby minimizing bubbles, alleviating cerebral edema, reducing endothelial damage caused by bubble-induced platelet aggregation, accelerating the reabsorption of nitrogen, preventing the release of free radicals, and increasing blood oxygen concentration to enhance tissue oxygenation and mitigate ischemic reperfusion injuries[8]. Administering hyperbaric oxygen therapy within the first 5 hours can substantially enhance the likelihood of achieving a complete recovery.

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#### FOOTNOTES

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