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ORIGINAL ARTICLE

The caudal space in fetuses: an anatomical study

Anjali Aggarwal · Daisy Sahni · Harjeet Kaur · Yatindra K. Batra · Rakesh Sondekoppam Vijayashankar

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Abstract
Purpose The caudal epidural space is a popular site for analgesia in pediatrics. High variation in blind needle placement is common during caudal epidurals, increasing the risk of intravascular and intrathecal spread. Knowledge of safe distances and angles for accessing the caudal epidural space in premature infants can improve the safety of caudal epidural blocks.
Methods Thirty-nine fetuses with crown–heel length between 33 and 50 cm, corresponding to gestational age of 7–9 months, were included. The dorsal surface of the sacrum from the fourth lumbar vertebra to the tip of the coccyx was dissected, following which measurements were taken on dorsal surface and midsagittal sections. The angle of depression of the needle was measured using a goniometer following the two-step method of needle insertion.
Results Right and left sacral cornua were palpable in 23 of 39 fetuses (58.97%). Termination of dural sac was at S2 in most of the fetuses (53.84%), whereas the apex of the sacral hiatus was at S3 in most (58.97%). The distance from the apex of the hiatus to the termination of dura ranged from 3 to 13 mm; the anteroposterior distance of the canal at the apex of the hiatus ranged from 1.72 to 4.38 mm. All sacral parameters correlated with crown–heel length except inter-cornual distance, depth of canal at hiatus, and height of sacral hiatus.
Conclusion Distances and angles for accessing the caudal epidural space in fetuses do not provide all parameters for safe performance of caudal epidural blocks in premature and low birth weight infants because the apex of the sacral hiatus and the termination of the dura show wide variation in location.

Keywords Caudal epidural space · Crown–heel length · Fetuses · Premature infants

Introduction

Caudal epidurals (caudal epidural blocks, CEB) are commonly employed in pediatrics to ensure postoperative analgesia in pediatric surgery [1]. A clear understanding of the normal anatomy of the sacral hiatus and surrounding structures is crucial to the success of CEB. Caudal blocks may be easier to perform in premature and ex-preterm infants [2] without increased risk of complications as compared to other pediatric populations [3] but require knowledge of anatomical dimensions and expertise to perform [4] because of the narrow dimensions of the caudal space and its proximity to other structures.

Although ultrasound-guided regional anesthesia is rapidly gaining acceptance in pediatrics, more traditional approaches such as landmark-based or nerve stimulator-guided techniques are still worthwhile. Although evidence to make a recommendation for its routine use in neuraxial anesthesia is lacking, ultrasound is becoming increasingly popular in recent years for the placement of caudal blocks [5], and knowledge of sacral anatomy may aid in the identification of structures during the performance of

A. Aggarwal · D. Sahni · H. Kaur
Department of Anatomy, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Y. K. Batra (✉) · R. Sondekoppam Vijayashankar
Department of Anaesthesia and Intensive Care, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India
e-mail: ykbatrapgi@gmail.com

caudal anesthesia. Identification of anatomical landmarks, especially the sacral hiatus, is key to successful placement of CEB by landmark-based approaches. Anatomical studies of the sacrum in pediatrics have mostly been conducted on dry sacral bones [6]. Studies employing ultrasonography or other imaging modalities [7, 8] have been conducted to evaluate the techniques of needle insertion rather than the safe distances for needle insertion in children, especially premature and very low birth weight infants. The best angle of needle insertion also needs evaluation in premature infants. This need has prompted interest in cadaveric study of the fetal caudal space to determine the safe distances and direction of needle insertion.

With this background, we aimed to study the safe distances and relationships of the bony landmarks used for the performance of caudal epidural anesthesia in fetuses corresponding to the age of premature infants. We also planned to determine the angle of needle insertion that would increase the likelihood of entry of the needle into the sacral hiatus, thus enhancing the success rate of CEB.

