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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study | Age | Gender | PMHx History | Procedure (Time in mins) | Sedation | Endoscopy findings and intervention | Gas used (Air/CO2) | CT findings | Echo findings | SPO2 | Heart rate | Mentation | Outcomes |
| Fang et al. (2019)31 | 67 | Male | Cardiac CarcinomaPancreatic neuroendocrine tumor | EGD (12 mins) |  Midazolam 1mg Propafol 100mg | Anastomotic stoma 45 cm from the incisor teeth. Congestion, edema, anderosion in the mucous membrane of the anastomotic stoma were observed. | Air | Multiple air emboli in the left andright frontal and parietal lobes of the brain. Furthermore,there were diffused gas density shadows mainly at theedge of the liver | No Right-to-left shunt | Low (82%) | Brady | Loss of consciousness |  Paralysis of LUEWeakness of RUE |
| Akhtar et al. (2001)32 | 80 | Female | Not mentioned | EGD (21min) | Conscious sedation | Malignant stricture at the esophagogastric junction, along with a small esophagotracheal fistula | Not mentioned | Parenchymal air in the right hemisphere | No Right-to-left shunt | Low | Brady | Loss of consciousness | Vegetative state |
| Lopez et al. (2010)33 | 50 | Female | Hep CCirrhosisSheehan Syndrome | EGD | Awakened state | multiple esophagealvarices grade II without gastric varices. A rupture located at 30 cm from the incisor teeth was found | Not mentioned | sulcus pneumatosis in the right parietal lobe | Not mentioned | Low (65-80%) | Brady | Loss of consciousness | Died in the next 24 hours |
| Bai et. Al (2018)34 | 61 | Female | Not mentioned | EGD | Not mentioned | Esophageal varices with signs of recent bleedingBands were placed | Not mentioned | Pneumocephalus and ischemic infarctionof the right hemisphere | PFO with R-L shunt | Low | Brady | Loss of consciousness | Brain death |
| Chavalitdhamrong et al.(2013)35 | 66 | Male | Not mentioned | ERCP | Not mentioned | Not mentioned | Not mentioned | air emboli in pulmonary artery branches air in the cerebral arterial system | left-sidedintracardiac air and a patent foramenovale | Low | Brady | Loss of consciousness | Died after severe cerebral injury |
| Chavalitdhamrong et al.(2013)35 | 51 | Female | Pancreatic cancer | ERCP | Not mentioned | Not mentioned | Not mentioned | Not mentioned | Intra-atrial shunt | Low | Brady | Loss of consciousness | residuallower extremity deficits remained |
| Demaerel et al. (2003)36 | 80 | Male | Recurrent spinocellular carcinomapulmonary tuberculosis | EGD | No sedation | fresh blood noted in the pharynx wasattributed to the recent surgery | Not mentioned | Several areas of markedly decreasedattenuation compatible with air within the sulci of the right frontal lobe | Not mentioned | Low | Brady | Loss of consciousness | residual left hemiparesis. |
| Efthymiou et al. (2012)14 | 62 | Female | Not mentioned | ERCP | Conscious sedationMidazolam 3mg  Fentanyl 200mg | Mid common bile duct (CBD) stricture with biliary dilation upstream. | Not mentioned | Pneumocephalus | Patent foramen ovale | Low | Brady | Loss of consciousness | Persistent left hemiparesis |
| Nern et al. (2012)37 | 58 | Female | Possible Cholangiocarcinoma | ERCP | Midazolam 1 mgPropofol 180 mg | Bilateral biopsy of the hepatic ducts and stenting of thecommon hepatic duct | Air | Air within the subarachnoid spaces most likely corresponding to embolism ofsuperficial cortical veins predominantly within the right hemisphere including sinus sagittalis superior with venous congestion and brain swellingAbdominal CT scan showed aerobilia and an obstruction of the left portal vein due to the mass near the liver hilus | Patent foramen ovale | Low (89%) | Brady | Loss of consciousness | Died after sever cerebral injury |
