Anesthetic management of infant with dural sinus malformation and high-flow arteriovenous fistula

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Method Article

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Abstract

Dural sinus malformations are rare congenital vascular abnormalities with variable anatomical features, and the lateral subtypes with arteriovenous fistulas may be difficult-to-treat. A perioperative particularity is that occlusion of high flow shunts in small children can cause hypertension and stroke, due to sustained shunt-induced high cardiac output. Therefore, anesthetic management focused on hemodynamic stability is crucial to avoid complications. Herein we report a successfully treated case of a 3-month-old infant with dural sinus malformations and high-flow arteriovenous fistula, evolving with periprocedural hypertension.

Introduction

The dural sinus malformations (DSM) are rare congenital vascular abnormalities presenting variable anatomical and clinical features.\(^1\) There are two subtypes: a more common form in the midline, called torcular DSM; and a lateral subtype, involving the jugular bulb and related to high-flow arteriovenous fistula (AVF).\(^1\) Although embolization is the treatment of choice for pediatric AVF, it represents a challenge for the management team because the lesions are complex, and small changes in the hemodynamics affect patient morbidity and mortality.\(^2\)

Case Report

A 3-month-old infant weighing 4500 g, presenting with a left retroauricular mass, palpable thrill, and audible bruit was referred for evaluation. She was born at 39 weeks of gestation by vaginal delivery, weight 3340 g, Apgar 8/9, and head circumference 35.5 cm. All neonatal screening tests resulted negative, and the brain MR imaging and digital subtraction angiography demonstrated a huge lateral type dural sinus malformation with high-flow AVF (Fig. 1a-d). Therefore, endovascular treatment using coils under general anesthesia was performed after informed consent. After basic monitoring with electrocardiography, temperature, pulse oximetry and non-invasive blood pressure monitoring, the anesthesia was induced using a face mask with oxygen, nitrous oxide, and sevoflurane. She was intubated with a 3.5 tube with cuff, and left radial artery was catheterized using a 24-G catheter for blood pressure measurement. The anesthesia was maintained with sevoflurane, while water balance, urine output, heparin anticoagulation (1 mg/kg), and contrast dosage (2 mL/kg) were monitored. The child’s baseline mean arterial pressure (MAP) was 40 mmHg, and a MAP target of 30 mmHg was arbitrarily chosen to facilitate embolization. The high flow through the fistula pushed the coil into the sinus, but the previously described feeder manual compression\(^3\) allowed precise embolization with coils and Onyx (Fig. 1e-g). Total shunt occlusion associated with sustained high cardiac output immediately increased MAP to 93 mmHg. To control hypertension, deepening anesthesia with fentanyl, propofol and sevoflurane reduced the MAP to 50 mmHg. At the end of the procedure, the patient was extubated and transferred to the intensive care unit, with a 59mmHg MAP. The patient recovery was uneventful, with occluded fistula and normal development in a 3-month follow-up.
Discussion

Embolization can cure and improve symptoms of brain AVF, however infants under 3 months of age have higher rate of complications. The hemodynamic stability is crucial to prevent secondary hemorrhage, stroke, or normal perfusion pressure breakthrough syndrome. The later may occur because the brain receives a much higher relative pressure after high-flow shunt occlusion, and close MAP control minimize that risk. Although hypotensive drugs like beta blockers, calcium channel blockers, adenosine, and nitrates are commonly used in adults, their use in small children requires specific knowledge and skills. After successfully AVF treatment, early recovery from anesthesia is also recommended for immediate neurologic evaluation. Additional risks include communication breakdowns, technical and equipment failures, especially for procedures performed outside the operating room.

Conclusion

Management of infants with high-flow AVF requires well-trained experienced teams to reduce adverse events, decrease reintervention rate, and improve outcomes.

Declarations

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Statement of Ethics: This study complies with all institutional guidelines regarding human subjects.

Consent to participate: Informed consent was obtained from the patient’s guardian.

Consent for publication: All authors read and approved the final manuscript and consent for publication.

Availability of data and material: All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Code availability: Not applicable

Author Contributions: ZDJ, MTB, and MMR: conception of the work and acquisition of the data; ACD, and ALVC: analysis and interpretation of the data. ZDJ, MTB, and MMR: drafting of the work; all authors: critical revision of the work for intellectual content, and final approval of the version to be published. All authors are responsible for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References


**Figures**

*Figure 1*
Axial (a) and coronal (b) brain TOF MR shows lateral subtype dural sinus malformation, with a high-flow arteriovenous fistula between the left occipital artery (white arrows) and the sigmoid sinuses (asterisks), as well as ipsilateral agenesis of internal jugular vein; in the left common carotid angiogram in anterior view (c) and lateral view (d) is possible to compare the normal diameter of internal carotid artery (double arrows) to the huge occipital artery (white arrows); selective shunt embolization with coils and embolic liquid (e) occludes the fistula (f), remaining normal intracranial flow (g).