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A Study On The Clinical Significance Of Sacral Hiatus In Caudal Anaesthesia In A Tertiary Care Hospital.

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ABSTRACT

The sacrum is a large triangular bone, formed by the fusion of five sacral vertebrae. The opening at the caudal end of the sacral canal is known as sacral hiatus. It is formed due to the failure of the fusion of laminae of the fifth (occasionally fourth) sacral vertebra. The bony process on either side of the sacral hiatus known as sacral cornua is an important landmark to locate the sacral hiatus. Sacrum is one of the bones which exhibit variations and the variation of sacral hiatus is of great clinical significance. This study was done to observe the variations in the level, shape, and dimensions of sacral hiatus. These will help the anesthetist to locate the sacral hiatus to give successful caudal anesthesia. The descriptive study was conducted on 102 human dry sacra of unknown sex in the Department of Anatomy at Meenakshi Medical College, Kancheepuram, Tamil Nadu. By using a vernier caliper the following measurements were made. In the present study, the most common shape of sacral hiatus is "U" shaped in 33.33%, complete agenesis of sacral hiatus in 6 sacrum, length of SH (mm)-24.1 ± 0.69 (Mean ± SD), Anteroposterior diameter of SH-5.1 ± 0.10, the transverse diameter of the base of SH-17.8 mm ± 1.8 and distance between the apex of SH and S2 - 41 mm ± 9.5 mm. Variation in the anatomy of the sacral hiatus is one of the reasons for the failure of the caudal epidural block. The variation also leads to a problem in transpedicular or lateral mass screw placement in the sacrum. The clinician should aware of the chances of agenesis of sacral hiatus or complete spina bifida while performing any procedure

Keywords: Caudal anesthesia Sacral hiatus, Sacral cornua.

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INTRODUCTION

The five sacral vertebrae articulate and fuse to form a wedge-shaped sacrum and it forms the posterior part of the pelvis. Laterally it articulates with hip bones to form a sacroiliac joint, above with the fifth lumbar vertebra and below with the coccyx to form a lumbosacral and sacrococcygeal joint. The sacrum provides strength and stability to the pelvis and transmits the weight of the body. The ventral surface is smooth and the dorsal surface is rough [1]. The rough median ridge is formed by the fused spinous processes of the upper three or four sacral vertebrae. The inverted "U" shaped hiatus present below the median sacral crest is known as sacral hiatus. The sacral hiatus is produced by failure of fusion of the lamina of the fifth sacral vertebra which is palpable in the living subjects,2 inches above the tip of the coccyx and beneath the skin of the natal cleft. The bony process on either side of the sacral hiatus known as sacral cornua is an important landmark to locate the sacral hiatus [2]**.** The dura mater and arachnoid mater are attached to the S2 vertebra and the filum terminale formed by the pia mater pierces the dura mater and arachnoid mater and gets attached to the first coccyx vertebra. The sacral hiatus transmits the 5th pair of sacral nerves, coccygeal nerves & filum terminale externa. The distance between the tip of the dural sac and the apex of sacral hiatus is 4.5cms and the needle should not be advanced more than 1-2 cm as it may puncture the dural sac resulting in spinal headache [3]. Malformations like Hiatal agenesis or complete agenesis of the dorsal wall of the sacrum can fail in the epidural block in 7% of cases. Ultrasound-guided caudal epidural block increases the success rate by 100% [4]. The sacral hiatus is used for the administration of epidural or caudal anesthesia during orthopedic surgery, in obstetrics during normal delivery, and in perineal surgeries. The caudal epidural anesthesia and analgesia are obtained by giving injections of local anesthetics through the sacral hiatus so that limited spinal segments are blocked. [5] Through the sacral hiatus, continuous caudal analgesia is given to have painless delivery. The successful induction of anesthesia during surgical procedures depends on the wide knowledge of morphology and morphometric values of sacral hiatus. Caudal anesthesia is a special type of epidural anesthesia, in which a needle enters the epidural space through the sacral hiatus lying in the natal cleft to induce anesthesia of the lower limb and sacral roots. This technique entirely depends upon the exact localization of sacral hiatus through which clinicians can access the epidural space. [6] The administration of corticosteroids through the sacral hiatus is done to treat sciatica. Caudal anesthesia has also been recommended for various surgical procedures performed below the level of umbilicus including inguinal hernia repair, urinary, and reproductive tract surgery, and orthopedic procedures on pelvic girdle and lower limbs [7]. Recently, fluoroscopy is being considered the gold standard for correct needle placement in hiatus which prevents sub-arachnoid puncture, and intrathecal/intravascular injection [8]**.** The posterior superior iliac spines impose on the superolateral sacral crests of the sacrum, the latter is accepted as forming the base of a triangle. The triangle formed between the apex of the sacral hiatus and the superolateral sacral crests was found to have the features of an equilateral triangle. However, the equilateral triangle located between the apex of the sacral hiatus and superolateral sacral crests will certainly be of use in determining the location of the sacral hiatus during the caudal epidural block (CEB) [9]. Less than 3 mm depth of sacral hiatus causes difficulty in the insertion of the needle. Its different shapes, surrounding bony irregularities, and defects in the dorsal sacral canal should be studied to avoid the failure of the epidural block. Hence detailed knowledge of sacral hiatus is essential [10]. The failure rate of caudal epidural anesthesia is 35% which is mainly due to anatomical variations of sacral hiatus and surrounding structures [11]. So the variations in the anatomy of the sacral sacral hiatus are clinically important for anesthetists, neurologists, radiologists, and orthopedic surgeons during their clinical practice [13].

