

## TRAUMATIC PNEUMOBILIA AFTER CARDIOPULMONARY RESUSCITATION

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**Abstract:** Pneumobilia is a rare pathological finding, which denotes an abnormal connection between the gastrointestinal and the biliary tract. In the absence of surgically created anastomosis between the bowel and the bile duct, the most common causes for pneumobilia are gallstone obstruction, endoscopic interventions, or emphysematous cholecystitis. We present this case of a middle-aged multiple-injured male who developed traumatic pneumobilia after cardiopulmonary resuscitation. We suppose that chest compression in combination with a sphincter of Oddi (SO) dysfunction forced intraluminal air retrograde through the SO into the biliary tract, since intraabdominal injury as well as former biliary pathology, inflammation, or biliary-enteric fistula were excluded.

**Key words:** Cardiac arrest; Cardiopulmonary resuscitation (CPR); Chest compression; Pneumobilia;

### INTRODUCTION

Most cases of pneumobilia are related to gallstone ileus of the duodenum, to emphysematous cholecystitis, to surgically created anastomosis between the bowel and the extrahepatic biliary tract, or to endoscopic interventions [1, 5, 7, 16]. Only two case reports of hepatic parenchymal air and pneumobilia secondary to blunt abdominal trauma were presented in the literature up to now [7, 10]. Both pathological findings may denote a direct injury of the biliary tract, however, pneumobilia may be caused also by a sphincter of Oddi (SO) dysfunction [15, 18]. In case of smooth muscle hypotension of the SO air can reach from the duodenum into the biliary tract. We present this case of a middle-aged multiple-injured male who developed traumatic pneumobilia after cardiopulmonary resuscitation (CPR) and chest compression due to cardiac arrest during operation.

### METHODS / PATIENT

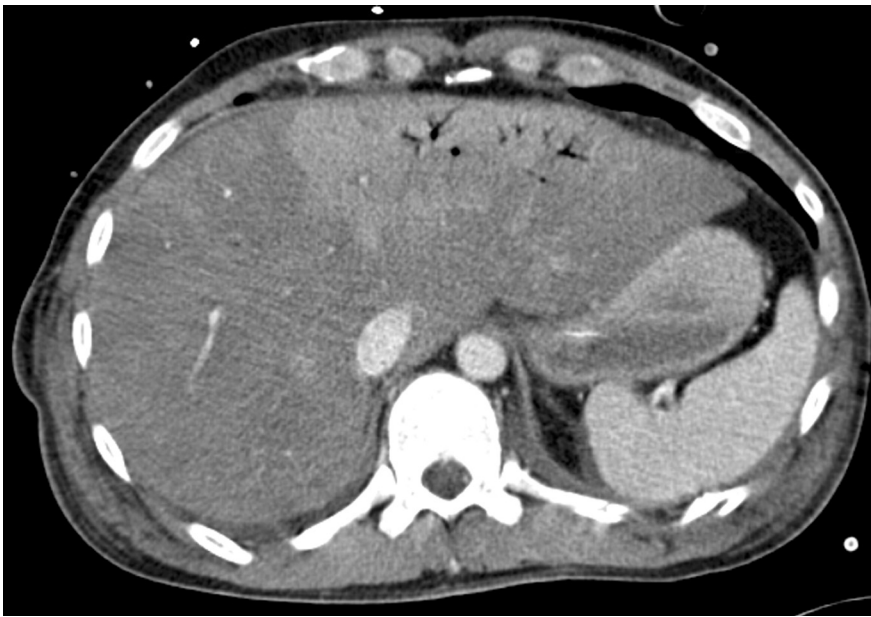
An alcoholised (alcoholhaemia 2,0 ‰) 50-year-old male was strucked by a freight train on his right side. On arrival of the EMS helicopter team 28 minutes after trauma the patient was unconscious with a Glasgow-Coma-Scale score of 3 points, his breathing was gasping, his mouth filled with blood and he was in a state of shock. After intubation, artificial ventilation and volume resuscitation, the patient was air-lifted and ad-

mitted 71 minutes after trauma to our level I trauma centre emergency room.

Primary clinical and computed tomography examination (Injury Severity Score 59; Revised Trauma Score 6.17; probability of survival according to the TRISS method 0.40 [3]) revealed a right frontal depressed skull fracture, a dislocated bursting fracture C3/C4, multiple rib fractures with a non-tension pneumothorax on the right side, bilateral pulmonary contusions, a total amputation of the right upper extremity, a grade 1 open fracture of the proximal right femur and a dislocated fracture of the right sacrum. After insertion of two computed tomography (CT)-guided chest tubes on the right side and temporary stabilization of the dislocated fracture C3/C4 with a stiff neck the patient was transferred to the operating theatre.

