# THE AIR THAT COULD KILL:
# A CASE REPORT OF A SYSTEMIC AIR EMBOLISM POST SINGLE PORT LAPAROSCOPIC CHOLECYSTECTOMY and INTRAOPERATIVE ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY

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## Introduction

Air embolism is a rare but potentially fatal manifestation which may result from a variety of procedures and clinical scenarios. This condition occurs when air or gas is introduced into the vascular system which can arise iatrogenically via interventional procedures such as laparoscopic cholecystectomy and endoscopic retrograde cholangiopancreatography (ERCP).[1]

ERCP is a commonly performed procedure used for both diagnostic and therapeutic purposes including the assessment of the pancreatobiliary system, endoscopic sphincterotomy for treatment of choledocholithiasis, and placement of biliary duct and pancreatic stents. The most common complications encountered with this procedure include pancreatitis (3.5%), infection (1.4%), gastrointestinal bleeding (1.3%), and perforation (0.6%). Air embolism following ERCP is a rare complication, with only a total of 26 documented cases reported up to this day.[2] The physiologic effects that result with this condition depend on the volume of air that has entered the system and the patient's symptoms may range from asymptomatic to cardiovascular collapse and death.

## Case Report

This is the case of a 69-year-old, female who was admitted for a one-week duration of tea-colored urine associated with intermittent crampy epigastric pain, non-radiating that would spontaneously resolve without intervention. There was no jaundice, icterisia, fever or vomiting. The patient is a known dyslipidemic on Atorvastatin 20mg 1 tablet once a day with ischemic heart disease on Clopidogrel 75mg 1 tab once a day. Hypertension is noted on both sides of the family. The patient is a non smoker and non alcoholic beverage drinker. Complete blood count of the patient was normal with a hemoglobin level of 14 g/dL. Liver function test were all normal except for the SGPT, at 138 U/L which was 2.5x elevated than the upper normal limit. Amylase and lipase were also requested which was normal. Other laboratory results were unremarkable. ECG showed normal rate with sinus rhythm.

The patient sought consult with her attending physician and was worked up. An MRI of the Upper Abdomen with MRCP was done revealing at least four calculi within the distal common bile duct (CBD), measuring 0.3 to 0.4 cm in diameter causing a mild upstream extrahepatic and intrahepatic biliary ductal dilatation with the CBD measuring 0.9 cm in diameter. The gallbladder was noted to be distended with innumerable gallstones measuring up to 1.0 cm with at least 2 gallstones measuring 0.9 and 1.0 cm lodged in the gallbladder neck. There was also note of mild diffuse gallbladder wall thickening, probably secondary to cholecystitis. The patient was then advised for admission.

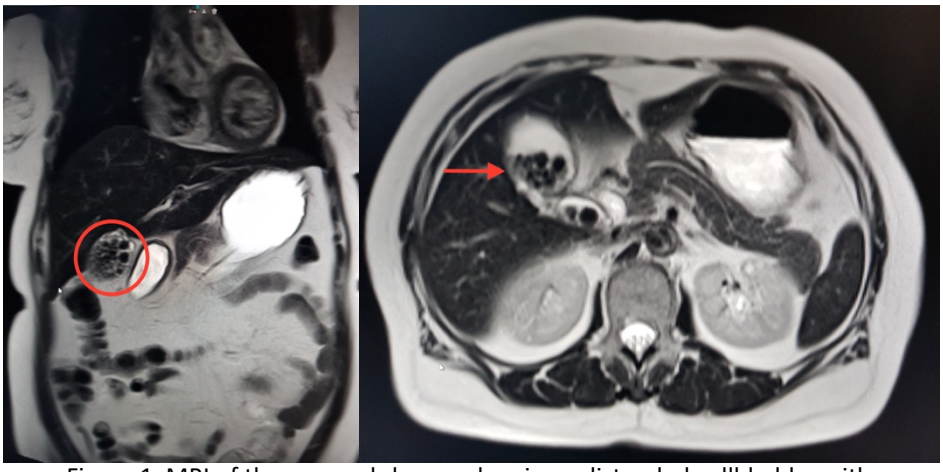

Figure 1. MRI of the upper abdomen showing a distended gallbladder with innumerable stones.

Figure 2. MRI of the Upper Abdomen showing the common bile duct with calculi.

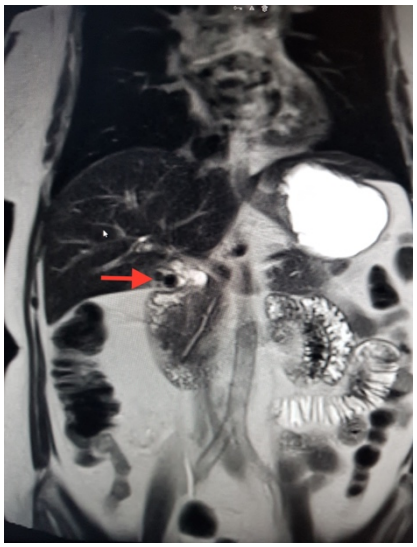

Figure 3. MRI of the Upper Abdomen showing the gall bladder neck bile with calculi.

