Section: Anatomy

Original Research Article

A MORPHOMETRIC STUDY OF SACRAL HIATUS AND ITS CLINICAL RELEVANCE IN SUCCESSFUL CAUDAL EPIDURAL BLOCK

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Abstract

Background: Knowledge on anatomical features of sacral hiatus, an inverted U shaped opening at caudal end of sacral canal, is important for successful administration of epidural anaesthesia and analgesics. Therefore this study was aimed to evaluate the detailed morphometric features of sacral hiatus. **Materials and Methods:** The study contained 110 normal, dry human sacral bones. Digital vernier calliper was used to measure sacral dimensions like antero-Posterior width, transverse width and intercornual distance. **Result:** The mean length of Sacral Hiatus was 20.19±7.83mm and ranged. The mean width of Sacral Hiatus was 13.39±2.33mm. The mean antero-posterior diameter of sacral hiatus at apex was 6.24±1.42mm. **Conclusion:** Understanding variations in sacral hiatus may improve the success of caudal epidural anaesthesia and decrease the incidence of complication.

INTRODUCTION

Sacrum is a wedge shaped bone which is formed by the fusion of five sacral vertebrae, present at the caudal region of vertebral column. It forms the postero-superior wall of the pelvic cavity, wedged between the two innominate (pelvic) bones.[1] The Sacrum supports the erect spine and provides the strength and stability to bony pelvis to transmit the body weight and also allows considerable mobility in childbearing.[2]

Sacral hiatus is an inverted U shape (most common) opening at the caudal end of sacral canal which is formed due to the nonfusion of the laminae of the (5^{th} or 4^{th}) sacral vertebra. The hiatus is covered by the superficial and deep posterior sacrocooccygeal ligaments along with subcutaneous fatty tissue and skin. The sacral canal contains cauda equina along with filum terminale and spinal meninges. The dura and arachnoid mater ends at the middle of sacrum while pia mater continues as filum terminale up to coccyx.[2]

Sacral hiatus has been used for the administration of epidural/ caudal anesthesia and analgesics in various clinical procedures. The procedure of caudal epidural anaesthesia is entirely depends upon the exact location and variation of sacral hiatus through which clinical material is placed in the epidural space. The absence of sacral hiatus is one of the important anatomical reason of failure of caudal epidural anaesthesia. Anatomical landmarks and knowledge of actual shape and size of sacral hiatus and its variations play very important role in the success of caudal epidural anaesthesia and administration of analgesics.[3]

MATERIALS AND METHODS

The present study was an Observational study, conducted in Department of Anatomy, Era's Lucknow Medical College & Hospital, Lucknow in collaboration with the Department of Anatomy KGMU, Lucknow. The study was carried out on 110 dry human sacra. Only normal sacral bones were included for the study. Sacrum with deformed or broken part or any pathological deformity and neonatal bones were excluded from the study. Few sacra with absent sacral hiatus and unfused lamina were excluded from the study.

Figure 1: a- Vernier caliper, b- Magnifying Hand Lens Instruments used [Figure 1a and Figure 1b]

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1. Magnifying hand lens was used to produce the magnification and for clear vision of the referral points during measurements.
2. Digital Vernier caliper was used for the measurement of length, anterioposterior diameter at apex and transverse width at base of hiatus to an accuracy of 0.1mm.

Figure 2: Measurement of length, width and AP diameter of Sacral Hiatus.

This article is a part of study which was performed on the observation of various features of sacrum including the dimensions of sacum and sacral hiatus. In this article, depth (Antero-Posterior width) at the hiatal apex and Transverse width of sacral hiatus at the base between the two sacral cornua (intercornual distance) were presented and discussed [Figure 2]. The observations were recorded and tabulated in a preformed proforma. Finally, they were transferred over an Excel sheet. The findings were compared with those of other studies. Clearance was obtained from the ethical committee of the Institution for the present study.

RESULTS

The mean length of Sacral Hiatus was measured as 20.19±7.83mm and ranged between 4.90mm & 46.90mm. The mean width of Sacral Hiatus was measured as 13.39±2.33mm and ranges between 8.32 mm & 19.46mm. The mean antero-posterior diameter of sacral hiatus at apex was calculated to be 6.24±1.42mm and ranged between 3.62mm & 10.00mm. [Table 1, Figure 3]

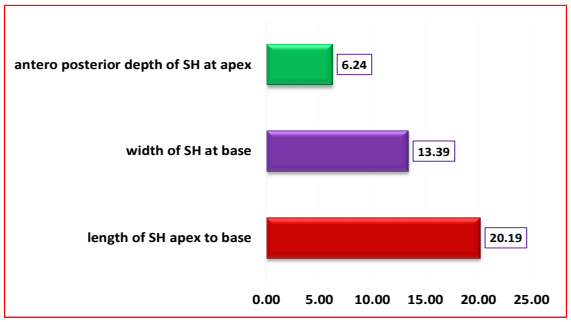

Figure 3: Bar representation of various dimensions of Sacral Hiatus

Table 1: Parameters showing the length, width and antero-posterior diameter of Sacral Hiatus (mm)

Parameters (n=110)	Length of Sacral Hiatus	Width of Sacral Hiatus	Antero-posterior diameter of Sacral Hiatus at Apex
Mean	20.19	13.39	6.24
SD	7.83	2.33	1.42
Min	4.90	8.32	3.62
Max	46.90	19.46	10.04

