

# Systemic air embolism during endoscopic retrograde cholangiopancreatography with myocardial and cerebral ischemia

Damir Mihic, Lana Maričić, Domagoj Loinjak

## ABSTRACT

**Introduction:** Endoscopic retrograde cholangiopancreatography (ERCP) has become the primary tool for the treatment of biliary and pancreatic stone diseases. Systemic air embolisms are a rare, but often a fatal complication of ERCP. **Case Report:** We present a 56-year-old woman, who was hospitalized for routine, elective ERCP due to recurrent cholangitis. The procedure complicated by development systemic air embolism with myocardial and cerebral ischemia. A transesophageal ultrasound was confirmed patent foramen ovale (PFO). Magnetic resonance imaging (MRI) of brain was done and it showed numerous zones of relatively fresh ischemic lesions through both hemispheres of the brain. The patient has survived but with serious consequences. One year after the incident, the patient presented with paresis of the right hand, walking with the assistance. **Conclusion:** Systemic air embolism presents a rare, but life-threatening complication, particularly with persons at an increased risk, that is, with a left-to-right shunt.

**Keywords:** Air embolism, Cerebral ischemia, Endoscopic retrograde cholangiopancreatography, Myocardial infarction

Damir Mihic<sup>1,2</sup>, Lana Maričić<sup>2,3</sup>, Domagoj Loinjak<sup>1,2</sup>

**Affiliations:** <sup>1</sup>MD, Department of Internal Medicine, University Hospital Osijek, Osijek, Croatia; <sup>2</sup>Faculty of Medicine, University J.J. Strossmayera Osijek, Osijek, Croatia; <sup>3</sup>MD and PhD, Department of Internal Medicine, University Hospital Osijek, Osijek, Croatia.

**Corresponding Author:** Lana Maričić, Department of Internal Medicine, University Hospital Osijek, J. Huttlera 4, Osijek, Croatia; Email: dr.lmaricic@gmail.com

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## INTRODUCTION

Endoscopic retrograde cholangiopancreatography has become the primary tool for the treatment of biliary and pancreatic stone diseases. It is essential for the endoscopist carrying out the ERCP to have a thorough understanding of the potential adverse events. Systemic air embolisms are a rare, but often a fatal complication of ERCP. Risk factors associated with air embolisms in this setting include situations where the mucosa is damaged or where high pressure is generated in the gastrointestinal tract [1]. In the systematic review in the PubMed database, air embolism after endoscopy is found in 60% of patients who underwent ERCP. In 46% of documented echocardiography, a PFO has been confirmed as the mechanism of paradoxical air embolism. Only 55% of patients survived systemic air embolism [2].

## CASE REPORT

A 56-year-old woman was hospitalized for routine, elective ERCP due to recurrent cholangitis. The patient in question had previously undergone cholecystectomy and had been subjected to ERCP two times because of repeated episodes of cholelithiasis, the last time was two years ago. Preoperative assessment was done neatly, and

as an introduction to anesthesia the patient was given premedication (fentanyl, propofol, and rocuronium). Fifteen minutes after the beginning of the procedure, a sudden drop of blood pressure occurs and the saturation of arterial blood with oxygen decreases to 65%, the end-tidal carbon dioxide ( $\text{CO}_2$ ) drops, accompanied by the loss of peripheral and central pulsations. Cardiopulmonary reanimation according to the Advanced Life Support (ALS) protocol was initiated, after which palpable peripheral pulses were achieved, accompanied by vasoactive support. A computed tomography (CT) of the brain and a CT pulmonary angiography were done at once. During the procedure, the blood pressure dropped again and cardiopulmonary reanimation was conducted again. After 10 minutes, there was a pulse rate of about 100/min, the patient was hemodynamically stable and the  $\text{O}_2$  saturation of 90% was restored. The CT angiography showed a considerable amount of gas within the right atrium and the ventricles, a minimal amount inside the pulmonary trunk, and a somewhat smaller amount inside the ascending aorta. The CT of the brain confirmed, along the left hemisphere of the brain, primarily subdural, clusters of gas content (Figure 1). Immediately, a central vein catheter was placed into the right internal jugular vein and an air aspiration under the ultrasound control is attempted. During the following course of hospitalization, the patient was placed into the intensive care unit. All the time, she was ventilated with 100% oxygen, held in left lateral position together with Trendelenburg position. The patient underwent transthoracic cardiac ultrasound which confirmed preserved systolic function left ventricular ejection fraction (LV EF) 60%, aneurysm of interatrial septum, which expanded to the right atrium. A transesophageal ultrasound of the heart was made and hereby a PFO was detected (Figure 2). An electrocardiography was showed ST elevation in inferolateral leads (Figure 3), also cardiac enzyme levels were noted (CK 6285 U/L, CK-MB 571 U/L, troponin I 647.262  $\mu\text{g/L}$ ). Coronarography did not confirm significant stenosis of epicardial arteries. The following day, an MRI of brain was done and it showed numerous zones of relatively fresh ischemic lesions through both hemispheres of the cerebellum, through both hemispheres of the brain, as well as in the area of basal ganglia on the left side (Figure 4). The distribution of the lesions was dominantly cortical. During the next few days, the patient was unconscious, mechanically ventilated in volume controlled-synchronized intermittent mandatory ventilation (VC-SIMV) mode, treated with the vasoactive and anti-edematous therapy. On the ninth day of the hospitalization, the patient was removed from the mechanical ventilation. Gradually, the recovery of the patient and the level of consciousness were monitored, followed by considerable psycho-organic changes. The further treatment of the patient was continued by carrying out neurorehabilitation, and after two months there was a remaining tetraplegia, with a mild motoric dysphasia. The patient was still undergoing a neurorehabilitation

