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Interesting Case Manuscript: Epidural Anesthesia in a Patient with Severe Thoracic Kyphosis Undergoing Primary Cesarean Delivery: A Case Report

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Abstract

The administration of neuraxial anesthesia among parturient patients with concomitant spine deformity poses challenges to anesthesiologists. The apprehension stems from the increased possibility of a failed block and complications arising from potential neurologic injury due to anatomic variance.

This is a case report of a 30-year old female gravida 1 para 0 at 36 4/7 weeks age of gestation with severe thoracic kyphosis who underwent emergency primary low segment cesarean section under epidural anesthesia. Ultrasonography of the spine was done pre-induction to visualize spinal anatomy and verify anatomic landmarks. Epidural anesthesia was attempted twice before achieving adequate block to dermatomal level T4 within approximately seven minutes. The patient was able to tolerate the procedure well without significant intraoperative events. Fetal outcomes were also favorable with APGAR scores of 9,9. This case report emphasizes that with extensive preoperative evaluation and preparation, an individualized anesthetic plan may be devised. Ultrasound-guided epidural catheter insertion can be a safe option for obstetric patients with thoracic kyphosis.

Keywords: Epidural anesthesia, Kyphosis, Cesarean section, Ultrasonography

Introduction

Spine deformity in obstetric patients poses challenges to the anesthesiologist. The choice of anesthetic technique must be discussed thoroughly, weighing the pros and cons for each, taking into consideration the maternal and fetal status, comorbidities, and logistics. Persistently, neuraxial anesthesia has offered more advantages over other anesthetic techniques for cesarean delivery. It has the advantage of avoiding the need for airway instrumentation, which may be difficult in parturients; keeping the mother awake and facilitate early bonding; minimizing the amount of systemic medications used and possible transfer to the fetus; and reducing the need for systemic opioids by allowing use of neuraxial route of opioid administration.[1]

There are a number of factors to consider when epidural anesthesia is used in this specific population. Preoperatively, a thorough evaluation of the patient's spinal anatomy, including the severity of kyphosis, should be performed. This assessment helps determine the feasibility of administering epidural anesthesia and the potential risks involved.[2] Imaging studies such as X-rays or magnetic resonance imaging (MRI) may be necessary to evaluate the spinal anatomy in more detail. This can help identify any potential

anatomical abnormalities or contraindications to epidural anesthesia. Ultrasound guidance may be used for locating the epidural space in patients with challenging anatomies. It provides real-time visualization of the spine, allowing for more accurate needle placement.[3]

Kyphosis is a type of spine deformity that refers to an abnormal outward curvature of the spine. In individuals with kyphosis, the upper back appears rounded or hunched, leading to a stooped posture.[4] During pregnancy, there are multiple impacts on the woman's biomechanics in terms of the spine curvature to allow fetal growth and accommodate anthropometric changes with the developing pregnancy. Although with conflicting data among multiple studies, there is evidence to suggest that there are increases in angles of lordosis and kyphosis in the spine of a parturient.[5]

There is limited information regarding the failure rate of epidural anesthesia in patients with severe kyphosis. However, some studies suggest that patients with spinal deformities, including kyphosis, may have a higher risk of experiencing incomplete pain relief or inadequate anesthesia during epidural anesthesia. This is likely due to the altered spinal anatomy in these patients, which can make it more challenging to place the epidural catheter and achieve adequate coverage of the nerves that transmit pain signals.[6] Additionally, patients with kyphosis may be at an increased risk of developing complications such as accidental dural puncture or spinal headache during epidural anesthesia, which can also contribute to treatment failure.

Case Description

This is a case of a 30-year old gravida 1 para 0 diagnosed with congenital thoracic kyphosis (Figure 1a. and 1b.) and mild, persistent bronchial asthma in acute exacerbation. No previous consults and workup were done regarding her spine deformity. She was maintained on Salbutamol 2mg/2mL nebulization as needed for acute asthma exacerbations. She had regular prenatal visits during her pregnancy and she was scheduled for cesarean section at 37 weeks age of gestation (AOG).