Methods

After Institutional Ethical Committee clearance and written informed parental consent, 39 fresh stillborn fetuses (21 male and 18 female) of gestational age between 7 and 9 months and crown–heel length (CHL) ranging between 33 and 50 cm, without any congenital anomaly, were included for this observational study. The fetuses were preserved in 10% formalin after dissection and recording of the measurements. Crown–heel length was noted by straightening each fetus, and measurements were taken in supine position before dissection. Skin and underlying soft tissue extending from the level of the fourth lumbar vertebra to the tip of the coccyx were removed to expose the right and left posterior superior iliac spines (PSISs) and the dorsal surface of sacrum and coccyx. The following measurements were taken with fetus in prone position (Fig. 1)

- Inter-cornual distance (ICD): between the apices of the bilateral sacral cornua (Rc–Lc)
- Distance between right and left PSISs from their tips (inter PSIS distance, IPSID)
- Distance between right PSIS and apex of sacral hiatus (RS–Apx)
- Distance between left PSIS and apex of sacral hiatus (LS–Apx)
- Height of sacral hiatus (Ht SH).

In the midsagittal sections (Fig. 2): the following details of the sacral canal were measured

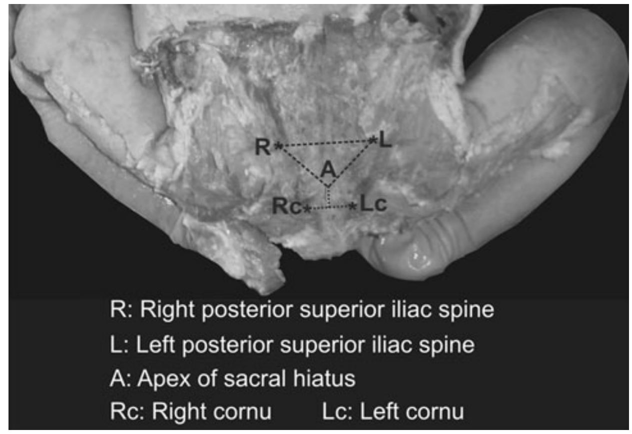

Fig. 1 Dorsal surface of the sacrum showing right (*R*) and left (*L*) posterior superior iliac spines, apex of sacral hiatus (*A*), and right (*Rc*) and left (*Lc*) sacral cornua

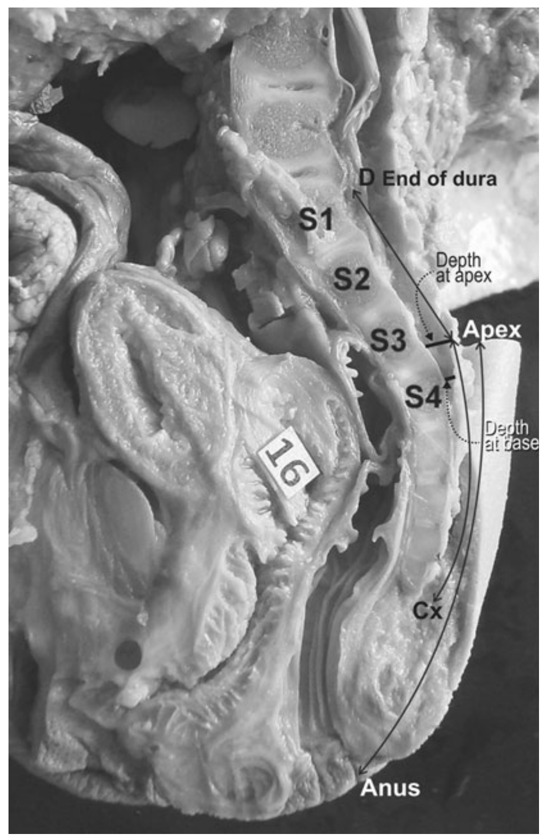

Fig. 2 Sagittal section showing termination of dura (*D*), apex of sacral hiatus (*Apex*) against the sacral vertebra (*S1–S4*), depth of caudal canal at the apex (AP at Apx) and base (AP at Base) of the sacral hiatus, distance from apex of hiatus to termination of dura (Apx–D), and distance from the apex of hiatus to tip of coccyx (Apx–Cx) and posterior anal margin (Apx–Anus)

- Level of termination of dural sac was noted as the lowest limit of dural sac in relation to the adjacent vertebral body (D)

- Level of apex of sacral hiatus in relationship to the adjacent vertebral body (Apx)
- Anteroposterior depth of sacral canal close to base of sacral hiatus (AP depth at Base)
- Anteroposterior depth of sacral canal close to apex of sacral hiatus (AP depth at Apex)
- Straight distance from apex of hiatus from caudal end of dural sac (Apx–D)
- Distance between apex of hiatus and tip of coccyx (Apx–Cx)
- Distance between apex of hiatus and posterior margin of anus (Apx–Anus).

