

The Anesthesia Incident Reporting System (AIRS) has been in operation for 10 years, with thousands of detailed reports and tens of thousands of reports letting us know that an anesthetic was associated with a complication. AIRS uniquely serves as a “canary in the coal mine,” giving our specialty a signal when there’s a rare event happening around the country. This case report describes a complication where prompt recognition of a rare event, and immediate action, can save a patient from severe morbidity or mortality. However, just like malignant hyperthermia, unless this is on the immediate differential, it can be easy to miss. We present this report as a reminder of an important consideration for a case that’s growing in volume and that occurs in patients who can be extremely ill, and in one of our most stressful areas – non-operating room anesthesia (NORA).

In this edition, we are going to review one of those rare events reported multiple times in 2010-2012. We published this report almost 10 years ago, and education on this complication has propagated through various publications and through the ABA’s MOCA Minute educational tool. Recognition of the risk for this complication has also driven changes in technique and technology for the underlying procedure.

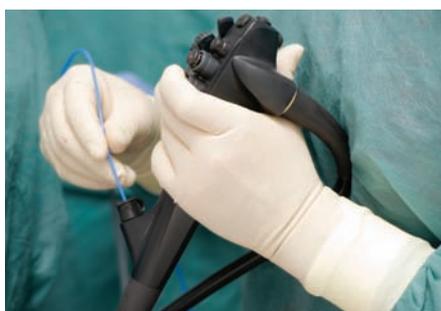
While AIRS can’t tell us the true incidence of a rare adverse event, we believe that the prevalence of this particular example has been reduced. When the original event was captured, a close search of AIRS revealed another half dozen cases that might have had a similar etiology; in seeking to revisit this issue in AIRS today, we found almost none.

An 80-year-old woman presented for endoscopic retrograde cholangiopancreatography (ERCP) for relief of gallstone pancreatitis. She had experienced one week of increasing abdominal pain, but no fever, chills, or hemodynamic instability. General anesthesia was induced with propofol and lidocaine, and the trachea was intubated following administration of succinylcholine. The patient was turned semi-prone for the procedure. Blood pressure remained stable at 110/70 and HR at 75 for the next hour. During removal of gallstones, EtCO₂ dropped suddenly from 35 to 5 mmHg. Pulse oximeter perfusion index fell immediately from 9 to 0.2, and noninvasive blood pressure and carotid pulse were unobtainable.

The patient was immediately turned supine. CPR was initiated and epinephrine was administered. After two minutes of CPR, the patient was pulseless with a narrow complex electrical heart rate of 32. CPR was con-

tinued and further epinephrine and calcium chloride were given. Arterial and central venous access were obtained, and vasopressin and sodium bicarbonate were administered. Heart rate increased and perfusion gradually returned over the next 10 minutes.

Transesophageal echocardiography demonstrated a small amount of residual air in the apex of the right ventricle. Subsequent abdominal CT scan showed air in the biliary tree as well. The patient was transferred to the intensive care unit and maintained on 100% oxygen for four hours. Sedation was reversed at 12 hours, emergence was uneventful, and the patient made a full neurologic recovery.



Endoscopic surgery is increasing steadily in volume and complexity. Anesthesia team participation in routine endoscopy is controversial, but value increases with sicker patients and longer and more technically challenging procedures (JAMA 2012;307:1178-84). ERCP represents a particular challenge because of competition for the airway, patient position (usually prone or semi-prone), longer duration, and concomitant use of fluoroscopy. Endoscopy suites are usually small and more cluttered than traditional ORs and may be remotely located. Necessary anesthesia equipment is harder to find, and the endoscopists and nurses are not as familiar with anesthesia issues as surgeons and nurses in the OR.

Review of cases submitted to AIRS in the past eight months reveals a disproportionately high number of incidents associated with less traditional operating environments, including the radiology and GI suites. Several events have been reported from ERCP cases, including difficulties with airway management, an unusual reaction to medication, and three cardiac arrests. Venous air embolus was suspected in one other case and was certainly the cause of arrest in this patient.

