



Anesthetic Management of Endovascular Embolization of a Mycotic Aneurysm in a patient with Hypoplastic Left Heart Syndrome (HLHS)

Lucas Davanzo, MD, Brian Blasiolo, MD PhD

Department of Anesthesiology, Children's Hospital Of Pittsburgh, Pittsburgh, Pennsylvania

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Introduction

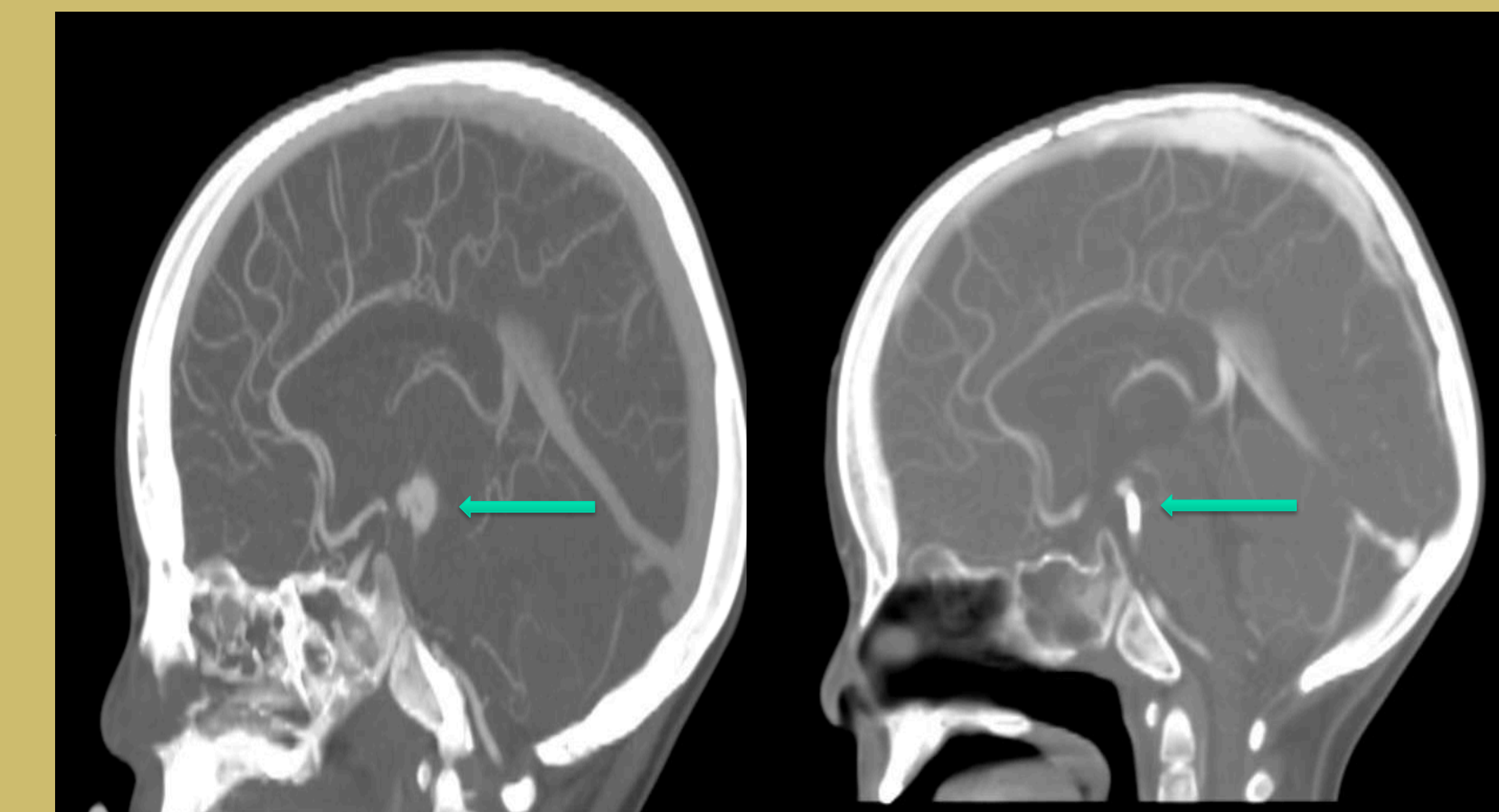
- Patients with congenital heart disease (CHD) undergoing non-cardiac surgery are at an increased risk for complications compared with patients without CHD.¹
- We report a case of a two-year-old male with a history of hypoplastic left heart syndrome (HLHS) status post bi-directional Glenn procedure who developed a mycotic aneurysm in the basilar artery and underwent placement of the Pipeline Embolization Device (PED)
- Given that the PED is currently approved for patients twenty-two years and older,² there are a paucity of case reports of use of the PED in the pediatric population
- The goal of this case report is to review the physiology of the superior cavo-pulmonary anastomosis (SCPA) and the anesthetic implications for non-cardiac surgery, to discuss the anesthetic management of endovascular repair of an intracerebral aneurysm, and to specifically discuss the unique anesthetic considerations in a patient with bi-directional Glenn physiology undergoing Pipeline Embolization of cerebral aneurysm