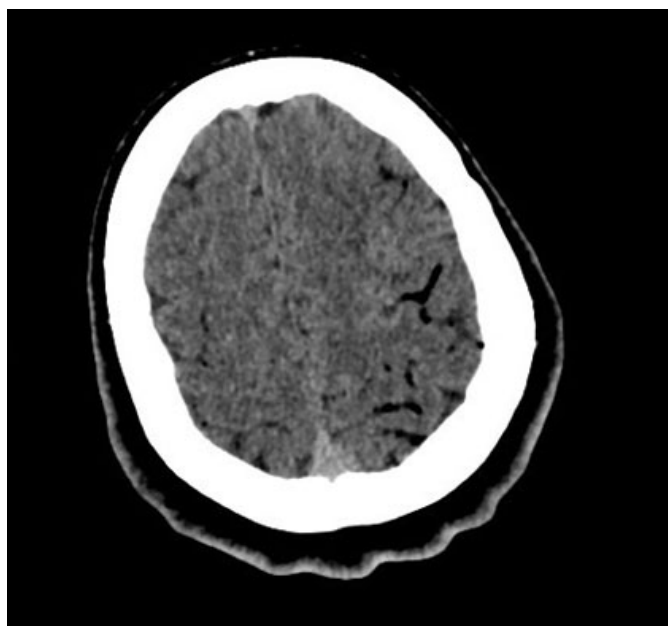


Figure 1: Computed tomography (CT) of the brain-subdural accumulations of the air in the area of the left hemisphere.

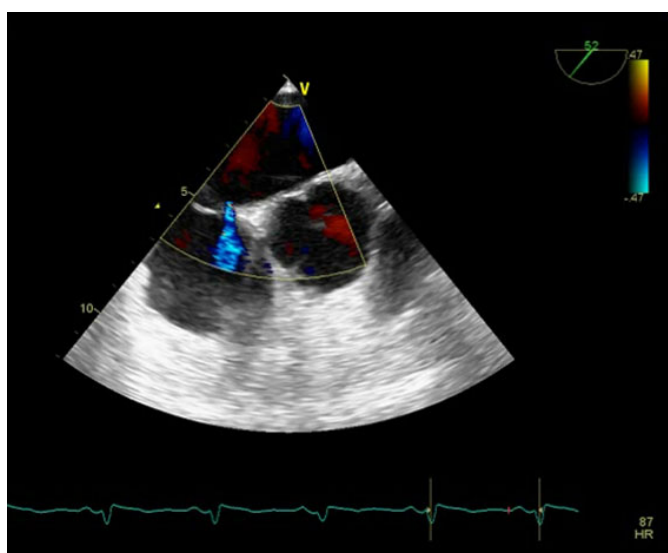


Figure 2: Transesophageal ultrasound (TEE) view-patent foramen ovale.

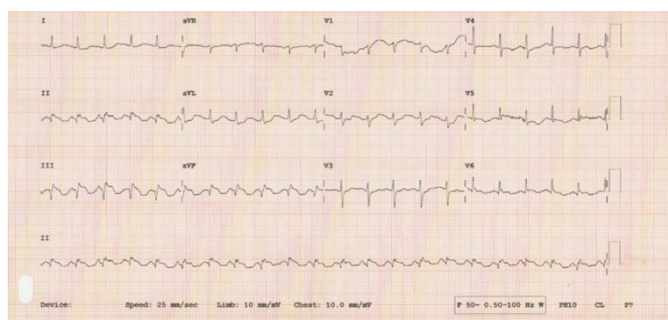


Figure 3: Twelve-lead electrocardiogram show ST elevation in inferolateral leads.

