Venous Air Embolism from Tisseel Use During Endoscopic Cranial Vault Remodeling for Craniosynostosis Repair: Case Report

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Introduction

Venous air embolism (VAE) is a potential complication during cranial vault remodeling that occurs as a consequence of air entry into the vasculature and requires early detection and prompt therapeutic intervention. The incidence of VAE has been reported to be as high as 82.6% during open cranioectomy for craniosynostosis repair(1). On the other hand, two separate studies reported a much lower incidence of VAE(1%) and 2%) during endoscopic strip craniectomy. As surgical advancements progress, there is a heightened emphasis on achieving hemostasis which has led to the use of fibrin sealants (Tisseel). We present a case where a VAE causing significant hemodynamic instability (grade III) ensued immediately following fibrin sealant (Tisseel) application(2).

Discussion

Infants undergoing craniosynostosis correction are at risk of sudden hemodynamic instability due to VAE and/or hemorrhage. The modified sphinx position prevents the head from being extended and the neck rested on the malar eminences so access to both the anterior and posterior fontanelles could be achieved. A precordial Doppler probe was used to monitor for venous air embolism. Correct probe placement was verified by rapid intravenous injection of 5ml of saline in a manner similar to that described by Faberowski et al(2). On the other hand, two separate studies reported a much lower incidence of VAE(1%) and 2%) during endoscopic strip craniectomy.

We report a case where Tisseel application at a close distance into an endonasal canal may result in air being forced into the venous sinuses. There are no previous reports of VAE during neurosurgical procedures following Tisseel application. This observation of hemodynamic instability during Tisseel use has led to multiple intra-hospital practice changes. During Tisseel application in endonasal repairs, doppler heart sounds are closely monitored, adequate distance from the tissue is adhered by the surgeons, use of carrier has been replaced by a manual syringe injection or aerozolization with low pressure (<5 psi), and Tisseel use is avoided when sinus injury is suspected. Early detection and awareness of this potential route for VAE entry can expedite therapeutic intervention and avoid serious complications.

Case Description

A 5 month old, 6.6 kg male presented for endoscopic cranial vault remodeling for sagittal craniosynostosis. General anesthesia was induced with propofol(3mg/kg) and fentanyl(4mg/kg). Neuromuscular blockade was achieved with vecuronium and the trachea was intubated uneventfully. A second PIV(20g) was placed for volume resuscitation and a radial arterial line was placed for close hemodynamic monitoring and blood gas analysis. The patient was positioned prone on the operating table with the head in a modified sphinx position. The neck was extended and the head rested on the malar eminences so access to both the anterior and posterior fontanelles could be achieved. A precordial Doppler probe was used to monitor for venous air embolism. Correct probe placement was verified by rapid intravenous injection of 5ml of saline in a manner similar to that described by Faberowski et al(2). We did not appreciate doppler tones characteristic of air entrapment during our case. This may be explained by Faberowski et al observation that air emboli are detected by doppler in only 48% of VAE. In addition, small air emboli (less than 0.25 ml) are often undetected by ultrasound.

For the completion of the surgical procedure and prior to skin closure, 4 ml of Tisseel was applied, to aid with hemostasis and blood loss with transfusion. Anesthesia was maintained with desflurane in oxygen/air mixture. Intravascular volume was maintained by gradually replacing the estimated deficit and blood loss with crystalloids and 5% albumin. At the conclusion of the surgical procedure and prior to skin closure, 4 ml of Tisseel was applied, to aid with hemostasis at an approximate distance of 5cm from the surgical site, with nitrogen as a propellant gas and a delivery device pressure of 15 pounds per square inch (psi). Immediately after Tisseel delivery, a sudden drop in blood pressure from 88/42 to 38/21 was noted. No change in the character of the doppler tones was heard. End tidal carbon dioxide dropped from 36 to 29, with no change in ECG tracing or pulse oximetry value. Surgeons were notified promptly and the surgical field was evaluated for open venous sinuses and was flooded with irrigation fluid. Minimal improvement of blood pressure was noted after administration of calcium chloride and 5% albumin. Epinephrine(0.5mcg/kg) was given 4.5 minutes into this episode with restoration of blood pressure. The duration of hemodynamic perturbations lasted 5 minutes. No metabolic derangements were noted on blood analysis. Patient received a total of 40cc of PRBCs for an estimated intraoperative blood loss of 100 ml. At the completion of the procedure, the trachea was extubated and he was admitted to PICU for close monitoring. On post-operative day two he was transferred to the floor with stable neurological status. Two days after his surgery, he was discharged home in stable condition.

Conclusion

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References