

BACKGROUND

- Short stature due to osteochondrodysplasia is caused by a variety of genetic disorders affecting bone and cartilage.
- The anatomy and physiology of osteochondrodysplasia patients pose several anesthetic and neuraxial challenges when undergoing lower extremity orthopedic procedures.
- Neuraxial anesthesia may be a preferred anesthetic plan for these cases, but can be technically challenging and involves careful planning.

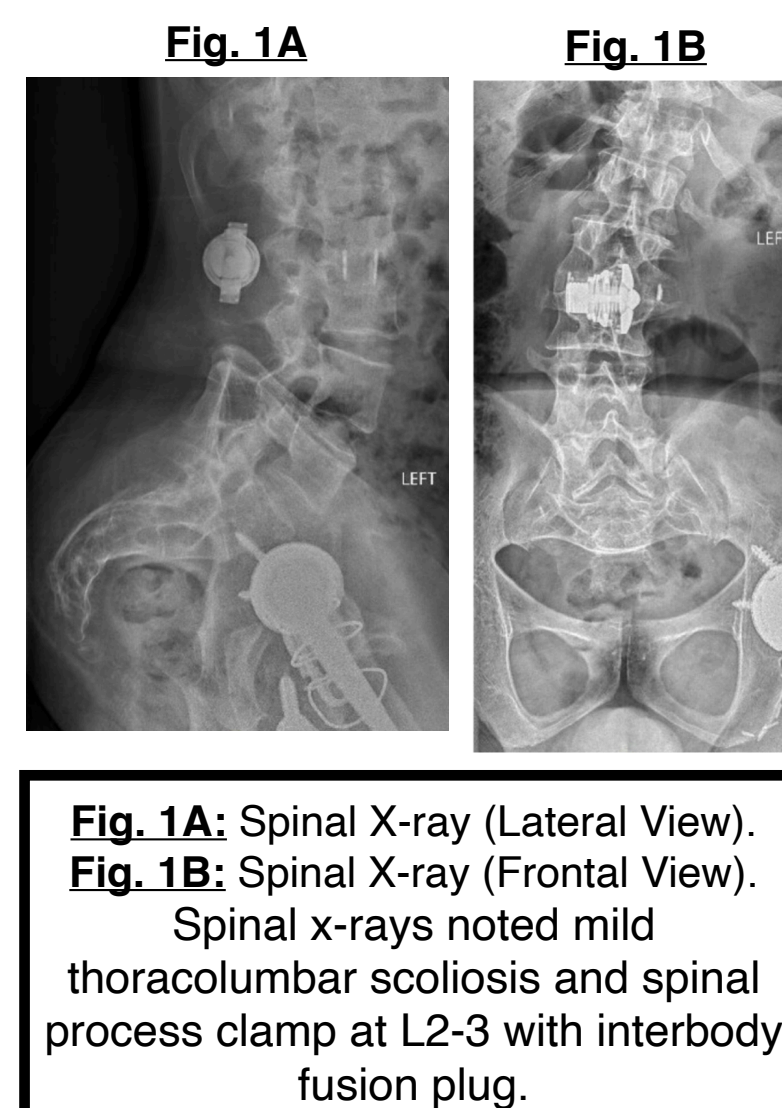
PURPOSE

- Review anesthetic and neuraxial considerations for osteochondrodysplasia patients undergoing lower extremity orthopedic procedures.

CASE DESCRIPTION

PATIENT PRESENTATION

- A 56 year-old, 3'11" male, presented with femoroacetabular impingement related to prior left hip arthroplasty and was scheduled for left hip hardware removal under neuraxial anesthesia.
- Past Medical History:
 - Cartilage hair hypoplasia due to heterozygous mutation in RMRP gene
 - Immune deficiency due to hypogammaglobulinemia
 - Bronchiectasis with recurrent pulmonary infections
 - Mild Scoliosis (Cobb Angle 17°)
 - History of difficult neuraxial placement involving multiple attempts from multiple anesthesiologists
- Past Surgical History:
 - Lumbar spinal fusion with existing scoliosis
 - Prior left hip arthroplasty