Case Description

- NF is a two year old male status post bi-directional Glenn procedure for HLHS
- At 32 months, the patient was noted to have an echogenic intra-cardiac mass concerning for thrombus and/or vegetation
- Ten days into treatment with lovenox and ceftriaxone for Gemella endocarditis, the patient was admitted to the hospital with emesis, behavioral changes and imaging demonstrating a non-occlusive basilar thrombus
- Serial imaging revealed sub-arachnoid hemorrhage (SAH)
- Digital Subtraction Angiography demonstrated a fusiform basilar apex aneurysm
- Serial imaging revealed rapid progression of the aneurysm
- An external ventricular drain (EVD) was placed pre-PED procedure
- For the PED procedure, Anesthesia was induced with propofol and rocuronium, and maintained with isoflurane and air
- An arterial line was placed for continuous blood pressure monitoring and repeated blood gas measurements
- Special attention was given to ventilation strategies with a focus on management of pH and PaCO₂
- PED was successfully placed across the left P1 segment to the upper basilar artery
- Neuromuscular blockade was antagonized and the patient was extubated following the procedure
- The patient's neurologic exam remained unchanged
- Repeat imaging revealed decreased size of aneurysm
- Ultimately the patient was discharged in stable condition

Discussion

- The anesthetic goals for PED placement is to reduce the risk of aneurysm rupture while maintaining adequate cerebral perfusion pressure (CPP)⁴
- Aneurysm Transmural Pressure (TMP) = Mean Arterial Pressure (MAP) - Intracranial Pressure (ICP)⁴
- Similarly, CPP = MAP - ICP⁴
- Decreasing TMP while maintaining CPP are competing objectives that need to be balanced
- Methods to decrease ICP include positioning, hyperosmolar therapy, CSF drainage, and hyperventilation⁴
- Hyperventilation results in hypocapnea and CSF alkalosis promoting cerebral arteriolar constriction reducing cerebral blood volume and ICP⁴
- SCPA or the Bi-directional Glenn Shunt is created when the superior vena cava is anastomosed to the right pulmonary artery (PA)³
- There is an enhanced effect on pulmonary artery flow following an SCPA secondary to the infant's relative large brain size and responsiveness to PaCO₂³
- Higher PA flow results in an increased cardiac output³
- Higher levels of PaCO₂ (40-45) improve cerebral and systemic oxygenation and cardiac output compared to lower levels of PaCO₂ (30-35)³
- Patients with SCPA physiology are reliant on a higher PaCO₂ for systemic oxygenation and systemic cardiac output, which presents the hemodynamic challenge of anesthetic management of an intra-cerebral aneurysm that is typically managed intra-operatively with hypocapnea and decreased cerebral blood flow to avoid catastrophic intraoperative complications secondary to increases in ICP
- This patient did well from a neurologic standpoint following placement of the PED, however his cardiac function deteriorated over the following months and successfully required and underwent a heart transplant



