

Role of ultrasound guided epidural anesthesia for lower limb surgery in children with previously repaired meningomyelocele

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Summary

Background: Children that have had a meningomyelocele repair often present for hip and bilateral lower limb surgeries. Due to vertebral, epidural, and nerve root abnormalities, placement of epidural catheter is difficult.

Aims: We aim to describe the potential role of ultrasound in delineating the most appropriate intervertebral space for central neuroaxial blocks in these patients.

Method: Twelve children with previous meningomyelocele repair, in the age group of 6-12 years posted for hip or bilateral lower limb surgeries were included. After induction of anesthesia, an ultrasound scan was done with the patient in the left lateral position. The central neuroaxial block was performed in the most appropriate intervertebral space seen on transverse scan of spine. These patients were studied with regard to visibility of the osseous framework of the spine, the anterior and posterior dural complexes, ease of insertion of catheter, evidence of dural puncture, and possibility of identification of the extent of peri-incisional fibrosis.

Results: One case required 2 attempts. There was no evidence of dural puncture. We could confirm the soft tissue shadow, the osseous framework, and the anterior and posterior dural complexes in all 12 patients. Ultrasonography guided in selecting the most appropriate space for epidural catheter placement.

Conclusion: Ultrasound guidance aids in identification of normal intervertebral space and explicitly shows the abnormal space. It can be used as an aid to differentiate between normal and abnormal space in post-meningomyelocele repair.

KEYWORDS

central neuroaxial block, intervertebral space, meningomyelocele repair, ultrasonography

1 | BACKGROUND AND OBJECTIVES

Meningomyelocele (MMC) is the most common primary neural tube defect and is the most severe form of spina bifida. Incidence of MMC is 1 in 1000 live births. It presents most commonly over the lumbar and sacral vertebrae as a cystic mass (85%).^{1,2} Patients operated on for lumbar MMC have an anomalous vertebral architecture, anomalous

epidural architecture, postoperative epidural fibrosis/adhesions, and deranged anatomy of lumbar rootlets forming lumbosacral plexus.^{3,4}

As pediatric anesthesiologists we come across post meningomyelocele repair cases for non-MMC surgeries such as hip, lower extremity, and urogenital surgeries or routine abdominal surgeries from infantile age group to adolescence. For bilateral foot surgeries and major hip surgeries, we depend on the central neuroaxial blocks for pain relief in

these patients. Ultrasonography guides us in selecting the most well-formed, well seen, vertebral architecture, and intervertebral space.

The purpose of this case series was to demonstrate the use of ultrasound guidance for selecting the most appropriate intervertebral space for epidural catheter placement in post meningomyelocele repair children.

2 | MATERIALS AND METHODS

This is an observational, retrospective case series. Twelve patients scheduled for hip and bilateral lower limb surgeries with minor motor and sensory impairment were included from records. Four out of 12 patients had a functioning ventriculo-peritoneal shunt in place. Patients posted for surgeries other than hip and bilateral lower limb were excluded from the study. The demographics were as shown in Table 1.

Informed consent from the guardian of the patients was taken for the procedure. The institutional ethical committee was clearance obtained. Standard fasting guidelines were followed. All patients received oral midazolam 0.5-0.7 mg/kg, 20-30 minutes before the scheduled procedure. They were induced with sevoflurane (2-8 vol%) in oxygen and air mixture. An appropriate gauge IV line was secured. They were maintained on spontaneous ventilation with oxygen air mixture with sevoflurane 1.5-2 vol% via JR circuit and laryngeal mask airway. Standard monitoring was implemented.

The scanning protocol was as follows.

The patients were placed in left lateral position with gentle flexion at hip and knee. Ultrasound scan was performed with high-frequency probe (Sonosite M turbo & Micromax HFL, linear, L38). The transducer was positioned transversely over the previously operated area on the spine in the midline. The probe was shifted upwards with the required adjustments to visualize structures.

The aim was to delineate the osseous framework of the spine, which indicated normal spine. The area of the MMC repair was devoid of any such framework (Figure 1). After identification of the osseous framework, the upward scanning was continued to pick up the subsequent spine and the interspinous space for the lumbar epidural (Figure 2) placement.