ANESTHETIC MANAGEMENT

- Goals:
 - Assess spinal imaging to increase probability of successful neuraxial block
 - Perform neuraxial anesthesia to provide analgesia while allowing spontaneous ventilation
 - Avoid general endotracheal anesthesia to avoid exacerbation of chronically inflamed airways
- Pre-op spinal imaging:
 - Spinal x-rays noted thoracolumbar scoliosis with convex angle of 17° degrees (Cobb Angle) and spinal process clamp at the L2-3 level with interbody fusion plug.
 - Pre-op physical exam and palpation of anatomic landmarks reaffirmed the degree of lateral spinal curvature seen on imaging.
- Intra-op management:
 - Lumbar spinal block was placed with ropivacaine 0.5% at 1.5mL.
 - Sedation with propofol infusion was given at 50-100mcg/kg/min.
 - Spontaneous ventilation was maintained throughout the case.

POSTOPERATIVE COURSE

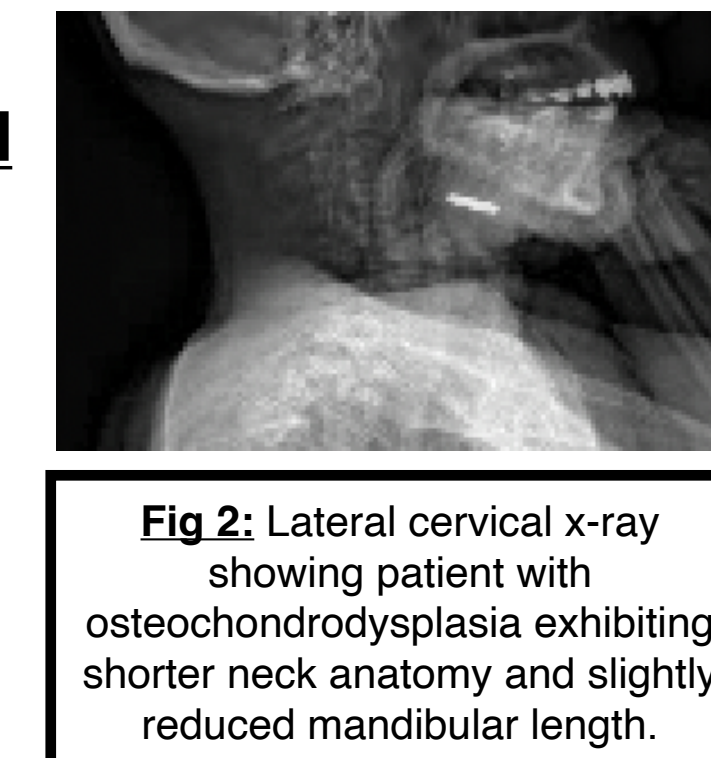
- The patient tolerated the surgery well, and was discharged home later that day.
- On follow-up 11 days after surgery, patient noted improved hip and knee flexion and extension and reported no difficulty walking.

DISCUSSION:

Airway and Ventilation Considerations

AIRWAY ANATOMY

- Osteochondrodysplasia often leads to altered neck anatomy and craniofacial abnormalities, which can lead to difficulties with ventilation and intubation.**
- Some anatomic abnormalities include:
 - Shorter neck anatomy
 - Limited neck mobility
 - Midface hypoplasia, mandibular hypoplasia, facial asymmetry, enlarged tongue, and other craniofacial abnormalities
- Difficult ventilation and intubation may be encountered and appropriate back-up plans should be considered.