| Goins et al. (2010)38 | 72 | Female | Cholangiocarcinoma | ERCP (20 mins) | General anesthesia propofol 50mg lidocaine 75mg rocuronium 5mgsuccinylcholine 60mg  | Not mentioned | Not mentioned | Not mentioned | large amount of trapped airwithin the right heart consistent with massive air embolism | Low (~50%) | Brady | Loss of consciousness | Not mentioned |
| Kjellberg et al. 201839 | 42 | Male | Not mentioned | EGD (7 mins) | Conscious sedationMidazolam | Biopsies from distal, middle and proximal esophagus taken | Not mentioned | Massive air embolism in the right hemisphere with slight reduced attenuation in the right parietal areaCT of the thorax was performed showing air around the whole length of the esophagus and small amounts of free air in the mediastinum behind the left atrium. | TTE: inconclusiveTEE: Not performed due to risk of complication | Low (90%) | Brady | Loss of consciousness | Minimal left spatial disability |
| Maccarone et al. (2011)13 | 45 | Male | Not mentioned | ERCP | Not mentioned | Visualized ampulla, cholangiogramshowed multiple filling defects in thecommon duct. | Not mentioned | Not mentioned | TEE: pulmonary outflow obstruction as well as a patent foramen ovale (PFO) | Not mentioned | Brady | Loss of consciousness | Not mentioned |
| Mcaree et al. (2008)40 | 69 | Male | Appendiceal adenocarcinoma | EGD |  | Distal erosive esophagitis from which biopsies were taken | Not mentioned | Numerous small hypodensities consistent withair are displayed in the frontoparietal region ofthe right hemisphere | No evidence of intracardiac air or shunt | Not mentioned | Brady | Loss of consciousness | Died 6 days later |
| Pandurangadu et al. (2012)41 | 71 | Male | Not mentioned | EGD | Procedural sedation | Esophageal biopsy and ablation of a duodenal arteriovenousmalformation | Not mentioned | Negative for any hemorrhage or infarct, but showed evidence of multiple air/gas emboli in the right frontal lobe and frontoparietal region of the brain | No PFO | Not mentioned | Brady | Loss of consciousness | residual left-sided hemiparesisand dysarthria |
| Pee et al. (2013)42 | 84 | Female | EsophagitisStrictures above 4cm hiatal hernia | EGD | Not mentioned | Esophageal strictureStricture was dilated with a “through the scope” CRE fixed wire esophageal balloon dilation cathetersmall linear tear was noted above the balloon | Not mentioned | Pockets of air in the right cerebral hemisphere, with slight hemorrhage in the basal ganglia. | Not mentioned | Not mentioned | Brady | Loss of consciousness | Died next day |
| Rabe et al (2006)43 | 87 | Male | Distal choledochalstenosisAdenoma of the distal bile duct | ERCP | Conscious sedation5 mg midazolam 50 mg pethidine | Stent was found to be partially obstructed and the obstructing debris were removed using a Dormia basket and balloon catheter | Not mentioned | air within the parenchyma of theright hemisphere of the brain | PFO with R-L shunt | Not mentioned | Brady | Loss of consciousness | Residual left sided hemiparesis |
| Rabe et al (2006)43 | 54 | Male | Chronic pancreatitisportal vein thrombosisCholedochal varices | ERCP | Not mentioned | Stenosis at and above the stent which was dilated usingballoon catheterA fistula was seen extending from the bile duct at theproximal edge of the stent into the cavernous vessels | Not mentioned | multiple large venous collaterals in proximity to the biliary system. | air in the right ventricle | Not mentioned | Brady | Loss of consciousness | Died same day |
| Raju et al. (1998)44 | 75 | Male | CADMICOPD | EGDx4 | Conscious sedationpentazocine 50 mgmidazolam 10 mg | Narrow stricture 6mm below the cricopharyngeusSecond stricture was encountered in the distal esophagus through which the endoscope could not be passed. A guidewire was passed through the distal stricture into the stomach. Over the guidewire 7, 9, and 11 mm Savary dilators were passed without any complications | Not mentioned | intravascular air bubbles in the distribution of the right middle cerebral artery; there was also cerebral atrophy, white matter disease, and an old infarction in the right parietal area | PFO with R-L shunt | Low (82%) | Brady | Loss of consciousness | peritonitis,septic shock, and death 2/2 persistant aspiration pneumonia |