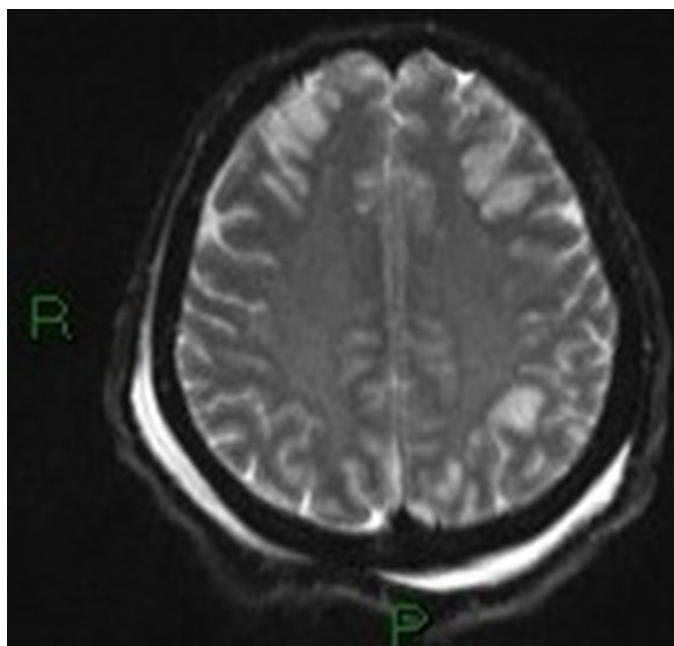


Figure 4: Magnetic resonance imaging (MRI) of brain shows numerous zones of ischemic lesions through both hemispheres of the cerebellum, through both hemispheres.

treatment in a specialized institution. One year after the incident, the patient presented with paresis of the right hand, walking with the assistance.

## DISCUSSION

We presented a case of systematic air embolism, which affects arterial and venous system, with an ensuing development of cerebral ischemia and acute myocardial infarction in a patient with a previously unknown PFO, who was subjected to ERCP. Until now, around 30 cases have been published in which air embolism occurred as an ERCP complication. Half of the described cases ended with a fatal outcome [3, 4]. The cases which dealt primarily with air embolism that affects cerebral arteries have been described and in one case it was a massive one, with a simultaneous development of cerebral and cardiac ischemia [5]. Unlike our case, the patient did not undergo an echocardiographic treatment, nor was the PFO confirmed. Based on the described cases, the age and the attached comorbidity of the ill person did not pose a significant risk factor for developing air embolism, but the existence of a left-to-right shunt, that is, the arteriovenous junction, is definitely a very important risk factor. The concurrent entrainment of the arteriovenous circulation is almost impossible, unless there is a left-to-right junction. Considering the severe consequences of the systemic air embolism, which in a large number of cases can be fatal, it can be concluded that the prevention and the preparation for the procedure might reduce mortality to a certain extent. Patent

foramen ovale is found in 20% of general population, and it is in these patients that the risk of fatal outcome and serious consequences is greatest [6]. So, the question arises whether, as a part of the preparation for an EPRC, a transesophageal ultrasound of the heart should be done in order to detect the existence of a left-to-right shunt [7]. The American Society for Gastrointestinal Endoscopy issued a recommendation for the application of CO<sub>2</sub> with the purpose of insufflation instead of air, especially concerning persons at an increased risk for air embolism and perforation [8].

## CONCLUSION

Systemic air embolism presents a rare, but life-threatening complication, particularly with persons at an increased risk, that is, with a left-to-right shunt.

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## Author Contributions

Damir Mihic – Conception of the work, Design of the work, Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Lana Maričić – Conception of the work, Design of the work, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Domagoj Loinjak – Conception of the work, Design of the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

## Guarantor of Submission

The corresponding author is the guarantor of submission.

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None.

## Consent Statement

Written informed consent was obtained from the patient for publication of this article.

## Conflict of Interest

Authors declare no conflict of interest.

### Data Availability

All relevant data are within the paper and its Supporting Information files.

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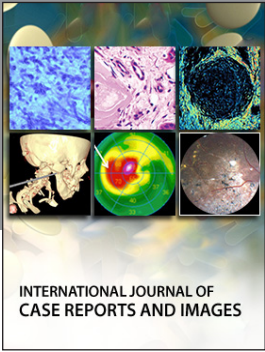
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