VENTILATION STRATEGIES

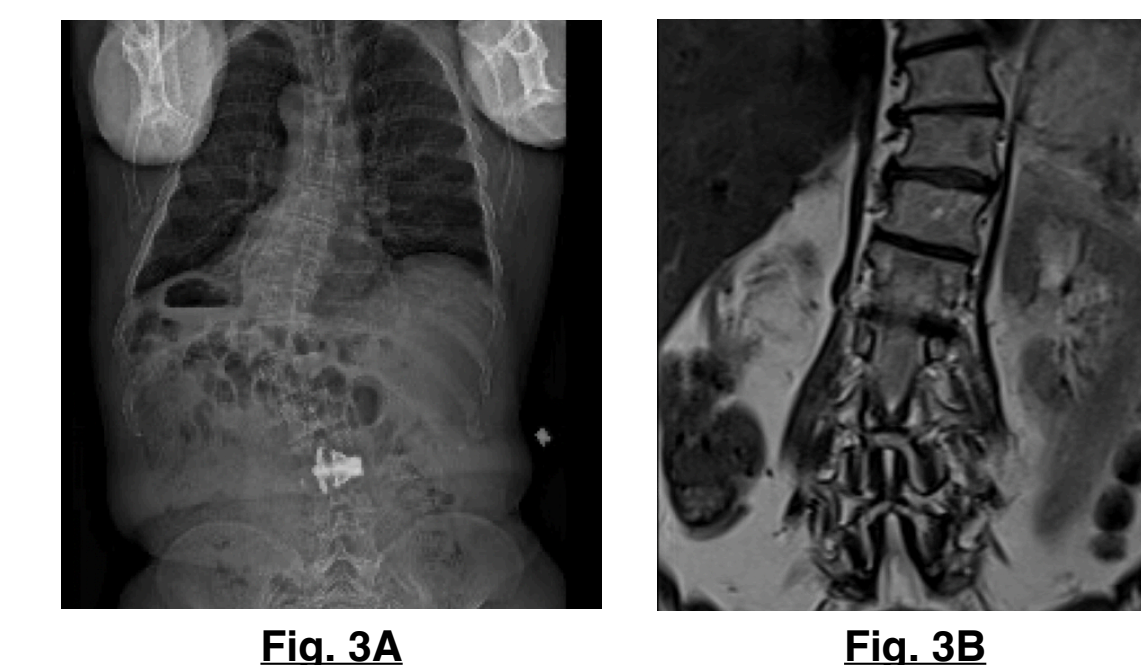
- Allowing for spontaneous ventilation under MAC (monitored anesthesia care) can reduce the risk of pulmonary injury compared to positive pressure ventilation under general anesthesia.**
- Osteochondrodysplasia patients often exhibit discoordinated bone growth, which alters thoracic anatomy.
- Altered chest wall anatomy can reduce thoracic compliance and patients may be prone to chronic atelectasis, chronic infections, and possible bronchiectasis.
- Under positive pressure ventilation, patients with chronic respiratory inflammation may have increased risk for further barotrauma and pulmonary injury.

DISCUSSION:

Spinal Anatomy and Neuraxial Technique

SPINAL ANATOMY

- Preoperative spinal imaging can help providers anticipate difficulties and adjust their neuraxial technique.**
- Dysmorphic bone growth in osteochondrodysplasia often affects spinal anatomy, which affects the trajectory of needle placement.
- Common spinal abnormalities include:
 - Kyphosis
 - Spinal stenosis
 - Scoliosis



OPTIMIZING NEURAXIAL TECHNIQUE

- Patients with spinal abnormalities or scoliosis can be managed intraoperatively by:
 - Optimizing patient positioning**
 - Optimizing needle placement**
 - Paramedian needle approach on the convex side of the spinal curve in scoliosis can improve needle placement.
 - Midline needle approach that angles in the axial plane towards the convex side of spinal curve in scoliosis can improve needle placement.
 - Utilizing ultrasound guided neuraxial technique**