While the right femoral shaft fracture was provided with antegrade intramedullary nailing and the amputation stump of the right upper extremity was simultaneously debrided, the patient suddenly suffered from ventricular fibrillation. Spontaneous circulation returned three minutes after starting CPR with defibrillation, chest compression and administration of epinephrine in a dose of 2 mg intravenously. The operation was immediately interrupted and CT scans of the chest and the abdomen were reperformed due to ongoing deterioration of oxygenation. The former right pneumothorax was relieved, however, additional air in the left intrahepatic bile duct system was now detected (Fig. 1). Subsequent echocardiography showed a normal myocardial function without abnormalities of the wall motion. In the following days at the intensive care unit the patient was hemodynamically stable.

Four days after admission the air in the biliary tract had disappeared in the CT scan of the abdomen. Repeated serum amylase and liver enzyme measurements showed initial slightly increased values which during the course of the clinical treatment normalized and in the follow up CT scans there was still now evidence of a pancreaticoduodenobiliary injury. Therefore we didn't perform more diagnostic procedure such as ERCP or surgical exploration. C3/C4 dislocation fracture was stabilized with a titanium plate and an autologous iliac crest bone graft. Moreover, the right frontal depressed skull fracture was lifted. After four weeks of artificial ventilation the patient was transferred to a rehabilitation centre. Ultrasound and liver function tests



*Fig.1.* Spiral CT with intravenous contrast medium immediately after CPR and chest compression showing air in the left intrahepatic bile duct system.

three month after the trauma where normal. In a clinical evaluation 11 month after the patient was in good state of health complaining no gastrointestinal disorders.

#### DISCUSSION

The presence of pneumobilia usually denotes an abnormal connection between the gastrointestinal and the biliary tract. In the absence of surgically created anastomosis between the bowel and the bile duct, most cases of pneumobilia are related to gallstone disease [7]. Spontaneous biliary-enteric fistulas may develop if a gallstone erodes through the gallbladder wall to an adjacent viscus, i.e. stomach, duodenum, small bowel, or colon [2, 11]. The reported incidence of biliary-enteric fistula in patients with gallstones is between 0.4% and 3.5%, and only about half of these patients develop pneumobilia [8, 17].

Similar to surgically created anastomosis between the bowel and the biliary tract, endoscopic retrograde cholangiopancreatography with papillotomy or surgical transduodenal sphincteroplasty may disrupt the SO, and have been also reported to cause pneumobilia [9]. Finally, emphysematous cholecystitis as well as biliary-bronchial fistulas secondary to liver abscess were cited as possible, but quite rare reasons for developing pneumobilia [12, 16].

Diagnosis of pneumobilia is made by plain radiography, ultrasonography or CT. Linear branching or tubular radiolucencies in the central portion of the liver are suspicious in plain radiography. In ultrasonography air in the biliary tree may be seen as bright linear and branching echoes within the intrahepatic bile ducts. However, CT is by far the most sensitive and specific technique to diagnose pneumobilia. To our knowledge, only two cases of hepatic parenchymal air and pneumobilia secondary to blunt abdominal trauma has been presented in the literature [7, 10]. As also described in these reports, our patient had no history of gallstones or former surgery of the right upper quad-

rant, and revealed no gallstones in the CT examination. Therefore, gallstone disease could be ruled out as reason for pneumobilia.

Some authors discuss the SO dysfunction in combination with an increased intraabdominal pressure as possible reason for retrograde transition of air into the biliary tract [1, 13]. The additional passage of small gallstones may often lead to an increase of this SO dysfunction [14].

The principal SO functions are to prevent duodenum-to-bile-duct reflux and to regulate the bile and pancreatic juice flow. The dysfunction is a motor SO abnormality, which may result in a hypotonic or more commonly in a hypertonic sphincter [15]. The baseline occluding SO pressure is about 13 mmHg above the duodenal pressure [4]. The SO relaxation may be induced by cholecystokinin, secretin and parasympathetic stimulation, whereas sympathetic stimulation causes an increased pressure. Drugs intending to relax smooth muscles such as nifedipine or midazolam may also reduce the baseline SO pressure [6, 15].

In our case the initial CT scan revealed no signs of pneumobilia. During the first operation the patient suddenly suffered from ventricular fibrillation requiring immediate CPR. Obviously, chest compression during CPR, but not blunt chest or abdominal trauma, could be regarded as reason for pneumobilia, since the following CT scan suddenly showed air in the left intrahepatic bile duct system. It induced an increase of both the intrathoracic and the intraabdominal pressure without evidence of an air-filled stomach. In combination with a reduction of the baseline SO pressure intraluminal duodenal air may be forced into the biliary tract. Since abdominal parenchymal and hollow organs were not injured, we did not perform an exploratory laparotomy. To our opinion, repeated CT scans were accurate to exclude an abnormal communication between the biliary duct system or the gall bladder and the upper gastrointestinal tract so that we didn't perform further investigations such as ERCP or surgical exploration.

## CONCLUSION

For the first time, we report about traumatic pneumobilia after CPR due to cardiac arrest, since intraabdominal injury as well as former biliary pathology, inflammation, or biliary-enteric fistula were excluded. We believe that chest compressions leading to increased intraabdominal pressure in combination with SO dysfunction forced intraluminal air retrograde through the SO into the biliary tract. Clinical observation and repeated CT scans were reasonable alternatives to surgical exploration.

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