

## THE STUDY OF SACRAL HIATUS IN TAMILNADU AND ITS CLINICAL IMPORTANCE IN CAUDAL EPIDURAL ANAESTHESIA

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### ABSTRACT

**Background and Aims:** The sacral hiatus is formed by the failure of lamina of the fifth sacral vertebra to meet in the median plane. The aim is to study the sacral hiatus, as the effectiveness of caudal epidural anaesthesia depends on the knowledge in anatomy of sacral hiatus and its variations.

**Materials and Methods:** In this study 107 sacral bones of unknown sex are obtained from Chengalpattu medical college in Tamilnadu and studied under various parameters like shape, apex, base, length, width and anteroposterior diameter of the sacral hiatus using vernier caliper of accuracy 0.1mm.

**Results:** The maximum number of sacra exhibits Inverted 'U' shaped sacral hiatus, with apex at S4 and base at S5. The average length, width and anteroposterior diameter are between 11-20mm, 11-15mm and 5-6mm respectively. Two sacra had absent sacral hiatus and 5 sacra had completely unfused lamina.

**Conclusion:** Caudal epidural anaesthesia is impossible in persons with absent sacral hiatus. Completely unfused sacrum and abnormally elongated sacral hiatus can result in accidental subdural injection and subarachnoid injection. The size and shape of sacral hiatus varies considerably. The awareness of such variations is essential for the clinicians during caudal epidural approaches.

**KEYWORDS:** Sacra, Sacral hiatus, Caudal epidural anaesthesia.

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### INTRODUCTION

Sacrum is a large triangular bone formed by the fusion of five sacral vertebrae and forms the posterosuperior wall of pelvic cavity [1]. Its blunted caudal apex articulates with the coccyx

and its superior wide base with the fifth lumbar vertebra at lumbosacral angle. It has a pelvic surface and dorsal surface [1].

The dorsal surface of sacrum bears a raised

interrupted median crest with four sacral spinous tubercles which represents the fused sacral spines. Below the fourth spinous tubercle there is an arched sacral hiatus, produced by the failure in the fusion of lamina of fifth sacral vertebra in the median plane [1]. Sacral hiatus transmits fifth sacral nerve, filum terminale externa, coccygeal nerve roots and contains fibrofatty tissue [2]. The sacral hiatus is found clinically by the palpation of sacral cornua [3]. The apex of the sacral hiatus is usually at the level of S4 vertebra and the base is seen at S5 level [4]. In some sacra, the laminae of all sacral vertebrae may be unfused leading to an incomplete bony dorsal wall [2], while in few, the sacrococcygeal ligament may become ossified resulting in absent hiatus [5]. In addition, the sacral hiatus exhibits wide range of morphometrical and morphological variations which warrants an awareness for the clinicians during caudal epidural procedures.

Caudal epidural anaesthesia is preferred in children because children have lesser amounts of presacral fat, non calcified sacral ligament and a considerably wider hiatus than adults [6]. It is also useful in minor gynaecological and perineal surgeries [6]. Caudal epidural steroid injection is used in symptomatic low back pain caused by lumbar disc herniation or spinal canal stenosis [7]. Hence, the present study has been undertaken to gain knowledge regarding the anatomy of sacral hiatus and its variations, which is essential for the anaesthetists, gynaecologists as well as orthopaedicians.

## MATERIALS AND METHODS

After obtaining the Institutional Human Ethical Committee approval, a total of 107 complete dry adult human sacra of unknown sex are taken from Chengalpattu government medical college. Measurements are made with vernier caliper of accuracy 0.1 mm [Figure 1]. Seven sacra are excluded from the study as two had absent sacral hiatus [Figure 2] and five had unfused lamina [Figure 3]. The following parameters are measured in the remaining 100 sacra,

1. Shape of the sacral hiatus
2. Level of Apex of sacral hiatus
3. Level of base of sacral hiatus
4. Length of sacral hiatus

## 5. Width of sacral hiatus

## 6. Anteroposterior diameter of sacral hiatus

The shape, level of apex and level of base of the sacral hiatus are observed and tabulated. The length of sacral hiatus is measured from apex to midpoint of the base. The width of the sacral hiatus is measured at the level of sacral cornua. The anteroposterior diameter is measured as the distance between the anterior and posterior walls at the level of apex. The results are tabulated and are depicted using frequency distribution charts.

