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CASE REPORT

Real-time ultrasound-guided epidural catheter placement in infants: a case series

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Abstract Although epidural catheter insertion under ultrasound (US) guidance in the pediatric age group has been reported in the literature, it is yet to be adopted widely in clinical practice. The incomplete fusion of bones in pediatric patients provides an acoustic window for the US. The epidural space in children is at shallow depth, hence a high-frequency probe, which provides better resolution can be used. We present a case series in which real-time US-guided epidural catheter placement was performed in 10 infants in lower thoracic and upper lumbar interspaces. We reiterate that the use of real-time US during epidural catheter placement in patients increases the success rate of epidural catheter placement while decreasing procedural complications.

Introduction

Epidural analgesia is the standard and reliable technique of perioperative pain relief in patients undergoing abdominal and thoracic surgeries.[1] But, its use in the infant age group is not that common because of concerns about higher chances of dural puncture and neurological complications as they have thinner and softer ligamentum flavum, narrower interspace, and as most of the epidural catheter in children is performed under general anesthesia[2] The ultrasound (US) improves the success rate and safety margin in epidural catheter placement.[3]

There is a dearth of literature on this. We present a case series of ten American Society of Anesthesiologists (ASA) physical status I/II infants undergoing abdominal surgeries, in which a real-time US-guided epidural catheter was placed. We also used a unique Parasagittal Oblique (PSO) view for performing this procedure.

Case presentation

Institutional ethics committee approval and informed written parental consent were taken. A thorough preoperative checkup was done one day before the scheduled operative day. Exclusion criteria included children with a history of spine deformity or surgery, neurological disorder, coagulopathy, local infection or sepsis, and allergy to local anesthetics.

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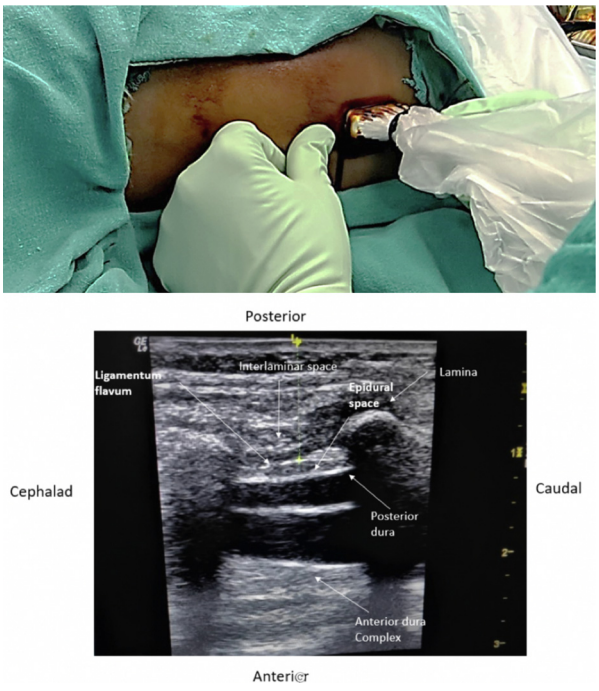

Figure 1 Probe placement and ultrasound image of epidural space.

All epidurals were performed by two anesthesiologists, who had sufficient experience in pediatric regional anaesthesia (MK and PB) under general anesthesia in the left lateral position, congruent epidurals were inserted in lower thoracic and lumbar regions using linear/hockey probe (8 to 13 MHz) (GE LOGIQe 9L, GE Healthcare, Wauwatosa, Wisconsin) after getting an optimal view of ligamentum flavum and anterior and posterior dura complexes by PSO approach (Fig. 1). The posterior epidural space is seen as a hypoechoic area between the hyperechoic ligamentum flavum and the posterior dura. A 19G, 50- mm Tuohy needle (Vygon, Aachen, Germany), marking at every 0.5 cm from 1 cm from the distal tip was inserted in-plane from the caudal end of the probe and advanced under real-time US guidance. Constant visualization of the lamina and the posterior epidural space helped in the depth determination and prevention of dural puncture or damage to the spinal cord. Further confirmation of epidural space was done by the 10- mL plastic syringe with loss of resistance to saline technique and simultaneous visualization of downward displacement of posterior dura complex on the US (Fig. 1). The 22G epidural catheter was threaded through the needle till 2.5–3 cm inside in epidural space. Procedure time (start from skin needle insertion to access of epidural space), number of bone contacts or needle redirections, number of attempts, and procedure-related complications like dural puncture, bloody tap were recorded.