a. *b.*

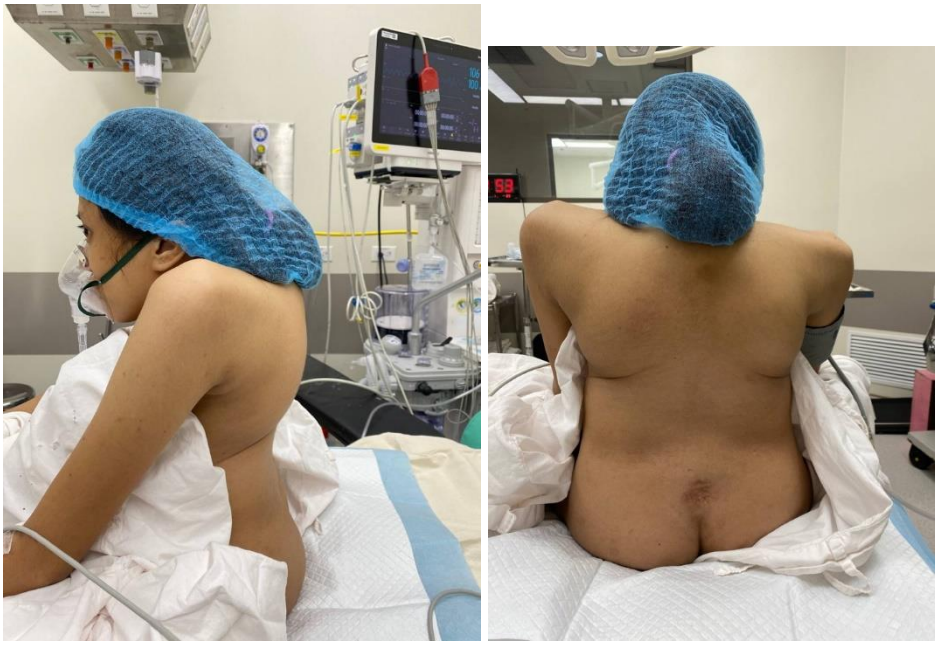

Figure 1. Patient with thoracic kyphosis (a.) with gross misalignment of spine (b.) while in sitting position

At 33 weeks and 1 day AOG, she presented at the emergency department for labor pains, with no associated vaginal bleeding or watery discharge. She was normotensive at 106/73 mmHg, tachycardic at 116 beats per minute, tachypneic at 25 breaths per minute, afebrile at 37.2ºC, and with oxygen saturation at 99% with oxygen supplementation via hudson face mask at 6 liters per minute. On gross physical examination, she has barrel chest deformity, thoracic kyphosis, short neck, and short stature. Chest auscultation revealed fine bibasal crackles and occasional wheezes. Baseline fetal monitoring using cardiotocography revealed a reactive trace with abnormal features of fetal tachycardia at 180 beats per minute. Threatened preterm labor was managed expectantly in the ward and she was given four doses of Dexamethasone 6 mg intravenously every 12 hours. She was started on Budesonide 160 mcg + Formoterol 4.5 mcg inhaler 2 puffs twice daily, Montelukast 10 mg 1 tablet once daily, and Salbutamol 2mg/2mL nebulization every 6 hours. Improvement of maternal and fetal status were seen on the third hospital day with no perceived uterine contractions and reactive cardiotocography tracing. Respiratory signs and symptoms persisted and she was diagnosed with community acquired pneumonia - moderate risk for which she was given intravenous antibiotics. At 36 weeks and 4 days AOG, there was recurrence of uterine contractions, now associated with watery vaginal discharge. Decision to deliver the fetus via emergency low segment cesarean section was made