Table 2: Comparison of length of sacral hiatus among various studies

Length of Sacral Hiatus	Range	Mean
Present study	4.9mm-46.9mm	20.90mm
Shinde A 2018 Maharastra	8.8mm-45.7mm	20.86mm
William F M (2017) Kota Rajasthan	10mm-65mm	22.46mm
Kujur B 2017 Bhubaneswar, Odisha	8.75mm-62.4mm	20.42mm
Sashikala P 2015 Velammal, Madurai.	15mm-40mm	24.00mm
Clarista M.Q 2013 Kerala	7.92mm-59mm	24.73mm
Shewale S 2013 Maharastra	5.53mm-50mm	22.87mm

Table 3: Comparison of Width of sacral hiatus among various studies

Width of Sacral Hiatus	Range	Mean
Present study	8.32-19mm	13.39mm
Shinde A (2015) Maharastra	8.5mm-25.7mm	17mm
WilliamFM(2017)Kota Rajasthan	10mm-20mm	15mm
Kujur B (2017) Odisha	_	12.31mm
Sashikala P(2015) Madurai.	15mm-29mm	12.48mm
Clarista M.Q(2013) Kerala	5.48mm-29.20mm	16.87mm
Shewale S N (2013) Maharastra	4.5mm-24.84mm	13.68mm

Table 4: Comparison of Depth of sacral hiatus at apex among various studies

Depth of sacral Hiatus	Range	Mean
Present study	3.62mm-10.04mm	6.24mm
Shinde A 2018 Maharastra	1.9mm-9.2mm	6.84mm
William F M (2017) Kota Rajasthan	3mm-8mm	5.2mm
Clarista M.Q 2013 Kerala	1.98mm-9.92mm	5.58mm
Shewale S 2013 Maharastra	2mm-10mm	5.18mm

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DISCUSSION

The human sacrum is a large triangular bone. It consists of five fused sacral vertebrae. Sacrum is the most variable portion of spine as a number of anatomical variations occur in this region quite frequently. So the detail morphometric study of sacrum as well as sacral hiatus is of great clinical relevance, since this route is frequently utilized for caudal epidural anaesthesia by anesthesiologist as well as by orthopedic surgeons for treatment and diagnosis of various disease conditions.[4]

The reliability and success of caudal epidural anesthesia depends upon the accurate knowledge of anatomical variations of sacral hiatus specially regarding their dimensions. Thus, the present study was done to find out the measurements of sacral hiatus in North Indian population.

The administration of continuous caudal analgesia may present technical difficulty while inserting a malleable needle through the sacral hiatus into the sacral canal. The increasing application of this method of analgesia is important for clinicians. The same route is also often used for continuous caudal analgesia for a painless delivery. However knowledge of anatomical confirmation and common structural modification of sacral hiatus is essential.[5]

In clinical studies, success rate of Caudal Epidural Anaesthesia has been reported to be about 70% to 80%. Some workers showed that there was a successful injection without using fluoroscopic view in 74% of the cases.[4]

Anatomical landmarks and knowledge of actual shape and size of Sacral Hiatus and its variations play very important role in the success of Caudal Epidural Anaesthesia and administration of analgesics.[6]

Although there are multiple well written texts over normal anatomy and development of sacrum but only a few studies are there depicting the variant anatomy of the bone specially its sacral hiatus part. So, the purpose of this study was to collect the normal base line as well as variant data in our population.

Length of sacral hiatus: In the present study, the mean length of sacral hiatus was 20.90mm. which was almost similar to finding of the Shinde A et al(2018),[7] Babita K et al (2017),[8] and Sashikala P et al (2015),[9] and slightly less than the findings of William FM et al (2017),[10] Clarista et al (2013),[11] Bagoji et al (2020),[12] and Shewala et al(2013) [Table 2].[13]

In the present study, the width of sacral hiatus was 20.90mm. which was similar to the finding of Babita et al (2017),[8] and Sashikala et al (2015).[9] And slightly less than finding of the William et al (2017),[10] Clarista et al (2013),[11] and Shewala et al (2013) [Table 3].[13]

Depth of sacral hiatus

Depth of the sacral hiatus at apex is important as it should be sufficient enough to allow the entry of the caudal needle into the sacral canal with ease. In the present study, the Mean depth of sacral hiatus was6.24mm. ShindeA et al (2018),[7] found approximately similar depth of the hiatus while other authors like William FM et al (2017),[10] Babita K. et al (2017),[8] Clarista M.Q. et al (2013),[11] and Shewale S et al (2013),[13] observed a little lesser depth than the present study [Table 4].

Thus, it can be observed that there are differences regarding various measurements among studies by different authors. The best possible explanation lies in the fact that different authors have selected different populations and sample size. We know that populations differ in their ethnical and zonal characteristics which lead to anthropometric differences. Moreover, if we perform the study on a bigger sample size which will be a true representation of population under study, then we will have a better explanation for the difference.

CONCLUSION

The conclusions drawn from this study were

- Length of sacral hiatus ranged from 4.90mm to 46.90mm with a mean of 20.29mm.
- Anterio-posterior diameter had range between 3.62mm and 10.04mm with a mean diameter of 6.24mm.
- Transverse diameter of sacral hiatus at the level of base ranged between 8.32 mm and 19.46mm with a mean diameter of 13.39mm.
- The lack of knowledge of variations of different dimensions of sacral hiatus may lead to failure of caudal epidural block.
- The incidence of variation may be due to genetic and racial factors.
- Understanding of these variations may improve the success of caudal epidural anaesthesia and decrease the incidence of complication and their manifestations.
- Further studies are needed on a large sample size to determine the factors responsible for such variations which could be taken into consideration during epidural procedures.

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