A) Coronal View of Aneurysm

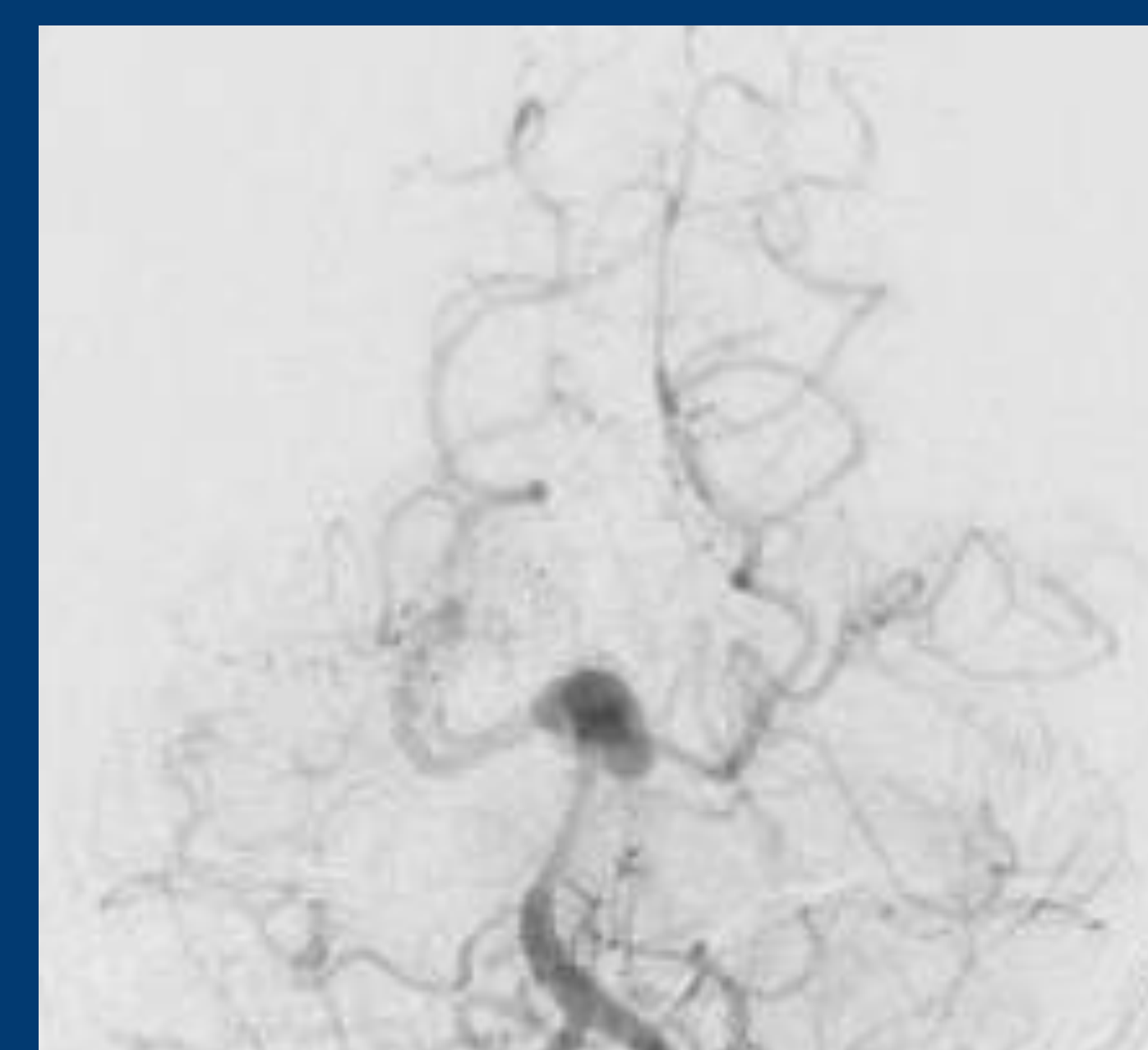
B) Coronal View of Aneurysm after PED

Conclusion

- To date, there are no case reports describing the anesthetic management of the PED placement for cerebral aneurysm in a patient with complex CHD, specifically bi-directional Glenn physiology
- Patients with bi-directional Glenn physiology benefit from a higher PaCO₂ to maintain systemic cardiac output
- The physiologic demands of patients with congenital heart disease are unique and must be balanced with the demands of the surgical procedure

REFERENCES

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Aneurysm pre-PED placement



Intra-procedural placement of PED



6 month post procedural angiography