

Letter to Editor

Venous air embolism in pediatric spine surgeries: Adrenaline as the magic bullet?

Shweta Naik¹, Parthasarathi Gayatri²

¹Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neurosciences, ²Department of Neuroanaesthesia and Neurocritical Care, Sagar Hospital, Bengaluru, Karnataka, India.

Dear Editor,

Venous air embolism (VAE) is a potentially life-threatening complication of many procedures with incidence in adults varying from 0.6% to 76%. The true incidence remains unknown in pediatric patients with occasional mention in case reports and case series. If unrecognized or misdiagnosed due to the overlap of clinical signs such as blood loss and hypotension, it can be associated with a fatal catastrophe.^[1] Cardiovascular collapse and arterial hypoxemia from air trapped in the right ventricular outflow tract and pulmonary arteries are the leading cause of death. In pediatric patients, the presence of undetected congenital heart disease additionally increases the risk of systemic embolism.^[2]

A 5-month-old child with diastematomyelia and split cord malformation from D12 to L4 was scheduled for surgical correction in prone position. Induction of anesthesia was uneventful and surgery was initiated following the prone positioning of the patient. During laminectomy removal of a chunk of bone led to a sudden significant blood loss, loss of plethysmographic signal, and low blood pressure. The resultant hypovolemia was treated with rushing of crystalloids and summoning of packed red blood cells (RBCs). The child worsened with bradycardia, decrease in end-tidal carbon dioxide, ST depression, and T wave inversion. The differential diagnosis which was considered was acute VAE, ongoing hemorrhagic shock, and cardiac depression due to electrolyte imbalances and drugs. Considering the sequence of events and stage of surgery acute, VAE was considered as priority and surgeon was informed to flood the surgical field with saline and control bleeding from the open epidural veins. The child was ventilated with 100% oxygen, intravenous atropine administered in the dose of 0.3 mg, along with ongoing fluid resuscitation. As there was no response to IV

atropine, we administered IV adrenaline in the dose of 10 micrograms (0.0015 mg/kg). This was followed by a dramatic improvement in all the hemodynamic parameters [Figure 1]. The rest of the surgery was uneventful and blood loss was treated with 150 mL of packed RBCs. The child was extubated and had a smooth recovery and post-operative course. Consent was provided by the child's parent for publication.

VAE in infants can be a potentially lethal complication during neurosurgeries due to its acute nature. The mortality is still high in pediatric patients where the physiological reserve and compensation are less compared to adults. A registry set up for reporting cases of VAE during spine procedures in the prone position, noted 9 (9/20) probable cases of VAE with eight deaths being children.^[3,4]

The management goal is firstly, to prevent entrapment at the point of entry which can be achieved by change in position and flooding the surgical field with saline. The next step is to reduce entry of air into the heart. Various therapies include use of oxygen therapy, increase in positive end-expiratory pressure, and aspiration of air from the right atrium with an existing central venous catheter. Finally, in event of cardiovascular collapse, fluid resuscitation and the use of inotropes and vasopressors have been advocated. In this setting, intravenous adrenaline is used as part of cardiopulmonary resuscitation, along with chest compressions in event of a cardiac arrest.^[2] Chest compressions are aimed at breaking the air lock at the ventricular outflow.

In this light, adrenaline in the lower doses has a role in each step. By increasing intravascular tone, it can prevent further entrapment of air at entry, by augmentation of inotropic effect it increases the intraventricular pressure and, thus, can cause breakdown larger air bubbles in the right ventricle to smaller ones displacing them to distal pulmonary vasculature and

*Corresponding author: Shweta Naik, Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India. neurodocms@gmail.com

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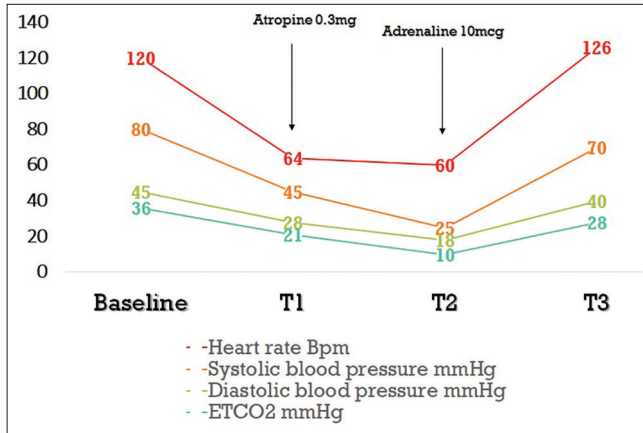


Figure 1: Hemodynamic changes in the intraoperative period. T1- Atropine administration, T2 - T1+ 1 min, T3 - T2+ 1 min.

can even prevent paradoxical embolism due to congenital shunts by increasing pressures in all four chambers of the heart.

With its ability to be able to work at all sites, intravenous adrenaline can be considered as a primary medication for treatment and prevention of further air entrapment, along with other supportive measures. Thus, can be described as a chemical bubble distractor, more so in pediatric cases where the time available for diagnosis and treatment is very small which can result in mortality. The use of adrenaline primarily as a treatment modality has not been described in literature to the best of our knowledge. However, the side effects of adrenaline administration in light of suspected cases such as cardiac arrhythmias, hypertension, and hyperglycemia should also be considered. Close monitoring is required during the administration of this drug.

VAE is a potentially life-threatening event. The incidence and severity can be decreased by the early diagnosis and prompt treatment. Early use of a potent inotropic agent like adrenaline can contribute to better patient outcomes.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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