Angle of depression of needle (Angle) was measured to determine the optimal angle for needle insertion into the caudal space through the upper part of the sacrococcygeal membrane (Fig. 3). The needle was first placed at a right angle to the sacrococcygeal membrane, then depressed by an angle such that it lies along the axis of the sacral canal. This angle of depression was measured using a goniometer. All linear measurements were taken using digital calipers with 0.02-mm precision. The measurements were taken twice by two independent observers blinded to each other's measurements, and the average of the two measurements was used for further analysis. Cohen's kappa coefficient to test for intraobserver reproducibility and interobserver variability was calculated to be 0.86 and 0.79, respectively.

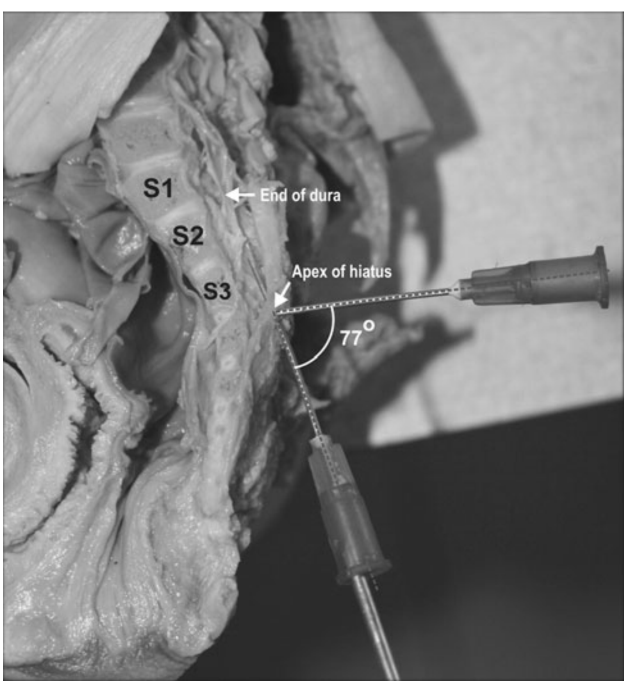

Fig. 3 Measurement of angle. The needle is inserted at the *apex of hiatus* perpendicular to the sacrococcygeal membrane and indented by an angle (here, *77°*) so as to lie along the axis of the caudal canal. The termination of the dura (*end of dura*) is also shown

Statistical analysis

Studies on the caudal space exclusive to premature infants and neonates are lacking in the literature. The depth of the caudal space at the level of the sacral hiatus, which is the level of performance of caudal blocks, was considered the primary outcome for calculating sample size, and distances in relationship to other bony landmarks and dura were the secondary outcome. A power analysis based on a previous study [8] employing the depth of caudal space at the hiatus, which was independent of age, height, weight, or body surface area, was therefore considered. Assuming the same variance (±1.79) as seen in the previous study [8], a sample size of approximately 35 was adequate to ensure a 95% confidence interval of measurement with that of the observed variance of the same measurement in the present study (±0.64). Our study included 39 fetuses, thus ensuring adequate sample size. The variables were tested by a one-way Kolmogorov–Smirnov test, which showed a normal distribution. A one-way analysis of variance (ANOVA) was applied to determine the variance between observations, which showed a standard deviation and standard error of measurements in the range of 0.018–0.197 and 0.008–0.070 mm, respectively. To compare CHL with other variables, Pearson's correlation coefficient was applied. Gender-related differences between the means of measurements were compared by using an unpaired t test. $P < 0.05$ was considered statistically significant. To test for an equilateral relationship of the sacral triangle, we compared the first norm of difference of the three sides with a standard error of measurement of 0.01 mm to know whether at least any two sides correlated with each other. Statistical analysis utilized SPSS (SPSS 14 for Windows; SPSS, Chicago, IL, USA).