One anesthesiologist performed the loss of resistance to saline in the appropriate intervertebral space as located by ultrasound, while the other observed the dural displacement in a space higher. An epidural catheter (18-gauge epidural minipack system, 21-gauge

TABLE 1 Illustrates the demographics, duration, and types of surgeries

Parameters	Mean and SD
Age in years	6.18 ± 3.52
Weight in kgs	20.27 ± 9.61
Sex (M/F)	8/6
Duration of surgery	4.79 ± 0.83
Type of surgery Hip/Foot	8/4

What is already known

- Establishment of central neuraxial blocks is challenging in post meningomyelocele repair patients

What this article adds

- Ultrasonography helps distinguish between normal and abnormal intervertebral space and makes placement of epidural catheters objective in post meningomyelocele repair patients.

multihole catheter, Portex, Smith medical) was inserted 2-3 cm beyond the epidural space. Of 0.25% bupivacaine, 0.5 mL/kg was injected in aliquots after negative aspiration for blood and cerebrospinal fluid. This was repeated after every 2 hours. Postoperatively, epidural infusion of 0.125% bupivacaine at 0.4 mg/kg/h was established. The pain scores were monitored by the resident on call.

Intraoperatively, an increase in pulse rate by 20% from the basal was considered as block failure. Fentanyl 2 µg/kg was administered as rescue analgesic in case of block failure. Pain scores were documented in the first 48 hours postsurgery. Along with the epidural infusion, they received paracetamol 15 mg/kg IV twice a day. In the postoperative period, pain was assessed using Faces pain scale. Inadequate pain relief was treated by epidural top boluses of 0.125% 0.5 mL/kg over and above the infusion.

2.1 | Statistics

The data were analyzed statistically using SPSS 15 software (IBM Inc., Chicago, IL, USA). All data are presented as mean ± standard deviation.

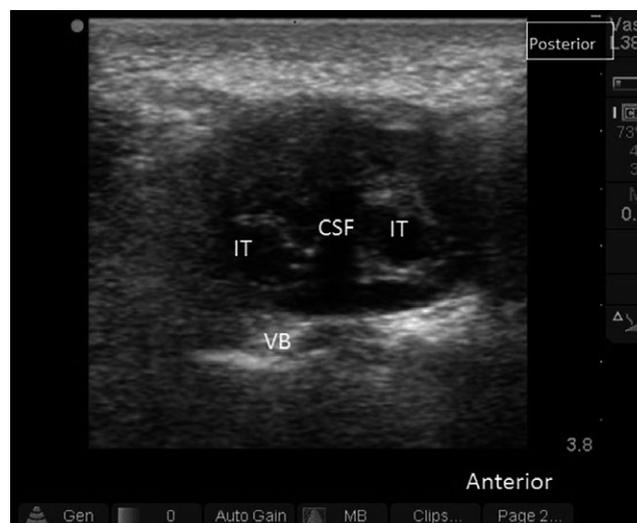


FIGURE 1 Abnormal spine at the level of MMC repair: SC, Bifid spinal cord; CSF, cerebrospinal fluid, osseous framework of the spine not appreciable; VB, posterior aspect of vertebral body seen; MMC, meningomyelocele

3 | RESULTS

The demographics, duration of surgery, and types of surgery are illustrated in Table 1.

With ultrasonography, we could confirm the presence and absence of osseous framework, the soft tissue shadow, and the anterior and posterior dural complexes in all 12 patients.

One of 12 cases required 2 attempts for insertion of the epidural catheter.

There was no incidence of dural puncture.

Displacement of dura as a marker coinciding loss of resistance to saline was identified in all patients.

We could identify the extent of peri-incisional fibrosis with ultrasonography over the operated area in all cases.

Heart rate response to incision was not observed in any of the cases.

Pain scores remained acceptable in the postoperative period in 9 patients (score ≤ 4).

Three of 12 patients required additional 1 top up in the first 24 hours. On the second postoperative day, epidural top ups were not required in these 3 patients.

4 | DISCUSSION

In our study, we could select the most well-formed and most normal appearing intervertebral space in all 12 cases by ultrasonography. As heart rate response to incision was not observed in any cases, the epidural catheters gave adequate pain relief intraoperatively. However, postoperatively, in 3 patients, pain relief was inadequate as indicated by the pain scores. The pain scores improved after an

additional top up bolus over and above the infusion administered. Interestingly, all the 3 cases were bilateral foot surgeries. This may be a probable sign that diffusion to the sacral roots was impaired due to local fibrosis. Perhaps successful catheter placement and initial successful block should not be assumed to guarantee adequate analgesia in the postoperative period and warrants fine tuning of dosages.

