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Ultrasound Guided Combined Spinal Epidural Anaesthesia in Scoliosis - A Case Report on Anaesthetic Precision

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Abstract: ***This case report discusses the use of ultrasound guided combined spinal epidural anesthesia in a 32yearold female patient with scoliosis, scheduled for hysteroscopic myomectomy. Due to the patient's distorted spinal anatomy, traditional neuraxial anesthesia posed significant challenges. The application of preprocedural ultrasound enabled precise localization of the spinal structures, reducing the risk of complications and improving anesthetic outcomes. This report highlights the effectiveness of ultrasound guidance in managing anesthesia for patients with complex medical histories and anatomical variations, demonstrating its potential to enhance the safety and efficacy of spinal and epidural anesthesia.***

Keywords: combined spinal-epidural anesthesia; preprocedural spine ultrasonography; scoliosis; myomectomy

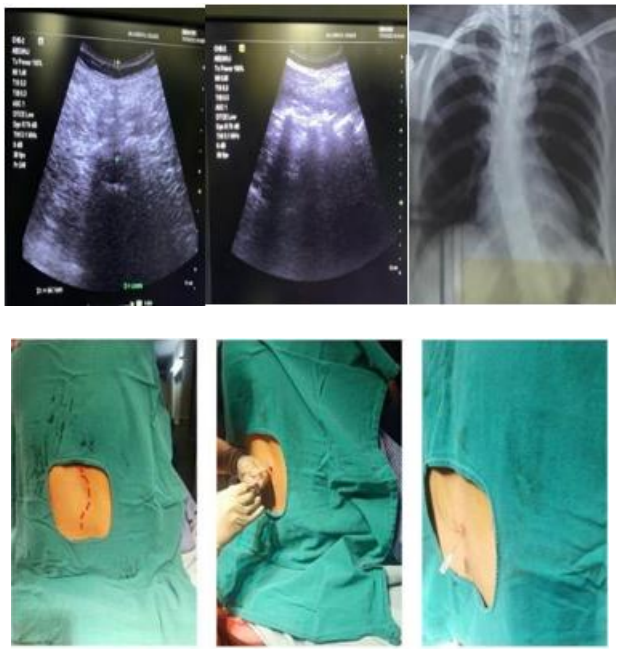
1. Introduction

Scoliosis is a rotational deformity of the spine and rib cage resulting from disruption of balance between structural and dynamic components of musculoskeletal elements of vertebral column. It is present in approximately 2% of the general population, with the prevalence in women twice that in men. Combined spinal-epidural anaesthesia includes an initial subarachnoid injection of local anaesthetic followed by epidural catheter placement, thereby achieving blockade of sympatho-somatic outflow from the spinal cord. Combined spinal-epidural block allows for rapid relief of pain or induction of regional anaesthesia by the rapid onset of the spinal drugs while the epidural catheter is applied to ensure an adequate block level during the surgery and for maintenance of postoperative analgesia. The popularity of the use of ultrasound for regional anesthesia and pain treatment methods has increased in recent years. Thus, this is beneficial in patients with both normal anatomy and patients with difficult vertebra examinations. In this patient, combined spinal epidural anaesthesia was preferred because of the high risk posed by poor cardiopulmonary reserves, and also to extend anaesthesia if surgery is prolonged due to the risks associated with general anesthesia. Due to distorted or absent spinous processes in both corrected and uncorrected scoliosis, which are key landmarks for placement of neuraxial anesthetics, USG was preferred due to potentially unsafe placement of epidural catheters in the absence of imaging as palpation is not always reliable. The significance of this case report lies in its demonstration of how ultrasound guidance can mitigate the challenges posed by complex anatomical variations, such as scoliosis, in administering neuraxial anesthesia, thereby improving patient outcomes and reducing procedural risks.