| Rangappa et al. (2009)45 | 50 | Female | Not mentioned | ERCP(45 min) | fentanyl 100mg midazolam 2mgpropofol 150mg  | SphincterotomyStone extraction with a balloon catheter was successful after several attempts and widening of the sphincterotomy to approximately 2.5 cm.Stent placement in the CBD | Not mentioned | cerebral artery gas embolism predominantly inthe right hemisphereglobal cerebral edema with uncal and early tonsillar herniation | Air within the rightatrium with a 5-mm probePatent foramen ovale | Not mentioned | Brady | Loss of consciousness | Brain death 22hrs after procedure |
| Stabile et al. (2006)46 | 65 | Male | Not mentioned | ERCP |  Fentanyl 100mg propofol 160 mg | Calculus in the extrahepatic biliary tree | Not mentioned | intrahepatic air and massive cerebral air embolism with severe brain swelling | Not mentioned | Low (82%) | Brady | Loss of consciousness | Died 3 days later |
| Park et al. (2016)47 | 59 | Male | Gastric cancerBone metastasis | EGD | Midazolam 2mg | Esophageal stricture at EJ anastomotic ringBalloon dilatation was chosen to achieve nutritional support | Not mentioned | Hypodense lesions indicative of air bubbles that were seen predominantly in the right hemisphere | Not mentioned | Not mentioned | Brady | Loss of consciousness | Left sided hemiparesis |
| Park et al. (2016)47 | 69 | Male | Not mentioned | ERCP/Percutaneous biliary drainage | Midazolam 2mg | Multiple filling defects were found, and EPBD was performed to avoid bleeding due to pericholedochal varicesMultiple stones were removed with a hurricane balloon dilatation catheter, and a fully covered metal stent wasinserted to compress the varices. | Not mentioned | multiple wedge-shaped low-density regions in the right hemisphere(right middle, left anterior,and left posterior cerebral artery territories) | Not mentioned | Low (80%) | Brady | Loss of consciousness | Returned to baseline |
| Van boxel et al. (2010)48 | 82 | Male | GallstoneAcute cholangitis | ERCP (20mins) | Not mentioned | Not mentioned | Not mentioned | Transverse view showing air in the cerebralveins in all the cerebral territories of the right hemisphere and the middle cerebral territory of the left hemisphereCoronal view showing air in the sagittal sinus | Not mentioned | Low (70%) | Brady | Loss of consciousness | Not mentioned |
| Weber et al. 200349 | 54 | Female | Ovarian cancer w/ bone metsLeft hemiparesis | EGD | Not mentioned | Esophageal bleeding caused by perforated Barret's ulcer | Not mentioned | Air-isodense spots in both hemispheresCT of the mediastinum eight daysafter the detection of bilateral cerebralair embolism revealed next tothe Barret’s ulcer an air-isodenseesophageal second lumen leadingto the pulmonary veins next to theleft atrium | Normal on TEE | Not mentioned | Brady | Loss of consciousness | Returned to baseline |
| Zampeli et al. (2013)50 | 72 | Male | Cardiac adenocarcinoma w/ pulm mets(Radiotherapy) | EGD | Moderate sedation | Dilation with an over-the-scope balloon dilator | Not mentioned | Bilateral multifocal cerebral air embolism with air bubbles within the sagittal sinus, straight sinus, great vein of Galen, and the cerebral venous network of the cortex | Not mentioned | Not mentioned | Brady | Loss of consciousness | Died 24 hours later |
| Nayagam et al.51 | 56 | Male | Adenocarcinoma (new) | ERCP | Moderate sedation | StrictureAdenocarcinoma+ Whipple's procedure performed after | Not mentioned | Positive findings of air in brain parenchymal or pneumocephalus or presence of air in the cerebral artery  | No right to left shunt | Low | Brady | Loss of consciousness | Expired |

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