MATERIALS AND METHODS

The descriptive study on morphological and morphometric analysis of the sacral hiatus was done in 102 human adult sacra of unknown sex in the Department of Anatomy at Meenakshi Medical College and Research Institute, Kancheepuram. The following observations were noted. The measurements were taken by using a vernier calliper. The different parameters of each Sacrum were studied under the following headings:-1) Shape of Sacral Hiatus was noted by naked eye experience.2) The level of the apex of Sacral Hiatus was noted concerning sacral vertebra.3) The level of the base of Sacral Hiatus was noted concerning sacral the vertebra.4) Length of sacral hiatus was measured from apex to mid-point of base 5) Anteroposterior diameter of sacral hiatus at the apex was measured .6) Transverse width of Sacral Hiatus at the base was measured between the inner aspects of the inferior limit of sacral cornua.7)Distance between the apex of sacral hiatus and the midpoint of the S2spinous process.8)The distance between the right and left superolateral crest, the distance between the apex of sacral hiatus and right and left

superolateral crest were measured(to know the type of triangle). Exclusion criteria: Damaged human dry sacra, Neonatal sacra

Stastical Analysis

The variables were entered into SPSS, version 15, statistical software for analysis. Statistical analysis was done by using descriptive statistics and cross-tabulation. The difference in proportions is tested for statistical significance using the nonparametric chi-square test for variables measured on a nominal scale. For variables measured on a continuous scale, the student "t" test was used. A p-value of <0.05 was considered to be statistically significant.

RESULTS

In the present study the different types of sacral hiatus like inverted "U" shaped in 33.33%, inverted "V" shaped in 28.43%, and Dumbbell shaped in 17.65%, Irregular shaped in 14.71% and total spina bifida in 5.88% was observed. **TABLE** :1 Total spina bifida of the sacral canal in 6 sacra were excluded from the study and in the remaining 96 sacra the location, base of the sacral hiatus, and the dimensions were observed. The apex of sacral hiatus was observed at the level of S2 at 2.08%, at S3 at 21.88%, at S4 at 73.96%, and S5 at 2.08%. **TABLE:2** The base of the sacral hiatus was taken at the level of S4 at 3.13% and S5 at 96.87%**.** The length of the sacral hiatus was a maximum of 40mm, the minimum was 14mm, and the mean was 24.1 ± 0.69. The anteroposterior diameter of sacral hiatus was a maximum of 08mm, a minimum of 04mm, and a mean of 5.1 ± 0.10. The transverse diameter of the base of the sacral hiatus was a maximum23 of mm, a minimum of 15mm, and a mean17.8 ± 1.8. The distance between the apex of the sacral hiatus and S2 was a maximum of 68mm, a minimum of 19mm, and a mean of 41 ± 9.5 **TABLE :3**. The distance between the right superolateral sacral crest and apex of sacral hiatus was a maximum of 87mm, a minimum of 43mm, and a mean ± 9.1. The distance between the left superolateral sacral crest and apex of sacral hiatus was a maximum of 87mm, a minimum of 42 mm, and a mean ± 8.6. The distance between the right and left superolateral sacral crest was a maximum of 70 mm, a minimum of 51mm, and a mean of 59.9 ± 4.8. **TABLE:4**