2. Case report

A 32 year old primiparous patient, recently diagnosed with hypothyroidism, on Tab. THYRNORM 75mcg OD since 1 month, presented with excessive vaginal bleeding and abdominal pain since 1 month for which she was put on Tab. PRIMOLUT N 10mg TID. Upon admission, she was started on Inj. PAUSE 500mg TID, Inj. TAXIM O 1g TID, Inj. METROGYL 500mg TID. She was posted for hysteroscopic myomectomy. Pre anaesthetic evaluation was done. She weighed 61kg and was 146cm tall. Patient underwent previous caesarean section under spinal anaesthesia 3 years ago, which was complicated by multiple attempts for needle insertion. She had undergone laparoscopic mesh repair for umbilical hernia along with cholecystectomy under general anaesthesia 1 year ago during which 2 pints PRBC was transfused. Patient also gives history of 3 spontaneous abortions. Her estimated metabolic equivalent of tasks >4. General physical examination showed presence of pallor. Airway examination was within normal limits. On inspection, chest was flat. On palpation of spine, scoliosis was present in mid-thoracic vertebra. Systemic examination was normal. On routine investigations, patient was found to have a Hemoglobin of 10.2g/dl, Blood group was O +ve. ECG showed poor R wave progression, Bifid P wave, ST-T-U changes in inferior and lateral chest leads. 2D ECHO showed mild mitral valve prolapse with ejection fraction of 55%. Chest X-ray showed normal lung fields, dextroscoliosis in mid-thoracic vertebra with Cobb angle of 30°. Lateral spine X-ray showed mild loss of lumbar lordosis, mild subarticular sclerosis involving superior and inferior articular process of T9-T12 facet joints. USG Abdomen and pelvis showed posterior cervical submucosal fibroid measuring 7*4.5*5cm prolapsing into

vagina and splaying and displacing the cervical canal with cervix stretched anterior to lesion. Rest of the investigations such as total count, platelet count, blood sugar, coagulation studies, renal function test, thyroid function test and serum electrolytes were within normal limits. Pulmonary function test showed restrictive and obstructive pattern, restrictive because of scoliosis and obstructive due of bronchial asthma. Pulmonologist advised to start Nebulisation with DUOLIN + BUDECORT 1-1-1-1, Tab. M-LIFE 1-0-0 (BILASTINE and MONTELEUKAST), Tab. ABEVIA SR 100mg 1-0-0 (ACEBROPHYLLINE). Pulmonologist advised that patient could undergo surgery with moderate risk. Hence, case was accepted under ASA III. Patient refused regional technique due to her bad experience during her LSCS. Patient was counselled and reassured about regional anaesthesia. Due to difficult epidural catheter placement, we planned for preprocedural ultrasound guidance for combined spinal epidural anaesthesia.



3. Method

The anaesthetic procedure, potential difficulties that may be encountered and also the use of ultrasound in reducing the number of needle pricks were explained to the patient. The patient was kept fasting for 6 hours for solid/semisolid food prior to surgery. As Premedication, Tablet ALPRAZOLAM (0.25 mg) was given on the night before surgery and Tablet PANTOPRAZOLE 40mg, Tablet THYROXINE 75mcg were given on the morning of surgery with sips of water. INJ. XYLOCAINE test done given, and pulmonology orders were followed. Adequate blood was arranged. Preprocedural ultrasonography of the spine was performed using the ultrasound machine, Siemens Acuson 500 with low frequency (2–5 mHz) curved array probe.

Two basic ultrasonography approaches are parasagittal and transverse method. The patient was placed in sitting position. For sagittal scan, the lumbosacral spine was maximally flexed and the transducer was placed 1 to 2 cm lateral to the spinous process at the lower back with its orientation marker directed cranially. The basic approach for US-guided neuraxial anesthesia is the identification of anatomical structures, which are the hyperechoic posterior complex (containing the ligamentum flavum, epidural space, posterior dura mater), the hypoechoic intrathecal space under it and the hyperechoic anterior complex (formed by the anterior dura, posterior longitudinal ligament). The erector spinae muscles are hypoechoic and “acoustic window” through which the neuraxial structures are lie superficial to the hyperechoic laminae. The interlaminar space is the gap between the adjoining lamina and is the visualized within the spinal canal.