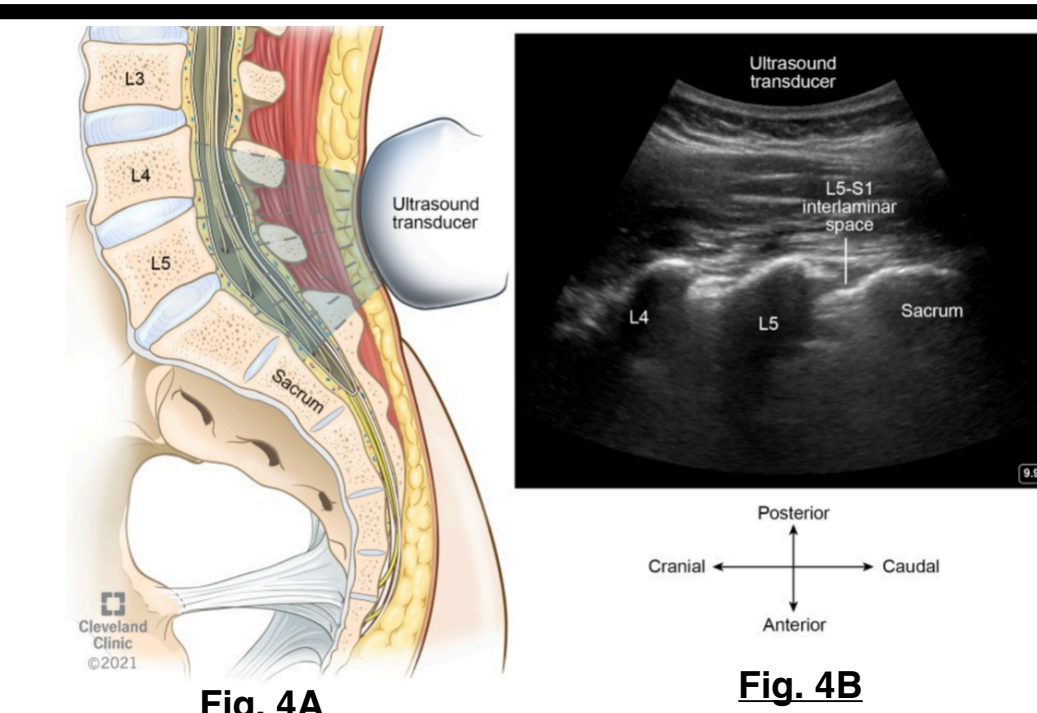


Fig. 4A: Graphic image of spinal anatomy and ultrasound probe for neuraxial block placement.
Fig. 4B: Parasagittal view of L5-S1 interlaminar space under ultrasound imaging.
(ref. 3)

DISCUSSION: Neuraxial Dosing

Neuraxial Spinal Dosing - General Adult Population

- Neuraxial spinal dose determined via height

Neuraxial Spinal Dosing - Patients with Osteochondrodysplasia

- Neuraxial spinal dose determined via height and weight**
 - Precise dosing guidelines have not been clearly delineated or protocolized**
 - Dosing currently relies on individual provider's clinical experience

Consequences of Improper Neuraxial Spinal Dose

- Underdosing spinal blocks
 - Insufficient analgesia and failed spinal block
 - Risk of converting to general anesthesia, which can risk barotrauma or pulmonary injury
- Overdosing spinal blocks
 - Risk of high spinal
 - Risk of converting to general anesthesia, which can risk barotrauma or pulmonary injury

Neuraxial Dosing Strategies

- Currently, there is a lack of clear spinal neuraxial dosing guidelines for patients with short stature due to osteochondrodysplasia.
- Lack of clear neuraxial dosing guidelines increases risks for underdosing or overdosing patients, which increases risks of associated medical complications.**
- While epidural neuraxial anesthesia may allow titration of neuraxial medications, epidural catheter placement may be difficult for patients with extreme spinal abnormalities.
- Filling this knowledge gap and refining neuraxial dosing guidelines and anesthetic care for these at risk patients would be essential to improve the safety and efficacy of neuraxial anesthesia for lower extremity orthopedic procedures.**

Table 1: Comparison of Advantages and Disadvantages of Spinal Neuraxial Anesthesia vs. Epidural Neuraxial Anesthesia for Patients with Short Stature due to Osteochondrodysplasia

	Spinal Neuraxial Anesthesia	Epidural Neuraxial Anesthesia and CSE
Advantages	No need to pass epidural catheter into epidural space, which is beneficial in cases involving extreme spinal abnormalities.	- Allows titration of neuraxial medications, which can provide adequate analgesia, while minimizing the risk of high spinal. - Allows continuous infusion of medication through epidural catheter for prolonged surgical cases.
Disadvantages	Increased risk of high spinal or inadequate analgesia due to lack of neuraxial dosing guidelines.	- Potential difficulty passing epidural catheter into epidural space for patients with extreme spinal abnormalities. - Potential for patchy epidural blockade or lower blockade density compared to spinal anesthesia.

CONCLUSION

- Osteochondrodysplasia patients undergoing lower extremity orthopedic procedures may benefit from neuraxial anesthesia over general anesthesia as a preferred standard of care.
- However, given the unique anatomy and physiology of this patient population, neuraxial techniques and dosing should be approached with careful consideration.

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