Table 1: Shapes Of Sacral Hiatus (N=102)

S.No	Shapes	No. of Specimens	Percentage
1	Inverted "U" Shape	34	33.33%
2	Inverted "V" Shape	29	28.43%
3	Dumbbell	18	17.65 %
4	Irregular	15	14.71 %
5	Total spina bifida	06	5.88 %

Table 2: Location Of Apex Of Sacral Hiatus (N=96)

Level	Frequency	Percent
2nd Sacral vertebra	02	2.08%
3rd Sacral vertebra	21	21.88%
4th Sacral vertebra	71	73.96%
5th Sacral vertebra	02	2.08%

Table 3: Location Of The Base Of Sacral Hiatus

Level	Frequency	Percentage
4th sacral vertebra	3	3.13%
5th sacral vertebra	93	96.87%
Total	96	100%

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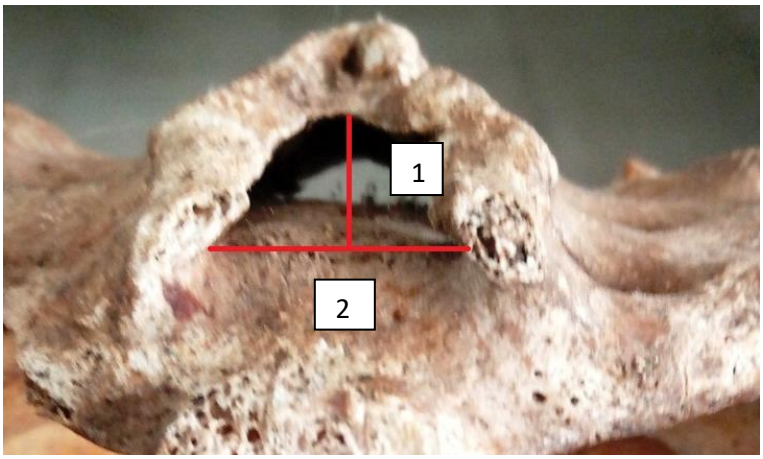
Table 4: Measurement Parameters

S.No	Values	Mean ± SD	Max	Min
1	Length of SH (mm)	24.1 ± 0.69	40	14
2	Anteroposterior diameter of SH(mm)	5.1 ± 0.10	08	04
3	Transverse diameter of base of SH(mm)	17.8 ± 1.8	23	15
4	Distance between apex of SH and S2(mm)	41 ± 9.5	68	19
5	Distance between right Supralateral sacral crest and apex of SH(mm)	62.8 ± 9.1	87	43
6	Distance between left Supralateral sacral crest and apex of SH(mm)	62.7 ± 8.6	87	42
7	Distance between right and left superolateral sacral crest(mm)	59.9 ±4.8	70	51

PICTURE 1: TOTAL SPINA BIFIDA OF SACRAL HIATUS

1. Anteroposterior diameter of SH 2. Transverse diameter of the base of SH



1. Length of SH 2. Transverse diameter of the base of SH 3. Distance between the apex of SH and S2 4. Distance between right superolateral sacral crest and apex of SH 5. Distance between left superolateral sacral crest and apex of SH 6. Distance between right and left superolateral sacral crest.

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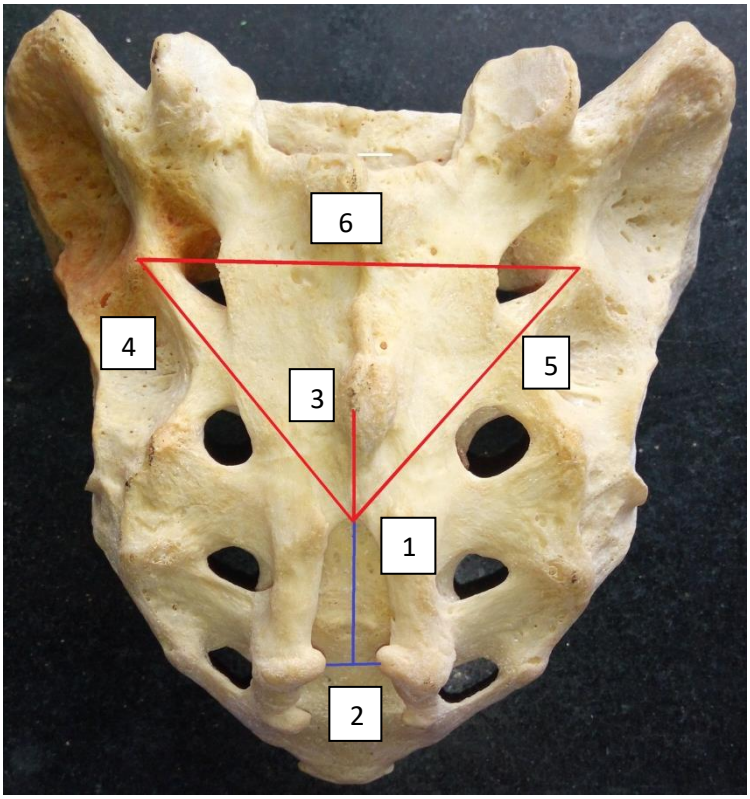