For transverse Scan, transducer was positioned over the spinous process. This view is useful for identifying the midline when the spinous processes cannot be palpated (e.g., in obese patients) and to examine for rotational deformities of the vertebra, such as in scoliosis. Normally, both the lamina and the articular processes on either side are located symmetrically. However, if there is asymmetry, then a rotational deformity of the vertebral column should be suspected and potentially difficult central neuraxial blockade can be anticipated. After imaging of the vertebral canal, identification of midline and estimation of depth of ligamentum flavum was done. The distance from the skin to the dorsal dura was measured at 4mm and pre-puncture marking of skin was done.

After written and informed consent, patient was taken to the operating room and standard ASA monitors- Non-invasive blood pressure (NIBP), Electrocardiogram (ECG) and Oxygen saturation (SpO2) monitors- were attached. IV line was secured with an 18G cannula on the right hand and IV Fluid, Ringer Lactate was started. The patient was kept in sitting position and the patient’s back was painted and draped under aseptic precautions preserving the skin markings. IVDS L2-L3 was identified. Inj. LIGNOCAINE 2% 2ml was infiltrated into skin and subcutaneous tissue. In the first attempt, 18G Tuohy’s needle was passed through IVDS upto 4cm, epidural space was identified by loss of resistance method and confirmed by hanging drop technique. Catheter was inserted and fixed at 10cm. Test dose of 3ml LIGNOCAINE + ADRENALINE was given after negative aspiration for blood and CSF. In the same space, 0.5 cm below insertion of epidural catheter, lumbar puncture was done with a single prick using 25G Quincke’s needle. Clear, free flow of CSF was noted at the needle hub and spinal anesthesia was given intrathecally with Inj. BUPIVACAINE (Heavy) 3ml + Inj. Nalbuphine 0.8mg.

Successful CSE was assessed by sensory block (loss of pin-prick sensation) and motor block (modified Bromage scale). A sensory block of T6 was achieved and was adequate for the procedure. Subsequently, vitals remained stable throughout the procedure maintaining a heart rate of 90-100 bpm, blood pressure of 100/60 mm Hg to 130/80 mm Hg and SpO2 of 97-98% with face mask with O2 at 4L/min. Level of spinal anaesthesia was monitored periodically and spinal anaesthetic administered was adequate for the surgery. Surgery lasted for 90 minutes and was uneventful, with a blood loss of 100ml and urine output of 150ml. I/V/F 2 pints of Ringer lactate were administered during the surgery. Patient was monitored for procedure related complications for 24 hours. The post operative analgesia lasted for 6 hours post procedure. There were no postoperative complications. Postoperatively, Inj.

BUPIVACAINE 0.125% was given Q8H via epidural catheter to provide analgesia. Patient had excellent pain control with the epidural catheter in place. The epidural catheter was discontinued on postoperative day three without sequelae.

4. Discussion

Ultrasonography is portable, non-invasive, safe, simple, relatively inexpensive, provides real time images and is devoid of radiation hazards. In the Banu K article, a patient with achondroplastic dwarfism with scoliosis and moderate restrictive lung disease was managed under spinal anaesthesia using ultrasound guidance. The success rates for spinal anaesthesia were similar for both pre-procedural and real time ultrasonography. In severe scoliosis with presence of adhesions and scarring in spinal and epidural space, spread and efficacy of the drug is of concern as it is unpredictable, contributing to catastrophic high block. For spinal anaaesthesia in scoliotic patients less than <110cm, recommended dose should not exceed 0.06mg/cm of height to avoid complications. Our patient was 146cm, so we proceeded with usual dosage. As the patient was on thyroxine replacement therapy, the perioperative care was further enhanced.

The asymmetry of structures on the two sides of the spinal canal, mainly the articular and the transverse processes in the interspace, can be used as a guide to determine the level of the rotation on the spinal column, which would have been otherwise impossible to detect using anatomical landmarks. By using ultrasound, we precisely determined the L2-L3 intervertebral space available for the placement of spinal block and also the depth of the dorsal dura from the skin was measured.