Results

The measurements of dorsal and sagittal sections are shown in Table 1. Both sacral cornua were palpable in 23 fetuses (58.97%), and at least one sacral cornu was palpable in 10 fetuses (25.64%); it was nonpalpable in 6 fetuses (15.38%). In sagittal sections, the termination of the dural sac was at the level of S1 in 5 fetuses (12.82%), the S1–S2 junction in 6 fetuses (15.38%), S2 in 20 fetuses (51.28%), the S2–S3 junction in 6 fetuses (15.38%), and S3 in 2 fetuses (5.1%). The apex of the sacral hiatus (Apx) was found to be at the level of S2 in 2 fetuses (5.1%), the S2–S3 junction in 2 (5.1%), S3 in 23 (58.97%), S3–S4 in 7 (17.94%), and S4 in 5 fetuses (12.82%). The distance between the apex of sacral hiatus and termination of dura (Apx–D) ranged from 3 to 13 mm with a mean (±SD) of 6.49 (±2.84) mm. The anteroposterior distance of the

Table 1 Sacral measurements on dorsal surface and midsagittal section

Measurements (mm)	Range (in mm) (min–max)	Mean (±SD) (in mm)	Pearson's correlation coefficient	*P* value
Measurements on dorsal surface				
1. Inter-cornual distance (ICD)	2.48–8.90	6.30 (±1.40)	0.257	0.162
2. Distance between right and left PSIS (IPSID)	10.83–20.92	15.62 (±2.64)	0.723	0.001
3. Distance between right PSIS and APX (RS–Apx)	6.6–15.0	9.62 (±2.02)	0.537	0.002
4. Distance between left PSIS and APX (LS–Apx)	6.3–15.0	9.74 (±2.12)	0.604	0.001
5. Height of sacral hiatus (Ht SH)	3.13–16.48	7.91 (±2.57)	0.073	0.697
Midsagittal sections				
1. Anteroposterior (AP) depth of canal at apex of hiatus (AP at Apx)	1.72–4.38	2.93 (±0.64)	0.269	0.143
2. AP depth of canal at base of hiatus (AP at Base)	1.20–3.95	2.09 (±0.65)	0.337	0.063
3. Distance of apex of hiatus from caudal end of dural sac (Apx–D)	3–13	6.49 (±2.84)	0.460	0.009
4. Distance between apex of hiatus and tip of coccyx (Apx–Cx)	14.8–34.9	24.70 (±4.61)	0.409	0.023
5. Distance between apex of hiatus and posterior margin of anus (Apx–Anus)	26.8–54.8	38.39 (±7.09)	0.669	0.001
6. Angle of depression of needle (Angle)	68–85	77.35 (±4.70)	–	–

sacral canal at the level of the hiatus (AP at Apx) ranged from 1.72 to 4.38 mm with a mean (±SD) of 2.93 (±0.64) mm.

The mean (±SD) angle of depression was found to be 77.35° (±4.70°) and ranged from a minimum of 68° to a maximum of 85°. All the measurements on the dorsal surface and sagittal section of sacrum correlated linearly with CHL (Fig. 4), except inter-cornual distance (ICD), height of sacral hiatus (Ht SH), and anteroposterior distance of canal at apex (AP at Apx) and base (AP at Base) of sacral hiatus (Table 1). No sexual dimorphism was observed for any measurements (Table 2).

None of the fetuses showed an equilateral relationship of the sacral triangle. In 12 fetuses (30.76%), at least one of the measurements showed equality with another measurement. Among the fetuses with agreement between at least two measurements of the sacral triangle, the distances from right and left PSISs to the sacral hiatus were the ones matching each other. The distance between the two PSIS was always greater than the distances between each PSIS and the sacral hiatus (Table 1). Also, the mean distances between each PSIS and sacral hiatus were similar to each other.