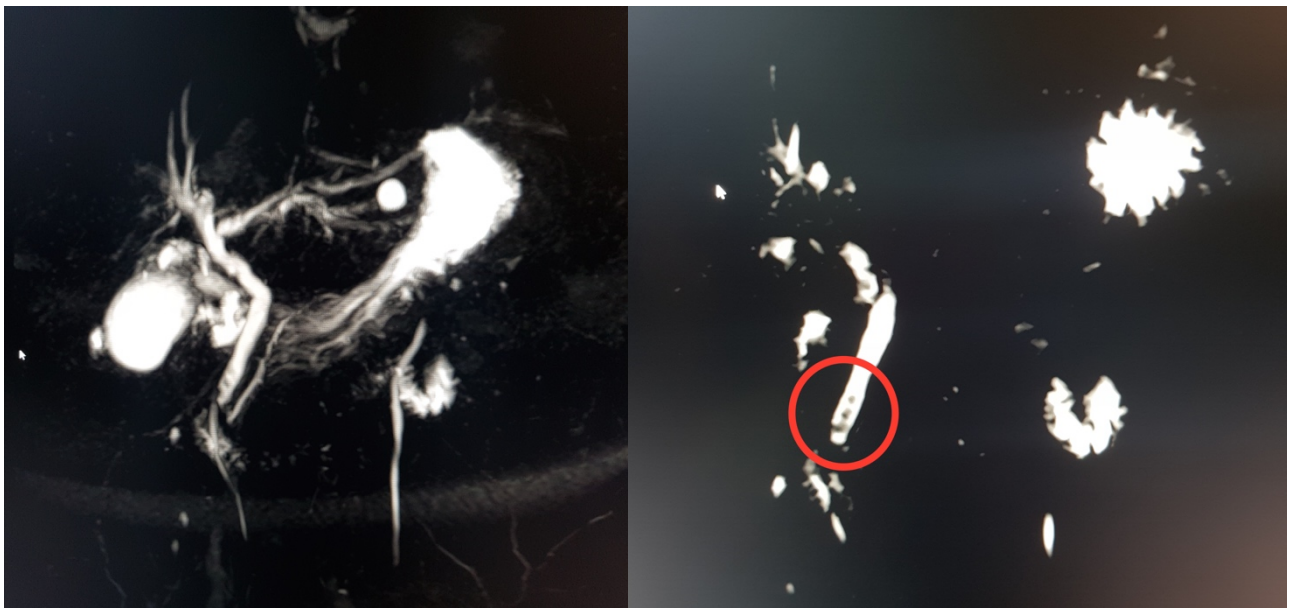

Figure 4. MRCP showing the pancreatobiliary tree with calculi noted at the distal common bile duct.

On the first hospital day, the patient was started on Ciprofloxacin 200 mg IV given every 12 hours. ERCP under IV sedation with midazolam, fentanyl and propofol was done the following day, where selective cannulation and opacification of the biliary tree showed a mildly dilated bile duct approximately 1.1cm in diameter with no filling defect. Biliary exploration was done after sphincterotomy of 0.8 cm which yielded no stones. The pancreatic duct was not cannulated. At this point, spontaneous stone passage was entertained.

The patient tolerated the procedure well with stable vital signs without abdominal pain or dyspnea. The duration of the procedure was twelve (12) minutes.

The patient was then referred to surgery for evaluation and co-management and a single port laparoscopic cholecystectomy with intraoperative cholangiogram under orotracheal general anesthesia was then scheduled on the third hospital day. The patient was induced using fentanyl, propofol and sevoflurane. Cholecystectomy was done with removal of the gallbladder containing close to 100 brownish black pigmented stones ranging in size from 0.1 to 1cm; the gallbladder wall was thickened. Intraoperative cholangiogram revealed three (3) filling defects at the distal common bile duct with good egress of bile (contrast) into the duodenum.

Figure 5. Post operative image of the gallbladder with innumerable stones.

Immediately post op, the patient was referred for intraoperative ERCP. ERCP was done with the patient assuming the left lateral position. The common bile duct (CBD) was selectively cannulated using a sphincterotome-guidewire system. Sphincterotomy was extended by 3mm (from approximately 0.8cm to 1.1cm) with subsequent evacuation of three (3) brownish black pigmented stones using a balloon extractor. Post-stone extraction cholangiogram showed no filling defects with good egress of bile and contrast. Duration of the intraoperative ERCP with stone extraction was fifteen (15) minutes.

