

Morphometric Study of Sacral Hiatus in Dry Human Sacra of Maharashtra Region

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Abstract

Introduction: The opening present at the lower end of sacral canal is known as sacral hiatus. The anatomy of sacral hiatus and its variations are clinically important during administration of Caudal Epidural Block (CEB) in Obstetrics and Gynaecology (OBGY), Orthopedic, Urology and General surgery practices. The success and reliability of CEB depends upon the sound knowledge of anatomical variations of sacral hiatus. Thus the present study was undertaken to find the variations in dry human sacra of Maharashtra region. **Aim:** To study the morphometry and variations of sacral hiatus. **Methods:** 138 adult, grossly normal dry human sacra of Maharashtrian origin were collected from anatomy department of various medical colleges in Maharashtra. **Results:** Inverted U was the most common observed shape. The most common site of apex and base was observed at S4 i.e. at fourth sacral spine and at the level of S5 i.e. at fifth sacral spine respectively. The length/Height of sacral hiatus most commonly ranged between 11-20 mm (42%). The width of sacral hiatus most commonly ranged between 11-15 mm (53.6%). The Anteroposterior (A-P) Diameter of sacral hiatus most commonly ranged between 3-6 mm (70.3%). **Conclusion:** The knowledge of variations in the shape, level and measurements of sacral hiatus will help in the effective and successful caudal epidural block (CEB) practices which are commonly used in various surgical practices.

Keywords: Morphometry; Sacral hiatus; Caudal epidural block.

Introduction

Sacrum is a large triangular bone, formed by fusion of five sacral vertebrae along with the intervertebral discs. It is present at the base of vertebral column, wedged between the two hip bones forming the posterosuperior wall of pelvic cavity. Sacral canal is formed by sacral vertebral foramina. The sacral canal contains cauda equina, filum terminale, CSF and meninges. The caudal opening of the canal is

the sacral hiatus. It is identified in the posterior wall of the sacral canal, due to the failure of fusion of the fifth pair of laminae, exposing the dorsal surface of the fifth sacral vertebral body.[1] The fifth inferior articular processes project caudally and flank the sacral hiatus as sacral cornuae. The filum terminale, the 5th sacral and 1st coccygeal pairs of nerves emerge from the sacral hiatus. It is roofed by the firm elastic membrane, the sacrococcygeal ligament.[2] Anatomical variations occur frequently making the sacrum the most variable portion of spine. Developmental malformations occur ranging from variations in the sacral hiatus to caudal agenesis.[2] Considerable variability occurs in sacral hiatal anatomy among individuals of seemingly similar backgrounds, race and stature.

Sacral approach to epidural space has been utilized for giving anaesthesia and analgesia. Sacral hiatus has been widely used for

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administration of Caudal Epidural Block (CEB) in OBGY and Orthopedic practices for treatment as well as diagnosis. The success and reliability of CEB depends upon anatomical variations of sacral hiatus as observed by many authors.[2,3] The practical problems related to caudal anesthesia are mainly attributable to wide anatomic variations in size, shape, and orientation of the sacral hiatus. Thus the aim of present study is to study the variations of sacral hiatus in Maharashtra region which will be useful during administration of Caudal Epidural Block (CEB).

Materials and Methods

The present Morphometric study was done on 138 adult, grossly normal dry human sacra of Maharashtrian origin, collected from anatomy department of various medical colleges in Maharashtra.

Photograph 1: Showing U shaped sacral hiatus



Photograph 2: Showing measurement of length in V shaped sacral hiatus



Photograph 3: Showing agenesis of sacral canal



Two Sacra were excluded from the measurements as typical sacral hiatus was not present in them and showed complete agenesis of the dorsal bony wall. The measurements were recorded by digital Vernier caliper accurate to 0.1 mm.

1. Shape of hiatus
2. Level of apex of hiatus in relation to sacral vertebra.
3. Level of base of hiatus in relation to sacral vertebra.
4. Length of Sacral Hiatus.
5. Width (Intercornual Distance) of Sacral Hiatus.
6. Antero-posterior (A- P) Diameter of Sacral Hiatus.

Results

Parameters were studied and analysis was done. The analyzed data was tabulated as follows:

Table 1: Shows shape of Sacral Hiatus

Shape	No	P (%)
H	1	0.7
Inverted U	69	49.6
Inverted V	59	42.4
W	10	7.2
Total	138	100

Table 2: Shows Level of Apex and Base of Sacral Hiatus

Vertebral level	Level of apex		Level of base	
	No	P (%)	No	P (%)
S 2	02	1.4	0	0
S 3	32	23.2	1	0.7
S 4	88	63.8	3	2.2
S 5	16	11.5	134	97.1
Total	138	100	138	100

Table 3: Shows Length of Sacral Hiatus

Length of Hiatus	No	P (%)
0 - 10 mm	4	2.9
11- 20 mm	58	42.0
21 - 30 mm	48	34.8
31 - 40 mm	18	13.0
41 - 50 mm	8	5.8
> = 50 mm	2	1.4
Total	138	100.0

Inverted U and V were most common observed shapes. 'U' was found in 69 (49.6%) and 'V' was found in 59 (42.4%).

The most common site of apex was observed at S4 i.e. at fourth sacral spine in 88 sacra (63.8%) where as base of hiatus was most commonly present at the level of S5 i.e. at fifth sacral spine in 134 sacra (97.1%).