The spinous processes point towards the midline (concave-side) and the vertebral bodies rotate towards the convex-side of the curve. Therefore, there is deviation of the midline of the epidural space toward the convex aspect of the scoliotic curve relative to spinous processes. To facilitate neuraxial placement in scoliotic patients, the needle can be oriented toward the convexity of the curve where the interlaminar spaces are generally larger. To overcome unilateral blockade, which may result from rotation of the scoliotic spine, the patient can be placed in the lateral position with the less blocked side in the dependent position. In our patient, we identified the space which was more favorable for insertion of epidural needle, but it was on the convex side. Therefore, we went ahead on the same space and there were no post operative complications.

Advantages of preprocedural spinal ultrasonography are as follows:

- The bony anatomy of the vertebral spine makes it more difficult to visualize structures in this region. Thus, ultrasound can provide enough anatomic detail to ascertain the location, depth of intrathecal or epidural space, and angle needed to successfully place a spinal or epidural catheter.
- It is useful in patients in whom anatomic landmarks are difficult to palpate, such as in those with obesity, edema of the back, or abnormal anatomy (scoliosis, post-laminectomy surgery, or spinal instrumentation).
- It allows to preview the neuraxial anatomy in order to identify ligamentum flavum defects and asymptomatic spinal abnormalities such as in spina bifida
- Accurate identification of the intervertebral levels reduces the risk of conus medullaris injury, post dural puncture headache, spinal infections, Cauda equina syndrome
- Combined spinal epidural anaesthesia offers the ability to establish the block gradually (avoiding hypotension), use of additional dose (avoiding patchy or inadequate block as well as systemic toxicity), and avoidance of accidental dural puncture

The ultrasound-guided technique is not without its limitations:

Imaging the vertebral canal on ultrasound can be difficult in the same patient populations in which it is most useful, like

a) In obese patients, structures are often less distinct because of the attenuation that occurs as ultrasound waves travel a greater distance through soft tissue and a phase aberration effect caused by the varying speed of sound in the irregularly shaped adipose layers
b) Patients with scar tissues and altered vertebral anatomy from previous spinal surgery
c) Obstetric patients
d) Elderly patients who may have degenerative spinal disease with narrowed interspinous spaces and interlaminar spaces as a result of ossification of the interspinous ligaments and hypertrophy of the facet joints and also tissue distortion due to loose and mobile skin.
e) Patients who have difficulty achieving optimal body positioning because of pain in certain positions, limited back mobility secondary to spinal fusion and/or due to implants in patients with prior corrective surgeries
f) Patients with difficult-to-detect and abnormal anatomical surface landmarks
    - Risk of hematoma formation in patients with coagulation disorders or patients on anticoagulant treatment and those who require larger anaesthetic dose
    - Ultrasonography effectiveness is significantly dependent on operator experience and expertise in this technique.
    - Prior surgical disruption of ligamentum flavum can make perception of loss of resistance nearly impossible
    - Technical difficulties with epidural catheter- Difficulty in threading the catheter, catheter kinking, catheter breakage during removal, migration of catheter tip into blood vessel or subarachnoid space.

With the above considerations in mind, we advocate anesthesia consultation well in advance of delivery, as this also allows for multidisciplinary planning and patient education regarding the potential difficulties that may be encountered.

5. Conclusion

The integration of preprocedural ultrasound imaging into anesthesia protocols enhances the success rate, safety and efficacy of combined spinal and epidural anesthesia, ensuring optimal analgesic coverage and hemodynamic stability, particularly in all patients with complex medical histories and anatomical challenges. By reducing needle manipulations and procedural duration, this approach minimizes the risk of

neurological complications that would've otherwise occurred in blind landmark technique, thereby increasing the quality of anaesthesia. Our case underscores the importance of individualized anesthesia strategies in complex surgical scenarios, representing a significant advancement in anaesthetic practice, contributing to improved patient outcomes, comfort and satisfaction. Ultrasonography has thus become the modality of choice because it precisely identifies the spinal canal anatomy and predicts the difficulty associated with central neuraxial blockade and enhances the ease of placement of the epidural and spinal anaesthesia. Therefore, ultrasound guided spinal anaesthesia is feasible and can lead to lesser peri-operative complications, better intra-operative vitals, especially in patients with co-morbid conditions.

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