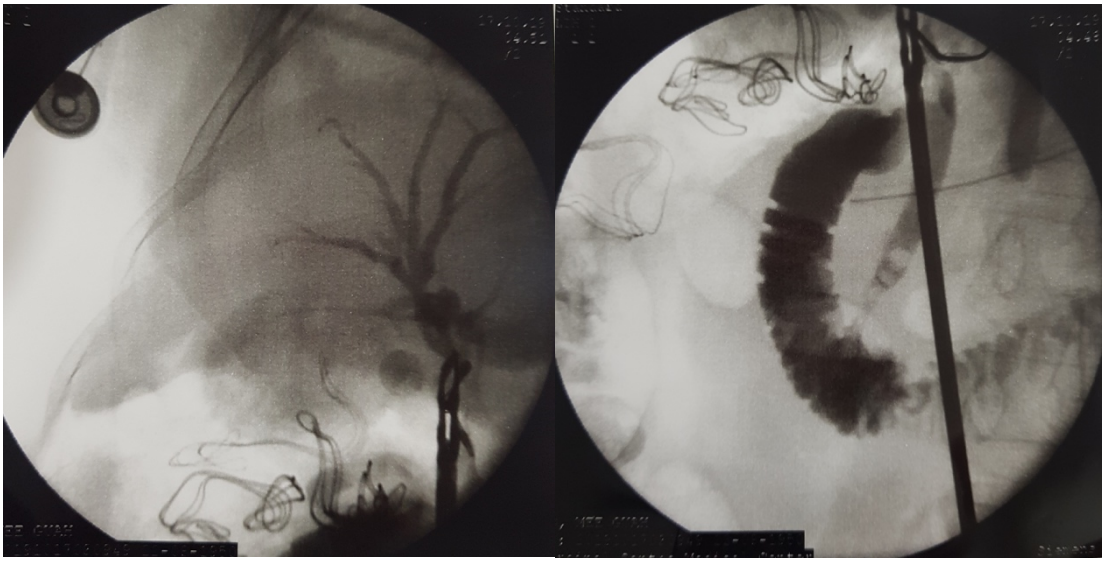

Figure 6. Intraoperative cholangiogram images showing a dilated biliary tree with intraluminal calculi noted at the common bile duct.

Post-ERCP, the patient was put on supine position from left lateral position. Almost instantaneously, within a matter of less than 30 seconds, blood pressure was unappreciable (no BP on cardiac monitor), no end tidal CO2 was appreciated, no peripheral or neck pulses were palpated and ECG showed sinus bradyarrythmia with pauses of eight (8) seconds noted. Patient was assessed to have near cardiopulmonary arrest secondary to post procedural air embolism. The patient was immediately placed on head-down position and aggressive fluid resuscitation was instituted (fast drip of 150ml of IV fluid), and epinephrine 3ml of 1:200,000 bolus was given. After two (2) minutes ECG reading on the cardiac monitor began to show sinus arrhythmia. Pulse was eventually appreciated then became more palpable. Blood pressure readings picked up initially at 40 systolic then increased to 60/40 mmHg, and eventually elevated to 80/50 mmHg until patient became normotensive. End tidal CO2 eventually became normal too. Patient was monitored at the recovery room, extubated and hooked to nasal prong for oxygen support at 3 lpm and transferred back to regular room after five hours with note of stable vital signs.

At the regular room, oxygen support was eventually decreased to 2 lpm via nasal prong maintaining an oxygen saturation of 95%. The patient was referred to pulmonary service for co-management. A chest x-ray and arterial blood gas was requested which revealed accentuation of the pulmonary markings with perivascular haziness representing pulmonary congestion and edema and fully compensated respiratory alkalosis with moderate hypoxemia (po2 67.3mmhg), respectively. Oxygen support was increased to 4.5lpm and diuresis with Furosemide 20mg IV relieved the patient of her difficulty of breathing. A 12 lead ECG was requested and revealed sinus tachycardia with a heart rate of 107. Venous duplex scan of the lower extremities done showed no evidence of acute proximal deep vein thrombosis; deep vein valve reflux of the femoral vein, popliteal vein, peroneal vein and anterior tibial vein; superficial vein valve reflux of the greater saphenous vein and an incompetent sapheno-femoral junction on the right lower extremity; venous duplex scan of the left lower extremity revealed chronic partially occlusive superficial vein thrombosis of the greater saphenous vein; deep vein valve reflux of the common femoral vein, femoral vein, popliteal vein posterior tibial vein, peroneal vein and anterior tibial vein and an incompetent sapheno-femoral junction.