Discussion

We conducted the study in fetuses with a gestational age corresponding to preterm neonates. Our study describes the measurements important for performance of caudal epidural blocks in premature infants. All the study parameters increased with CHL except inter-cornual distance (ICD), height of sacral hiatus (Ht SH), and anteroposterior length of sacral canal at base (AP at Base) and at apex (AP at Apx) of the sacral hiatus. No equilateral relationship was observed in the three sides of the sacral triangle. There was no sexual dimorphism in any measurements.

Improved survival of extreme premature and low birth weight infants has led to a subsequent increase in the numbers of early surgeries in the neonatal period [9]. CEB find increased applicability with concerns over postoperative apnea and a renewed interest in regional anesthesia as a risk reduction strategy [10]. Crucial to the success of caudal epidural block is identification of the sacral hiatus and knowledge about the direction and depth of needle insertion. The rate of failure could be much higher than in adults [11] because of the narrow dimensions of the canal. The proximity to other structures, such as dura, which is greater in this population, makes performance of caudal block more challenging to the anesthesiologist, necessitating accurate knowledge of the anatomy of the region.

The sacral cornua provide information about the location of the hiatus and space available to pass the needle into the caudal epidural space. In our study, both cornua or at least one sacral cornu was palpable in the majority of fetuses (85%); no cornu was palpable in 6 fetuses (15%). Studies on ICD in fetuses are sparse. In an ultrasonographic study of caudal epidural space in children, Park et al. [7] noted the median (range) to be 17.0 (9.6–24.6) mm. The measurements in our study are quite smaller than those observed by Park et al. [7], reflecting the different age groups studied. We noted the smallest ICD that would safely allow the passage of a needle for CEB to be 2.48 mm. The three distances used to locate the sacral hiatus, namely, distance between the two PSIS (ipsilateral