The length / Height of sacral hiatus most commonly ranged between 11-20 mm.

The width of sacral hiatus most commonly ranged between 11-15 mm.

The Anteroposterior (A-P) Diameter of sacral hiatus most commonly ranged between 4-6 mm.

Table 4: Shows Width (Intercornual Distance) of Sacral Hiatus

Width of Hiatus	No	P (%)
5 - 10 mm	2	1.4
11 - 15 mm	74	53.6
= 15 mm	62	44.9
Total	138	100.0

Table 5: Shows Anteroposterior (A-P) Diameter of Sacral Hiatus

A-P Diameter	No	P(%)
0 - 3 mm	11	8.0
4 - 6 mm	97	70.3
7 - 9 mm	27	19.6
= 9 mm	3	2.2
Total	138	100

Discussion

Caudal epidural block (CEB) is a procedure which involves injection of a drug into the epidural space through the sacral hiatus for anaesthesia. Study on the anatomical variations of the sacral hiatus and the dorsal wall of sacral canal are related to successful caudal epidural block. Caudal epidural block (CEB) has 25 % failure rate.[4]

In the present study, 2 Sacra were excluded from the measurements as typical sacral hiatus was not present in them and showed complete agenesis of the dorsal bony wall.

Shape

In the present study the shapes of sacral hiatus were variable and were found to be predominantly of either inverted 'U' (49.6%) or inverted 'V' (42.4%). The most common shape of sacral hiatus was inverted 'U' in 69 (%) and findings were similar to Nagar and Seema.[5,7] Vinod Kumar[6] also noted various shapes, most common being inverted 'V' (46.53 %).

Apex of hiatus

The level of apex of the sacral hiatus was most commonly seen at S4 in 88 sacra (63.8%), which was similar to Sekiguchi M and Nagar (65 %)[2,5] and other researchers. All studies including the present study noted that the location of apex can vary from upper part of S3 sacral vertebra to S5 vertebra. The knowledge of distance from the apex of sacral hiatus to the lower lumbar spinous process is important to develop the technique to prevent

Table 6 & 7: Shows Comparison between the findings of different Authors

Author	Year	Shape %	Level of apex%	Level of base%
Nagar	2004	U (41.51 %)	S4 (55.9 %)	S5 (72.6 %)
Dipali Rani pal	2012	U (40 %)	S4 (50 %)	S5 (82.5 %)
Vijisha	2013	U & V (35 %)	S4 & S5 (46 %)	-----
Seema	2013	U (42.95%)	S4 (56.36%)	S5 (70.46 %)
Present study	2014	U (49.6 %)	S4 (63.8 %)	S5 (97.1%)

Table 7

Author	Year	Length of hiatus %	Width of hiatus %	A-P dia. of hiatus %
Nagar	2004	11-20mm	10-15mm	4-6mm
Dipali Rani Pal	2012	21-30mm (46.3 %)	11-15 mm (56.2%)	4-6mm (75 %)
Vijisha	2013	10-20 mm (60%)	11-20 mm (92%)	4-6 mm (57%)
Seema	2013	11-20 mm (52%)	11-15 mm (51.67%)	4-6 mm (71.81 %)
Present study	2014	11-20 mm (42 %)	11-15mm (53.6 %)	3-6 mm (70.3%)

the neurological injuries associated with the neuraxial injections.[11]

Base of hiatus

In the present study the level of base of the sacral hiatus was most commonly seen at S5 in 134 sacra (97.1%). The findings were similar to previous researchers like Nagar, Seema[5, 7].

Length of Sacral Hiatus

The length of sacral hiatus ranged between 8.14- 57.78 mm, with a mean of 22.8mm. The most common length was found between 11-20 mm in 58 sacra (42%). This wide variation in the length is because of the wide variation in the location of apex and base of hiatus. Similar results were noted by Nagar, Seema and Vijisha. [5,7,8]. Study by Dipali showed the common range between 21-30 mm (46.3%).

Width (Intercornual distance) of hiatus

The width of sacral hiatus ranged between 4.51-20.53 mm, with a mean of 14.47mm. The

most common width between 11-15 mm was found in more than half i.e. in 74 sacra (53.6%). Similar results were noted by Seema, Vijisha and Dipali.[7,8,9]

Anteroposterior diameter at the apex

A bony septum in the sacral hiatus, hiatal agenesis or complete agenesis (spina bifida) cause failure of CEB. The diameter of sacral canal less than 2 mm can impede the use of 22 G needles for CEB.[4] The anteroposterior diameter at the apex of sacral hiatus is important as it should be sufficiently large to admit the needle [10]. In the present study, anteroposterior diameter ranged from 0.73 to 9.37 mm, with a mean of 4.84 mm. The diameter of canal was predominantly between 4-6 mm in 97 sacra (70.3 %). Hiatal agenesis was observed in 2 sacra (1.4 %). These findings were similar to that of Seema and Dipali.[7,9]

Conclusion

For caudal epidural block (CEB) to be successful identification of sacral hiatus is

mandatory. Variations in the shape and level of hiatus may lead to failure of CEB. The sacral hiatus has anatomical variations and knowledge of these variations may improve the success of caudal epidural block (CEB). Hence detailed knowledge of sacral hiatus with its variations and its surrounding anatomy is essential.

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