The use of regional anesthetic techniques in patients with preexisting central nervous system disorders was considered relatively contraindicated. The fear of worsening neurologic outcome secondary to mechanical trauma, local anesthetic toxicity, or neural ischemia was commonly reported and remained a concern.⁴ The largest series of neuraxial anesthesia in the patient with a preexisting central nervous system condition involved 139 patients. There were no patients with new or worsening postoperative neurologic deficits when compared to preoperative findings.⁵ In our study, we used ultrasonography to select the interspinous space with normal anatomy for epidural placement.

Alterations in the intracranial pressures due to epidural injection are known. Lee⁵ et al estimated the effects of caudal block on intracranial pressure with 1 and 1.5 mL/kg volumes of local anesthetic. They measured the intracranial pressure using ultrasonography measurement of optic nerve sheath diameter. They concluded that the intracranial pressure increases in proportion to the volume of local anesthetic used. In post meningomyelocele repair children, some part of the epidural and subarachnoid spaces is occupied by fibrosis or even missing. We have used a volume of 0.5 mL/kg in the epidural space, a volume significantly lesser than the study referred to. However, we should be aware that this can alter the intracranial pressures due to epidural injection.

Platis et al⁶ demonstrated in their case series that the use of caudal anesthesia for abdominal and orthopedic surgery was safe and effective in children with shunt devices. Four of 12 cases in our study had a ventriculo-peritoneal shunt. As these were major orthopedic surgeries with severe postoperative pain, we placed continuous epidural catheters.

In unilateral footsurgeries, peripheral nerve blocks could be a valuable alternative to epidural analgesia. In bilateral foot surgeries, it adds to the challenge of managing bilateral sciatic perineural catheter infusions. We selected epidural analgesia due to the bilateral nature of the surgery. Catheter in fascia iliaca compartment was another alternative for hip surgeries. The postoperative mid waist spica casts makes it difficult to maintain the continuous infusion.

Nevertheless, central neuraxial blockade in this population will still remain a delicate procedure keeping in mind that the remaining neural structures may be at the limit of their viability.

The decision of epidural continuous block was taken because we could identify a well-formed intervertebral space with ultrasonography. Secondly, these surgeries cause severe postoperative pain. We believed that the risk-benefit ratio justified the intervention.

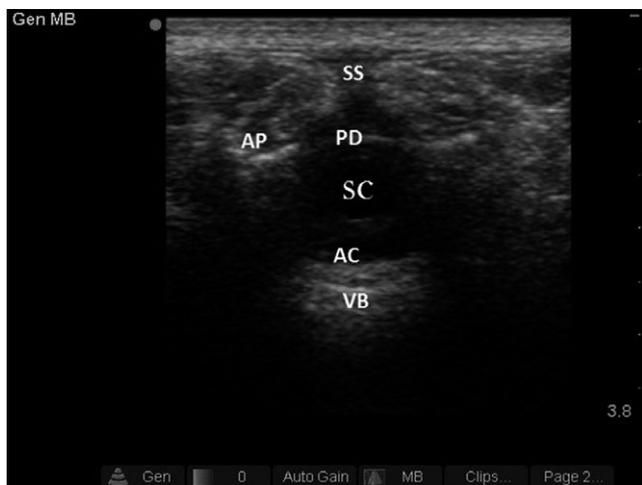


FIGURE 2 Normal lumbar spine above the level of MMC. SS, soft tissue shadow; AP, articular process; PD, posterior dura; SC, spinal cord; AC, anterior complex; VB, vertebral body; MMC, meningomyelocele

5 | CONCLUSION

Ultrasound guidance helps in identification of normal vertebral space and explicitly shows the abnormal space. It can be used as an aid to differentiate between normal and abnormal space in post-meningomyelocele repair. This should make our decisions to select and insert epidural catheters easier in children having lower limb surgery post meningomyelocele repair.

ETHICAL APPROVAL

Any necessary ethical approval(s): Approved by the institutional ethical committee. Number EC-09/03/2017.

CONFLICTS OF INTEREST

The authors report no conflict of interest.

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