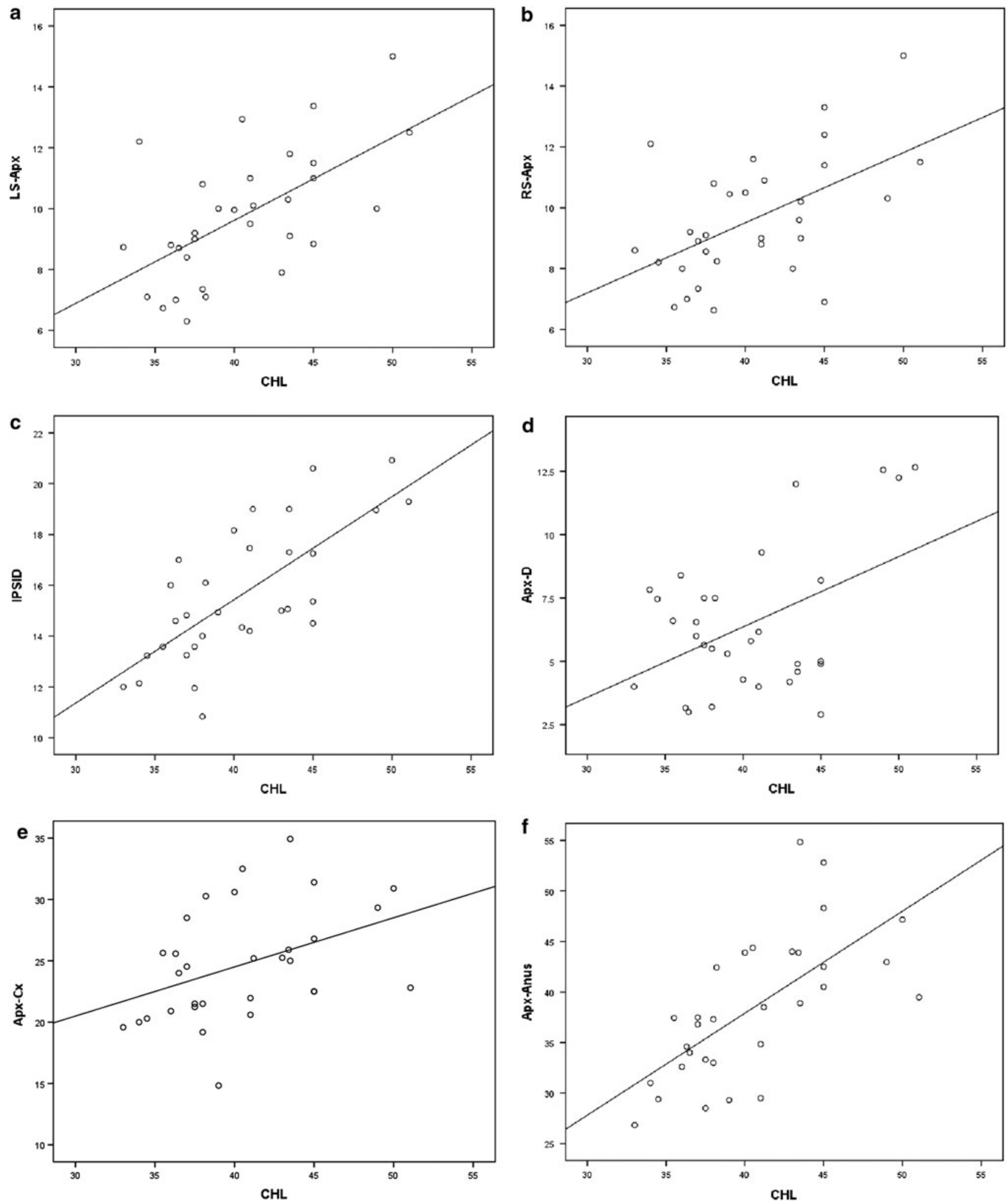

Fig. 4 Scatterplots of measurements correlating positively with crown–heel length (*CHL*). **a** *LS–Apx* distance between left posterior superior iliac spine (PSIS) and apex of hiatus. **b** *RS–Apx* distance between right PSIS and apex of hiatus. **c** *IPSID* distance between right and left PSIS. **d** *Apx–D* distance from apex of hiatus to caudal end of dural sac. **e** *Apx–Cx* distance between apex of hiatus and tip of coccyx. **f** *Apx–Anus* distance between apex of hiatus and posterior margin of anus

Table 2 Comparison of measurements between the two sexes

Measurements (mm)	Females, mean (±SD)	Males, mean (±SD)	*P* value
Measurements on dorsal surface			
1. Inter-cornual distance (ICD)	6.82 (±1.15)	5.87 (±1.61)	0.075
2. Distance between right and left PSIS (IPSID)	16.42 (±2.92)	14.97 (±2.27)	0.132
3. Distance between right PSIS and apex of hiatus (RS–Apx)	10.66 (±2.20)	9.76 (±1.41)	0.070
4. Distance between left PSIS and apex of hiatus (LS–Apx)	10.69 (±2.19)	9.37 (±1.76)	0.062
5. Height of sacral hiatus (Ht SH)	7.29 (±1.99)	8.42 (±2.93)	0.227
Midsagittal sections			
1. AP depth of canal at apex of hiatus (AP at Apx)	2.99 (±0.67)	2.89 (±0.63)	0.663
2. AP depth of canal close to base of hiatus (AP at Base)	2.23 (±0.76)	1.98 (±0.55)	0.294
3. Distance of apex of hiatus from caudal end of dural sac (Apx–D)	6.43 (±3.49)	6.55 (±2.27)	0.906
4. Distance between apex of hiatus and tip of coccyx (Apx–Cx)	24.92 (±4.98)	24.51 (±4.44)	0.808
5. Distance between apex of hiatus and posterior margin of anus (Apx–Anus)	40.13 (±7.41)	36.96 (±6.70)	0.222

PSIS, IPSID) and the distances between each PSIS and the apex of the sacral hiatus, are known to exist as an equilateral triangle.

