Emboli, Air, in the Newborn

Description/Etiology
An air embolism (AE) is an air bubble trapped in a blood vessel, obstructing blood flow. AE in the newborn is a rare but life-threatening event that typically results in hemodynamic collapse, multiorgan failure, and death.

In order for an AE to form, two conditions must exist: there must be a direct communication between the vasculature and an air source (e.g., the lung or gastrointestinal tract) and there must be a pressure differential that favors the passage of air into the circulation rather than bleeding from the vessel. The most common cause of AE in newborns is positive-pressure ventilation, which can cause barotrauma to the lungs (e.g., alveolar rupture due to elevated transalveolar pressure), allowing for entry of air into the pulmonary vasculature. Other causes of AE in this patient population include necrotizing enterocolitis (i.e., a life-threatening condition characterized by acute mucosal necrosis of the intestines; for more information, see Quick Lesson About ... Enterocolitis, Necrotizing, in Premature Infants), surgical procedures (e.g., neurosurgery, cardiac surgery), medical procedures (e.g., umbilical vein and I.V. catheterization, epidural procedures, neonatal resuscitation, injections during resuscitation, peripheral I.V. infusion), and trauma.

There is no specific treatment for AE. Following initial resuscitation, intensive supportive care is provided, including careful monitoring, administration of medications and volume expanders, and lowering of ventilatory pressures as much as possible to allow the neonate's lungs to heal. Provision of emotional support to the parents/family members is critical and can be accomplished by allowing parents to hold or be physically close to their newborn, explaining all procedures and their purpose, and requesting a referral to a mental health clinician and social worker. Strategies for prevention of AE in the newborn include carefully following guidelines for neonatal resuscitation, minimizing airway pressures in mechanically ventilated patients to prevent pulmonary barotrauma, careful insertion of lines into the circulatory system, locking adaptors on all I.V. lines, filling I.V. tubing completely with solution, use of an air detection alarm on an I.V. infusion pump, and replacing leaking or open infusion systems.

Facts and Figures
AE in newborns is extremely rare; data on incidence are not available. Just 7 cases of AE in infants due to peripheral I.V. infusion have been documented in the English-language literature. AE is almost invariably fatal; there are just a few reported cases of patients surviving the condition.

Risk Factors
Risk factors for AE in the newborn include mechanical ventilation (usually due to respiratory distress syndrome; for more information, see Quick Lesson About ... Respiratory Distress Syndrome, Neonatal), necrotizing enterocolitis, insertion of central venous lines, intravenous injections, and cardiopulmonary resuscitation. Premature infants are at increased risk for developing ventilator-associated AE.
**Signs and Symptoms/Clinical Presentation**

Clinical signs of AE include dyspnea; palpitations; tachypnea; weak, rapid pulse; increased central venous pressure; hypotension; loss of consciousness; and cyanosis.

**Assessment**

› **Physical Findings of Particular Interest**
  - Air popping in the heart may be audible on chest auscultation

› **Laboratory Tests That May Be Ordered**
  - ABGs will indicate hypoxemia (which may be severe) and hypercapnia
  - Blood tests may reveal ↓ platelets and/or ↑ serum creatine kinase activity

› **Other Diagnostic Tests/Studies**
  - EKG likely reveals sinus tachycardia, right heart strain, nonspecific ST-segment and T-wave changes, and acute myocardial ischemia or infarction
  - X-rays may reveal the presence of air within intravascular structures; chest X-rays may show pulmonary edema
  - Echocardiograph may show one or more air bubbles within the heart chambers
  - CT scan may confirm the presence of AE in the heart chambers, peripheral vessels, and/or the vessels of the brain

**Treatment Goals**

› **Assist with Resuscitation, Carefully Monitor Patient, and Provide Intensive Supportive Care**
  - Assist with resuscitation, as appropriate
    – Administer supplemental oxygen, as prescribed
  - Continuously monitor vital signs and pulse oximetry, assess all physiologic systems, and review laboratory/diagnostic study results; immediately report abnormalities to the treating clinician
    – Carefully monitor ventilation and initiate changes in ventilatory pressure, as ordered
  - Administer blood volume expanders to correct hypotension
  - Administer prescribed sedatives, inotropics, and/or nitric oxide (NO), as ordered
    – Monitor treatment efficacy and for adverse effects of all medications administered
  - Suction gently, if ordered, as infrequently as possible to improve airway patency
  - Maintain conservation of heat within a neutral thermal environment
  - Closely monitor intake and output; provide parenteral nutrition, I.V. fluids, and/or blood transfusions, as ordered, and frequently assess for edema/other complications

› **Provide Emotional/Psychological Support and Educate**
  - Assess parent/family member anxiety level and coping ability; educate about AE in the newborn, potential complications, treatment risks/benefits, and individualized prognosis
  - Provide emotional support to the parents/family members and demonstrate how to hold or be physically close to the newborn; keep parents updated about the neonate’s status
  - Request referral, if appropriate, to a mental health clinician or clergyperson for supportive counseling and a social worker for identification of local resources or support groups for bereavement

**Food for Thought**

› AE may be underdiagnosed in the newborn for several reasons. Postmortem X-rays and autopsy may be unable to detect AE because intravascular air is rapidly absorbed and disappears within a half hour after death

**Red Flags**

› Signs of cerebral arterial gas embolism include seizure, focal, neurological deficits, depressed consciousness, and cardiac arrhythmias

**What Do I Need to Tell the Patient’s Family?**

› Provide parents with realistic, clear, and factual information about their newborn’s condition
  - Request referral to a clergyperson and/or mental health clinician for grief support and counseling, if appropriate
References