Pressurized air is used during endoscopy to distend the GI tract and allow anatomic visualization. Instrumentation of the biliary tract and laceration of the duodenal mucosa during ERCP can create false passages, allowing air to move from

the duodenum to the circulation. The incidence of asymptomatic air entrainment is unknown, but if too much air reaches the right ventricle, a “vapor lock” can occur, leading to sudden and complete loss of cardiac output. Systemic or paradoxical embolization to the cerebral circulation can occur through a patent foramen ovale, through right-to-left shunts, or by a large enough embolus that air transits the pulmonary circulation more rapidly than it can be cleared. Cerebral air embolus may present with hypertension, decreased level of consciousness, and focal neurologic symptoms even before circulatory deterioration.

Numerous case reports in the GI and anesthesia literature have described this phenomenon; a PubMed search of “ERCP and air embolus” yields multiple hits, including the first report of a patient death, in 1997 (Gastrointest Endosc 1997;45:187-8; Eur J Gastroenterol Hepatol 2010;22:1157-62; Minerva Anesthesiol 2012;78:622-5). A 2009 review article collected 13 cases from the world literature (Eur J Gastroenterol Hepatol 2010;22:1157-62). A subsequent review one year later increased this number to 19, and a paper dated May 2012 referenced 21 cases, suggesting that this is a rapidly emerging complication (Minerva Anesthesiol 2012;78:622-5). Numerous fatalities have been reported, and the outcome appears to be especially grim when cerebral embolization occurs.

Recommendations

Primary prevention of air embolus may not be possible, as the disruption of duodenal mucosa is happening at the microscopic level. Risk of air embolus is thought to be increased in patients who have had previous biliary procedures and in those with more extensive inflammation and scarring. Awareness of risk and vigilance for hemodynamic instability are recommended. Early detection of air entrainment might be possible with precordial Doppler technology, and use of carbon dioxide rather than air for distention might reduce the risk for symptomatic embolization. It is possible that positive pressure as opposed to spontaneous ventilation might also decrease risk, which

would be an argument for general anesthesia in these patients. Once symptoms of air embolus have been recognized, the ERCP should be immediately terminated. Hemodynamic support with fluids and pressors should be initiated. Specific recommendations for management include positioning the patient head down and turned to the left side (to trap remaining air in the apex of the right ventricle), aspirating air from the heart through a central catheter, and maintaining the patient on 100% oxygen to facilitate clearance of nitrogen bubbles. Hyperbaric oxygen therapy will shrink bubbles faster and may improve watershed perfusion of ischemic brain tissue, but hard evidence of benefit is lacking.

Conclusion – 2013

Advancing procedural technology can create new and unexpected risks for patients. This is especially true today with the increasing number and diversity of anesthetizing locations outside the OR. The range of procedures and patients in these areas is expanding rapidly, and norms for monitoring, anesthesia type, and patient selection are in the process of evolution. Vigilant monitoring, suspicion for risk, and the ability to rescue patients from distress are required for anesthesia practice in these new venues – maybe more so than in the main OR.

Conclusion – 2022

As noted above, the original publication of this item in the ASA Monitor and subsequent presentation in AQI-sponsored panels and educational sessions helped raise awareness of the risk among anesthesiologists. As a consequence, upper-GI endoscopy is now commonly done with CO₂, rather than air insufflation, which reduces the physiologic impact of embolized gas. Gastroenterologists have become more sensitive to this concern, with evolution of dissection equipment and technique designed to minimize creation of false passages. While difficult to prove, we believe that our profession’s heightened awareness of this risk has led to a substantial improvement in overall outcomes.

To all of our readers, and those who have submitted cases – thank you. You are improving the safety of our specialty. ■

Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to AIRS and authors a discussion of the safety and human factors challenges involved. Absence of commentary should not be construed as agreement with the clinical decisions described. Reader feedback can be sent to airs@asahq.org. Report incidents or download the AIRS mobile app at www.aqiairs.org.