In our study, none of the showed this equilateral relationship. In an adult study [12], the sacral triangle was found to be equilateral in only 51% of cases, whereas another study [6] found the left and right sides of the triangle similar in each sacrum and always greater than the base of triangle. In contrast to this fetuses report [6], although the left and right sides of sacral triangle measurements were similar in our study, the base of the triangle (IPSID) was always greater than either RS–Apx or LS–Apx (Table 2). Afshan et al. [13]. noted complications following caudal epidural injections resulted from misplacement of the needle into the superficial soft tissues, or intravascular, intra-osseous, and intrathecal injections leading to technique failure, systemic toxicity, or accidental spinal anesthesia, respectively. They attributed the high incidence of intra-osseous puncture in children younger than 10 years to the dimensions of the canal that is narrower than that of adults. The mean (range) caudal epidural space depth as noted in two studies [7, 8] in children of varying age groups was 4.9 (2.0–10.0) mm and 3.5 (1–8) mm. In our study, the anteroposterior distance of the sacral canal at the apex (AP at Apx) and base (AP at Base) of the hiatus was 2.93 (1.72–4.38) and 2.09 (1.20–3.95) mm, respectively. These distances provide a safe distance that can be allowed for the needle to progress after piercing the sacrococcygeal membrane at right angles in premature infants and neonates. Porzionato et al. [14], in a recent review of sacral hiatal anatomy, noted the mean sacral space depth to be 4.6 mm in adults and 3.5 mm in infants. The measurements of fetuses of gestational age around 9 months from our study correlated fairly well with their measurements noted in neonates [14].

In a review of the anatomical characteristics of the sacral hiatus, Porzionato et al. [14] noted the mean distance between the hiatal apex and the dural sac to be in the range 45–60.5 mm in adults and 31.4 mm in children [8]. In a majority of fetuses in our study, the termination of the dura was at the level of S2 or higher, and could be seen as low as the S2–S3 junction in 6 (15%) fetuses and S3 in 2 (5%) fetuses. The apex of the sacral hiatus was found to be at or below the S3 vertebra in the majority of fetuses, but it was as high as S2 in 2 fetuses (5%) and the S2–S3 junction in 2 fetuses (5%). The straight distance between the apex of hiatus to the termination of dura is more important to determine the safe distance to which the needle can be inserted in the caudal epidural space. In our study, this distance showed a wide variation, from 3 to 13 mm, with a mean (±SD) of 6.49 (±2.84) mm. Placing a CEB in patients of this age group is fraught with increased risk for dural puncture if the needle is advanced more than 3 mm after piercing the sacrococcygeal membrane.

There are many insertion techniques for needle placement in the caudal epidural space [7, 15, 16]. In a recent review of the sacral hiatus [14], lower insertion angles of around 21° were suggested for infants. In our study, the mean (±SD) angle of depression required to align with the sacral canal was found to be 77.35° (±4.70)° with the vertical and ranged from a minimum of 68° to a maximum of 85°. These angles were measured with the vertical to sacrococcygeal ligament as per the two-step technique of insertion, and hence cannot be compared with single-step insertion techniques determining angle of insertion with the skin, although the need for low insertion angles to align the needle along the sacral canal is quite evident. So, from our study, we can deduce an insertion angle less than 20° is needed in premature infants if employing the “no-turn technique” [17]. This extreme angulation may result from the flatter nature of the fetal sacrum and the vertical alignment of sacral canal. In the two-step approach, we recommend not to advance the needle for more than 2 mm after vertically piercing the sacrococcygeal membrane, to align the needle along the canal by depressing the needle by about 75°, and not to insert beyond 3 mm along the sacral canal. Abnormalities of the sacral hiatus such as agenesis, bony septum, and posterior closure contribute to failure of CEB in 3–7% of cases [18, 19].

One of the drawbacks of our study is the inability to measure the distance from skin to sacrococcygeal membrane because of the small distance between these two structures. We excluded fetuses with congenital malformations of sacrum from our study; however, such conditions could be more common and may require further studies to detect their incidence. Although the fetuses were in the flexed and knee–chest position, mimicking the position for performance of CEB, the implications of the abduction of the legs on the measurements needs further evaluation.

In conclusion, the sacral anatomy of fetuses shows wide variability and confirms the need for extreme caution in placing CEB. This study reiterates that not proceeding beyond 2 mm after vertical approach, using lower angles of insertion, and avoiding insertion of the needle more than 3 mm along the canal after piercing the sacrococcygeal membrane enhance the safety of performance. The equilateral relationship of the sacral triangle may be unreliable to locate the sacral hiatus in premature and term neonates, which requires further confirmation. Ultrasound may enhance the safety of performance of caudal block in premature infants, given the wide variability of height of the sacral hiatus and termination of the dural sac.

