INTRODUCTION
Neuraxial anesthesia techniques have demonstrated multiple benefits in pediatric cardiac surgeries. Benefits include attenuation of the stress response related to surgery, early tracheal extubation, improved postoperative respiratory mechanics, and shortened hospital length of stay1-2. For pediatric open heart surgery, both single intrathecal injections and epidural catheters have been used without significant complications3-4.

Risks of neuraxial anesthesia, and in particular indwelling epidural catheters, include hematoma formation, neurologic injury, and infection.

We report a novel case of a caudal epidural catheter, placed preoperatively, and maintained for 18 days in the setting of anticoagulation.

CASE DESCRIPTION
The patient is a six-month old male, transferred from an outside facility after Tetralogy of Fallot repair followed by failure to wean from cardiovascular support. A caudal epidural catheter had been placed preoperatively.

He arrived to our hospital on VA ECMO and was admitted to the cardiac intensive care unit. Early in his hospital course, he could not be weaned from ECMO due to severe branch pulmonary artery stenosis.

On POD 5, he underwent dilatation of the right upper lobe, right lower lobe, and had stent placements in the right and left pulmonary arteries.

On POD 6, the acute pain service was consulted to assist in management of a preoperatively placed caudal thoracic epidural catheter.

This presented an unusual management dilemma: removing the catheter while the patient was actively anticoagulated would risk hematoma formation and neurologic injury; leaving an indwelling caudal catheter would place the patient at increased risk for infection.

HOSPITAL COURSE
After a multidisciplinary discussion weighing the risk of epidural hematoma formation and possible neurologic injury with catheter removal versus infection with catheter retention, the epidural catheter was left in place. On admission, the catheter tip was located at the level of the second lumbar vertebra (Figure 1). The team felt the risk of infection was mitigated by the broad-spectrum antimicrobials being given for his open chest. As the infant was fully anticoagulated, the risk of hematoma formation and neurologic injury with catheter removal was increased. Due to required anticoagulation, an epidural hematoma would be difficult to treat.

The catheter dressing was examined daily and reinforced as needed to maintain sterility. The patient remained afebrile with negative urine, wound and blood cultures. The epidural catheter was not tunneled and despite dressing maintenance, it migrated down to the L5-S1 level (Figure 2).

In preparation for repeat left and right PA stenting, his heparin infusion was decreased on POD 18 and the epidural catheter was removed.

At the time of catheter removal, heparin was at 32 units/kg/hr. Relevant laboratory findings are outlined in Figure 3. There were no signs of infection and catheter tip culture was negative.

After epidural catheter removal, the patient had no obvious neurologic sequelae. He was able to sit with support and maintained upper and lower extremity strength.

IMAGING AND LABORATORY STUDIES
![Figure 1](image1.png) X-ray on admission (PCD 4), epidural catheter tip located at L2 level.

![Figure 2](image2.png) X-ray on POD 16, epidural catheter tip located at the L5-S1 level.

![Figure 3](image3.png) Graphic trends of white blood cell count, platelets, INR and PTT from admission to catheter removal. Vertical purple line indicates time at which epidural catheter was removed: 5/9/16 at 0830.

DISCUSSION
This case involves the management of a prolonged (18 days) caudally placed epidural catheter in an anticoagulated patient on ECMO.

Neuraxial infection and hematoma were the most significant potential complications. Despite the prolonged duration with anticoagulation, neither complication occurred.

Although Peterson et al. found no risk of epidural hematoma formation in pediatric cardiac surgery patients with epidural catheters, it does not appear that any research patients required postoperative ECMO.

Vandermeulen et al., in a retrospective analysis of case reports from 1906 to 1994, found 61 cases of epidural and/or subdural hematomas associated with spinal and epidural techniques. 42 of those 61 cases had clotting abnormalities, either in the form of a disorder or from medications. Of those 61 patients, only 20% had good neurologic recovery.

Infections are rare events. In a retrospective review involving more than 10,000 epidural catheters over the course of 17 years, Sethna et al. found 13 cases of infections. A single case of epidural abscess was reported.

This case presented a significant clinical dilemma and poses the question: Should epidural catheters be placed in patients undergoing cardiopulmonary bypass with anticoagulation?

REFERENCES