On the 4th hospital day, oxygen saturation of 98% was noted at 4lpm, oxygen support was then decreased to 2 lpm via nasal prong and incentive spirometry was initiated. No recurrence of desaturation was noted thereafter and on the 6th hospital day, oxygen support was discontinued. On the 7th hospital day, the patient was discharged apparently well with the following vital signs, BP 120/70, heart rate 80, respiratory rate of 17 with oxygen saturation of 98% at room air.

A week after discharge, the patient was seen during follow-up, asymptomatic with good functional capacity.

**Discussion**

Endoscopic retrograde cholangiopancreatography is widely used in both diagnosis and treatment of pancreatic and biliary diseases. Complication rates of ERCP vary from 5-10%.[2] Common complications of ERCP, which are generally easily recognizable include acute pancreatitis, bleeding, perforation, and infection. However, rare complications such as air embolism can also occur which can be fatal and difficult to detect. Tran et al., in their review article mentioned 41 cases of air embolism following various endoscopic procedures with more than 60% of those cases were related to ERCP, of which 12 had a fatal outcome.[2]

Medina et al., in 2018 emphasized that in a systematic review of 41 cases of air embolism secondary to endoscopic procedures, only 26 cases were reported secondary to endoscopic retrograde cholangiopancreatography up to this day.

Air embolism is a result of the direct communication between a source of air and the vasculature and a pressure gradient favoring the passage of air into the circulation. The effect of an air embolus depends upon both the rate and the volume of air introduced into the circulation. Many cases are subclinical with no adverse outcome.[3] Potential deleterious outcomes include arrhythmias, hypotension, myocardial ischemia, acute right heart failure, hypoxia, cyanosis, jugular engorgement, ocular deviation, mydriasis, altered consciousness, hypertonicity, hemiparesis, cerebral edema, coma and death.[4]

In this case the patient presented with a one-week duration of tea-colored urine associated with intermittent crampy epigastric pain, non-radiating that would spontaneously resolve without intervention. The MRI of the Upper Abdomen with MRCP revealed at least four calculi within the distal common bile duct (CBD), causing a mild upstream extrahepatic and intrahepatic biliary ductal dilatation with the CBD measuring 0.9 cm in diameter. The gallbladder was distended with innumerable stones, with at least 2 gallstones lodged in the gallbladder neck. No stones were noted during the first ERCP. This raised the issue of whether the stones spontaneously passed out or were missed by the endoscopist. In a very recent study, Sejpal et al., mentioned that occlusion cholangiogram can miss residual stones in up to 11%-30% of cases, especially in the setting of a dilated bile duct. Missed bile duct stones can lead to recurrent biliary symptoms, pancreatitis, cholangitis, and can have significant cost implication with the need for repeat imaging and/or procedures,[5] and accompanying inherent risks and complications associated with ERCP.

Medina et al in 2016 in their paper entitled “Case report of a pulmonary air embolism secondary to endoscopic retrograde cholangiopancreatography in a liver transplant patient” cited that associated risk factors for air embolism include previous endoscopic or surgical intervention of the biliary tree, transjugular intrahepatic portosystemic shunts (TIPS), closed or penetrating liver trauma, inflammatory processes of the digestive tract (pylephlebitis, hepatic abscesses, inflammatory bowel disease, necrotizing enterocolitis, mesenteric ischemia), postoperative gastrointestinal fistula, gastrointestinal neoplasms, atresia of the biliary tract, interventional procedures (cholangioscopy, biliary sphincterotomy, percutaneous hepatic drainage, metallic biliary stent), liver biopsy, high-volume air insufflation and/or high pressure at site of a procedure above the level of the heart, and the use of nitrous oxide. Insufflation with carbon dioxide ($CO_2$) instead of air decreases the risks of air embolism as $CO_2$ is absorbed more quickly and easily.[4]

Wenham noted that air embolism is a rare but potentially lethal complication of many forms of surgery, especially posterior fossa neurosurgery where the incidence is reported to be up to 80% - but it can also occur

in laparoscopic surgery; the often catastrophic complication usually occurs early in the procedure during insufflation of the abdomen.[6]

The diagnosis of air embolism may be challenging because of its clinical presentation, which can overlap with sedation-related cardio-pulmonary problems or neurologic symptoms possibly attributed to an ischemic or hemorrhagic central nervous system event but with prompt recognition of this disease entity, it would allow us to institute potentially life-saving therapy.

**Conclusion**

ERCP is a commonly performed endoscopic procedure. Well-known associated adverse events include pancreatitis, bleeding and perforation. Gastrointestinal endoscopists need to be aware that air embolism, though rare, is a potential complication which is deemed the most catastrophic and lethal as it may lead to sudden cardiopulmonary death. A high index of suspicion should be maintained so that prompt and immediate action can be taken to address this potentially reversible life threatening complication.

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