Results

The median age was 10 (8.8–11.25) months and the median weight was 7.25 (6.6–7.6) kg. The real-time US-guided epidural catheter placement was performed with a 100% success rate. The mean procedure time taken was 212 seconds (range 60–480 seconds). Seven out of 10 required single needle insertion attempts, while 2 and 3 attempts were needed in 2 and 1

Table 1 Patient details.

Name of surgery	Sex	Age (months)	Weight (kg)	Level of epidural	Number of attempts	Bone contacts	Redirections	Time (sec)	Complications
Colostomy closure	M	12	7.0	L1–L2	1	1	2	130	None
Colostomy closure	M	10	8.2	T12–L1	2	2	2	180	None
Case of ARM – Colostomy formation	F	9	6.8	T11–T12	1	None	0	60	None
Colostomy closure	F	10	7.5	T11–T12	1	2	2	360	None
Elective kasai procedure	F	2	3.7	T9–T10	1	1	2	70	None
PSARP	M	9	7.5	T12–L1	1	1	1	210	None
Hepatico-enterostomy	F	7	7.0	T8–T9	1	None	0	300	None
Urethroplasy	M	11	7.5	L3–L4	1	1	1	115	None
Gastric pull up	F	12	9	T7–T8	3	2	2	480	None
Colostomy closure	M	11	6	T12–L1	1	2	2	150	None

ARM, Anorectal malformation; PSARP, Posterior Sagittal Anorectoplasty.

patients, respectively. Two patients had no bone contact, while 4 had single bone contact, and 4 had it twice. No needle redirections were required in 2 patients, single redirections in 2 patients, and two redirections in 5 patients (Table 1). Any procedure-related complications were not observed.

Discussion

Ultrasound guidance has advantages, particularly in young children in terms of success rate.

The US helps in visualizing interlaminar space, ligamentum flavum, dural complexes, needle tip, the position of the epidural catheter, and the spread of the local anaesthetic solution. In pediatric patients, due to the lack of ossification of posterior elements of the spinal canal, an acoustic window can be easily obtained. The ultrasound can also be used to locate conus medullaris and dural sac as well as any structural abnormalities that preclude the use of epidural blockade. The US helps in precise localization of targeted interspace and to visualize the spread of caudally administered drugs, hence it will help in achieving better postoperative analgesia. The real-time visualization of the epidural needle under the US offers additional safety and benefits. However, additional studies are required before concluding that ultrasound guidance reduced the rate of bloody puncture.

The Pediatric Regional Anesthesia Network (PRAN) provided highly audited data on practice patterns and complications in infants and children. Almost all (95%) blocks were placed under GA, single-injection caudal blocks were the most frequently performed (40%). Single-injection blocks had fewer adverse events than continuous blocks, although the most frequent events (33% of all events) in the latter group were catheter-related problems.[4]

The longitudinal PSO view is a good view for epidural catheter placement in pediatric patients. It allows needle manipulation along with probe placement in limited space available in children. The complications like dural puncture and injury to the spinal cord encountered during traditional epidural catheter placement in pediatric patients can be minimized by using the US. Commonly practiced caudal route of epidural catheter placement in children also comes with risks of contamination with anal bacteria and chances of coiling and failure.[5]

However, real-time US-guided epidural catheter placement in small children and infants needs some degree of expertise and has a learning curve.

Conclusion

Lumbar or thoracic epidural catheter placement in infants is gaining momentum in pediatric anesthesia practice. US use can increase the success rate and margin of safety while reducing needle redirections and insertion attempts.

Authors' contribution

The manuscript has been read and approved by all the authors, that the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work, if that information is not provided in another form.

Conflicts of interest

The authors declare no conflicts of interest.

Previous presentation in conferences

Euroanaesthesia 2019 conference at Vienna, Austria.

Institutional Ethical Committee

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