Epidural catheter placement was done with the patient in a sitting position. Ultrasound was used to identify the landmarks (Figure 2). Skin markings were placed over L3-L4 and L4-L5 interspaces to mark target puncture sites (Figure 3). Initial attempt at inserting epidural catheter was done at L4-L5 using the paramedian approach. Location of epidural space was confirmed using the loss of resistance to air (LORTA) technique. Epidural catheter was threaded with ease with five centimeters of the catheter left indwelling. To confirm correct placement of epidural catheter, a test dose using Lidocaine 2% + Epinephrine 0.15 mg was given. A loading dose of Lidocaine 2% (10 mL in increments) with Fentanyl 50 mcg was given. Upon testing the adequacy of block, there was note of inadequate analgesia over the abdomen; hence a second attempt at reinserting an epidural catheter was done. On the second attempt, the tuohy needle was inserted at L4-L5 using the midline approach. The epidural space was approximated using LORTA technique and epidural catheter was threaded with five centimeters of catheter left indwelling. Epidural test dose was negative and Lidocaine 2% (6 mL in increments) loading dose was given. A block height of T4 was achieved this time with loss of motor and sensory functions. Infraumbilical midline incision was done by the obstetrician and fetal extraction was performed without difficulties. APGAR scores were 9, 9 on the first and fifth minutes after birth. The estimated blood loss was 800 milliliters which was greater than the allowable blood loss of 583 milliliters. Hence, the patient was transfused with one unit packed red blood cells. The epidural catheter was removed immediately postoperatively. The blue tip was shown to the patient and nurse to confirm complete removal of the epidural catheter. The patient was transferred back to ward and stayed for five more days without immediate postoperative problems. The patient and newborn were discharged well with follow-up checkup in the outpatient department after one week.

Discussion

In this case report of a parturient patient with severe kyphosis who underwent cesarean delivery, a number of challenges related to neuraxial anesthesia were anticipated attributed to the spinal deformity. Additional limitations in the choice of anesthetic technique for this specific population are the unique physiologic changes they usually present with. Airway management is more difficult due to the limited range of motion

in their neck and spine. The abnormal curvature of the spine can affect the alignment of the airway structures, making intubation and ventilation challenging. Severe kyphosis can affect lung capacity and respiratory function, potentially leading to reduced pulmonary reserve. This decline in pulmonary reserve concomitantly reduces the oxygen reserve. This results in a shorter apnea time before critical hypoxia ensues during induction of general anesthesia. Chest wall compliance is also markedly decreased which adds to the decreased forced vital capacity and forced expiratory volume in one second.[7] These changes result in a combined obstructive and restrictive pulmonary disease. General anesthesia was therefore avoided as much as possible to reduce exposure from systemic anesthetics and prevent augmentation of the previously mentioned physiologic changes and patient comorbidities.

The anticipated challenges for the different options for anesthetic technique in this patient were minimized thoroughly. From the preoperative phase up to the postoperative follow up phase, the patient was optimized and monitored closely. Preoperative anesthetic planning is of utmost importance in high-risk patients due to their increased vulnerability and potential for adverse events during surgery and anesthesia. This involves a comprehensive assessment of the patient's medical history, physical examination, and diagnostic test results. This evaluation helps identify specific risk factors associated with the patient's medical condition, surgical procedure, and anesthesia. By understanding the individual patient's risks, the anesthesiologist can tailor the anesthetic plan accordingly and take proactive measures to optimize the patient preoperatively.[8] Preoperative optimization improves the patient's overall medical status, reduces the risk of perioperative complications, and enhances their ability to tolerate anesthesia and surgery. With thorough preoperative assessment, an individualized anesthetic plan can be developed.

The patient was seen early on at 31 weeks AOG at the Preoperative Assessment, Testing and Education Center (PATEC). Preoperative neurologic physical examination was done to establish baseline normal sensory and motor functions. A close collaboration between the obstetrician and anesthesiologist was established to plan and discuss the potential challenges and develop an appropriate anesthetic plan. Subarachnoid block was considered but was not the most appropriate due to risks of early block regression warranting conversion to general anesthesia. Continuous lumbar epidural anesthesia was deemed the most suitable anesthetic technique to permit gradual titration of block height. To address the bronchial asthma, the patient was placed on round-the-clock bronchodilators, inhaled corticosteroids, and leukotriene receptor blocker.

While the use of epidural anesthesia averts the possible complications of general anesthesia for this patient, the technique is not devoid of risks. The incidence of complications in epidural anesthesia among patients with spine deformity can vary depending on various factors, including the specific type and severity of the deformity, the skill and experience of the anesthesiologist, and the overall health of the patient. Spine deformities can lead to significant anatomical variations, including abnormal curvatures, fusion of vertebral segments, or altered bony landmarks. These variations can make it difficult to identify and accurately localize the desired neuraxial space for needle insertion.[9] Kyphosis may result in a distorted spinal canal or altered alignment of the vertebral column, making it more challenging to insert the needle accurately into the epidural space. Patients with spine deformities may have a higher risk of complications during neuraxial anesthesia. These complications may include accidental dural puncture, difficulty in threading the catheter, inadequate anesthesia, and post-dural puncture headache. Proper patient positioning is crucial for successful neuraxial anesthesia. However, spine deformities may restrict the patient's ability to achieve the ideal position, such as sitting or flexing the back.[10] Epidural anesthesia carries a risk of neurologic complications as well, including nerve injury or damage. Patients with spine deformities may

have compromised spinal cord or nerve root function due to the deformity itself, and the placement of an epidural catheter may further increase the risk of nerve-related complications.[11] Baseline neurologic physical examination for this patient was done preoperatively and monitored after removal of epidural catheter.