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Conflict of interest The authors have no conflicts of interest.

References

1. Najman IE, Frederico TN, Segurado AV, Kimachi PP. Caudal epidural anesthesia: an anesthetic technique exclusive for pediatric use? Is it possible to use it in adults? What is the role of the ultrasound in this context? Rev Bras Anestesiol. 2011;61: 95–109.
2. Hoelzle M, Weiss M, Dillier C, Gerber A. Comparison of awake spinal with awake caudal anesthesia in preterm and ex-preterm infants for herniotomy. Paediatr Anaesth. 2010;20:620–4.
3. Brenner L, Kettner SC, Marhofer P, Latzke D, Willschke H, Kimberger O, Adelmann D, Machata AM. Caudal anaesthesia under sedation: a prospective analysis of 512 infants and children. Br J Anaesth. 2010;104:751–5.
4. Bouchut JC, Dubois R, Foussat C, Moussa M, Diot N, Delafosse C, Claris O, Godard J. Evaluation of caudal anaesthesia performed in conscious ex-premature infants for inguinal herniotomies. Paediatr Anaesth. 2001;11:55–8.
5. Lönnqvist PA. Is ultrasound guidance mandatory when performing paediatric regional anaesthesia? Curr Opin Anaesthesiol. 2010;23:337–41.
6. Senoglu N, Senoglu M, Oksuz H, et al. Landmarks of the sacral hiatus for caudal epidural block: an anatomical study. Br J Anaesth. 2005;95:692–5.
7. Park JH, Koo BN, Kim JY, Cho JE, Kim WO, Kil HK. Determination of the optimal angle for needle insertion during caudal block in children using ultrasound imaging. Anaesthesia. 2006;61:946–9.
8. Adewale L, Dearlove O, Wilson B, Hindle K, Robinson DN. The caudal canal in children: a study using magnetic resonance imaging. Paediatr Anaesth. 2000;10:137–41.
9. Lederhass G. Spinal anaesthesia in paediatrics. Best Pract Res Clin Anaesthesiol. 2003;17:365–76.
10. Craven PD, Badawi N, Henderson-Smart DJ, O'Brien M. Regional (spinal, epidural, caudal) versus general anaesthesia in preterm infants undergoing inguinal herniorrhaphy in early infancy (review). Cochrane Library 2009;4.
11. Barham G, Hilton A. Caudal epidurals: the accuracy of blind needle placement and the value of a confirmatory epidurogram. Eur Spine J. 2010;19:1479–83.
12. Aggarwal A, Kaur H, Batra YK, Aggarwal AK, Rajeev S, Sahni D. Anatomic consideration of caudal epidural space: a cadaver study. Clin Anat. 2009;22:730–7.
13. Afshan G, Khan FA. Total spinal anaesthesia following caudal block with bupivacaine and buprenorphine. Paediatr Anaesth. 1996;6:239–42.
14. Porzionato A, Macchi V, Parenti A, De Caro R. Surgical anatomy of the sacral hiatus for caudal access to the spinal canal. Acta Neurochir Suppl. 2011;108:1–3.
15. Dalens B. Caudal anesthesia. In: Dalens B, editor. Regional anaesthesia in infants, children, and adolescents. Baltimore: Williams & Wilkins; 1995. p. 178–81.
16. Shin KM, Park JH, Kil HK, et al. Caudal epidural block in children: comparison of needle insertion parallel with caudal canal versus conventional two-step technique. Anaesth Intensive Care. 2010;38:525–9.
17. Ivani G. Caudal block: the 'no turn technique'. Paediatr Anaesth. 2005;15:83–4.
18. Aggarwal A, Aggarwal A, Harjeet, Sahni D. Morphometry of sacral hiatus and its clinical relevance in caudal epidural block. Surg Radiol Anat. 2009;31:793–800.
19. Sekiguchi M, Yabuki S, Satoh K, Kikuchi S. An anatomic study of the sacral hiatus: a basis for successful caudal epidural block. Clin J Pain. 2004;20:51–4.