DISCUSSION

The sacral canal is a continuation of the spinal canal and runs throughout the greater part of the sacrum. The failure of the fusion of the lamina of the fifth sacral vertebra or sometimes the fourth sacral vertebra results in sacral hiatus. In our observation inverted "U" shaped sacral hiatus was the most common type followed by a "V" shape. The same observations were also noted by Dr. Rita Kumari1et al [14], The shape, size, and agenesis of sacral hiatus are clinically important during the caudal epidural block. The success rate of the caudal epidural block mostly depends on the position of the apex. The apex of the sacral hiatus is a very important bony landmark for clinicians to give caudal epidural block but identifying the apex due to anatomical variations in an obese patient is very difficult. In the present study, the apex of sacral hiatus was present at S4 in 73.96%. [15] Themean length of the sacral hiatus was 24.1mm, which is similar to the previous studies by Seema [13] 22.69mm and Nadeem G [16]25.2mm. The mean anteroposterior diameter of sacral hiatus at the apex was observed as 5.1mmwhich was similar to the previous studies by Kamal ahmm et al[8]the mean anterior-posterior diameter at the apex of sacral hiatus was 4.76±1.73 mm in male and 4.92±2.13 mm in female and Ashok K. R [17] 5.53mm. The transverse diameter of the sacral hiatus is very important during introducing the needle in caudal anesthesia. To locate the sacral hiatus for successful caudal epidural block the equilateral or isosceles triangle is used. A.K. Manickavasukin et.al [18] have reported an equilateral triangle, as the distance between the two superolateral sacral crests was 66.5 (SD 53.5), the distances between the sacral apex and the right and left superolateral sacral crest were 67.1 (10.0) and 67.5 (9.5) mm respectively. IrungbamDevan Singh et. al has reported Isosceles triangle, the distance between right and left posterior superior iliac spines (superolateral sacral crests) was 6.48 (mean) ± 0.5232 (SD)cms, the distance between right and left superolateral sacral crest and apex of sacral hiatus were 5.841 (mean) + 0.2705 (SD), 5.837 (mean) + 0.2769 (SD)cm [19]. In the present study, the isosceles triangle was observed. The distance between the apex of the sacral hiatus to right superolateral sacral crest the maximum was 87, the minimum was 43, and the mean was 62.8 ± 9.1. The distance between the apex of the sacral hiatus to the left superolateral sacral crest maximum was 87, the minimum was 42, and the mean was 62.7 ± 8.6. The distance between the right and left superolateral sacral crests forming the base, the maximum was 70mm, the minimum was 51mm, and the mean was 59.9 ± 4.8. The success rate of caudal epidural anesthesia depends on the normal anatomy of the sacral hiatus [20].

CONCLUSION

The knowledge of anatomical variations of sacral hiatus is significant when giving caudal epidural anesthesia which helps to improve the success and reduces the incidence of complications. Sacral cornu is an important bony landmark to locate the sacral hiatus during caudal epidural anesthesia. The length of the sacral hiatus is too long and is not favorable for caudal epidural anesthesia. Variation in the anatomy of the sacral hiatus is one of the reasons for the failure of the caudal epidural block. The variation also leads to a problem in transpedicular or lateral mass screw placement in the sacrum. The clinician should aware of the chances of agenesis of sacral hiatus or complete spina bifida while performing any procedure. The precise knowledge of the normal and abnormal anatomy of the sacral hiatus is clinically important for the anesthetist, neurologist, radiologist, and orthopedic surgeon in the clinical practice.

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