The use of ultrasonography allows the anesthesiologist to assess the patient's spine and select the optimal site for needle insertion. This helps visualize the patient's spine and identify the relevant anatomical landmarks necessary for neuraxial anesthesia, such as the intervertebral spaces, spinous processes, and epidural or subarachnoid spaces. This improves accuracy during needle insertion, reducing the risk of complications and increasing the success rate of the procedure. Ultrasound guidance has shown to minimize the number of epidural catheter placement attempts and specific levels selected for epidural catheter insertion. [12, 13] In this case, a sonographic scan of the spine was done to visualize spinal anatomy and verify anatomic landmarks. Skin markings at levels L3-L4 and L4-L5 interspaces were drawn as accurate locations of possible needle puncture sites.

In case of a failed neuraxial anesthesia, conversion to general anesthesia should be considered. The incidence of conversion to general anesthesia from inadequate neuraxial block in pregnant patients with spine deformity is not well-defined due to the limited data on this specific population. However, studies have examined the success rates of neuraxial anesthesia in pregnant women with spine deformity. A retrospective study in 2017 involving pregnant women with scoliosis showed a success rate of 90% for neuraxial anesthesia, with 6.7% requiring conversion to general anesthesia, with inadequate surgical anesthesia as the most common cause of conversion. This data highlights the importance of preparing for shifting of anesthetic technique.[11] In this case, the team of anesthesiologists was composed of a regional anesthesiology consultant, two residents, and an obstetric anesthesiology fellow and were involved in the planning and the actual operation. Airway rescue devices such as bougie, video laryngoscope, supraglottic airway devices, and nasopharyngeal and oropharyngeal airways were prepared. Intravenous anesthetics for induction of general anesthesia such as Midazolam, Fentanyl, Propofol, and a short-acting neuromuscular blocker: Succinylcholine were also prepared.

Conclusion

Patients with spine deformity present significant challenges for the anesthesiologist. Careful and extensive preoperative assessment and planning is a crucial phase of the process and is necessary to guide clinical judgment for the anesthetic choice in this specific population. Anticipating the possible problems and preparing for potential complications is prudent to ensure patient safety and optimal patient care. Despite the challenges, ultrasound-guided epidural catheter insertion can be a safe option for obstetric patients with thoracic kyphosis.

Appendix

Table 1. Preoperative Laboratory Results

CBC			Coagulation profile (seconds)			Serum chemistry	
Hemoglobin	98 g/L		PT (ref)	13.2/(12.6)		BUN	1.1 mmol/L
Hematocrit	0.33		INR	1.05		Creatinine	22 µmol/L

<table>
<tr><td>Leukocyte</td><td>11.7 x 10^9/L</td><td></td><td>aPTT (ref)</td><td>31.2/(30.38)</td><td></td><td>Sodium</td><td>134 mmol/L</td></tr>
<tr><td>Platelet</td><td>303 x 10^9/L</td><td rowspan="2"></td><td colspan="2" rowspan="2">b.</td><td rowspan="2"></td><td>Potassium</td><td>3.8 mmol/L</td></tr>
<tr><td colspan="2">a.</td><td>Chloride</td><td>105 mmol/L</td></tr>
<tr><td colspan="5">CXR:
Airspace opacities seen in both lower lung fields, obscuring cardiac borders
Trachea is midline
The costophrenic angles and hemidiaphragms are intact
The osseous structures and soft tissues are unremarkable
Impression: Pneumonia, considered</td><td></td><td>c.</td><td></td></tr>
</table>

d.

PT, Prothrombin time; ref, Reference value; INR, International Normalized Ratio; CXR, chest x-ray; aPTT, Activated Partial Thromboplastin Time

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