## RESULTS

The sacral hiatus has Inverted 'U', Inverted 'V', dumbbell, irregular and bifid shape. The most common shape observed is Inverted 'U' [Table 1 and Figure 4,5,6,7].

The highest level of apex of the sacral hiatus is at S2 and the lowest at S5. The apex of sacral hiatus is at S4 in maximum number of sacra [Table 2]

In maximum number of sacra the base of sacral hiatus is found at S4 [Table 3].

The length of sacral hiatus in the present study is ranging from 9mm to 56 mm. In maximum number of sacra the length is in the range between 11 to 20 mm [Table 4].

The minimum width of sacral hiatus in the present study is 4mm. In maximum number of sacra the width is in the range between 11 to 15 mm [Table 5].

In the present study, the maximum number of sacra has anteroposterior diameter between 5 to 6 mm. [Table 6].

**Fig. 1:** Measurement of sacral hiatus using vernier caliper.



**Fig. 2:** Absent sacral hiatus.



**Fig. 3:** Unfused sacrum.



**Fig. 4:** Inverted 'U' shaped sacral hiatus.



**Fig. 5:** Inverted 'V' shaped sacral hiatus.



**Fig. 6:** 'Dumbbell' shaped sacral hiatus.



**Fig. 7:** Irregular shaped sacral hiatus.



**Table 1:** Shape of sacral hiatus.

S.No.	Shape	Percentage Of Sacra (n=100)
1	Inverted U	38
2	V	35
3	DUMBBELL	8
4	IRREGULAR	13
5	BIFID	6

**Table 2:** Level of apex of sacral hiatus.

S.No.	Level Of Apex	Percentage Of Sacra (n=100)
1	S2	6
2	S3	31
3	S4	58
4	S5	5

**Table 3:** Level of base of sacral hiatus.

S.No.	Level Of Base	Percentage Of Sacra (n=100)
1	S4	68
2	S5	16
3	COCCYX	16

**Table 4:** Length of sacral hiatus.

S.No.	Length (mm)	Percentage Of Sacra (n=100)
1	0 to 10	10
2	11 to 20	43
3	21 to 30	28
4	31 to 40	18
5	41 to 50	0
6	51 to 60	1

**Table 5:** Width of sacral hiatus at the level of sacral cornua.

S.No.	Width (mm)	Percentage Of Sacra (n=100)
1	0 to 5	5
2	6 to 10	30
3	11 to 15	48
4	16 to 20	15
5	21 to 25	2

**Table 6:** Anteroposterior diameter of sacral hiatus.

S.No.	Anteroposterior Diameter (mm)	Percentage Of Sacra (n=100)
1	1 to 2	0
2	3 to 4	36
3	5 to 6	46
4	7 to 8	15

## DISCUSSION

**Shape of sacral hiatus:** According to Vinodkumar et al, the shape of sacral hiatus is inverted U and inverted V in 76.23% of the cases and dumbbell shape in 13.3% of cases. Nagar S.K., observed the shape of sacral hiatus as inverted U in 41.5% of the cases, inverted V in 27% of cases, dumbbell in 13.3%, irregular in 14.1%,



and bifid in 1.5% of cases[9]. Similarly, in the present study, the sacral hiatus is inverted 'U'shaped in maximum number of sacra.[Table 1 and Figure 4]. Irregular, bifid or dumbbell shaped hiatus can lead to failure in caudal epidural anaesthesia [Figure 6,7].

**Apex of sacral hiatus:** According to Vinodkumar et al, the apex of sacral hiatus is at the level of 2<sup>nd</sup> sacral vertebra in 4.95% of cases, 3<sup>rd</sup> sacral vertebra in 8.9% of cases, 4<sup>th</sup> sacral vertebra in 76.23% of cases, 5<sup>th</sup> sacral vertebra in 7.43% of cases[8]. Nagar S K. reported the apex level at S2 in 3.40% of cases, S3 in 37.3% of cases, S4 in 55.90% of cases and S5 in 3.40% of cases [9]. Sekiguchi et al reported apex level at S2 in 4% of cases, S3 in 15% of cases, S4 in 65% of cases, S5 in 15% of cases [10]. According to Vijaykumar et al, apex is at the level of S2 in 1.03% of cases, S3 in 17.52%, S4 in 79.38%, S5 in 2.06% of cases [2]. Similarly in the present study, the most common level of apex is at S4 and the highest level of apex is at S2 [Table 2]. During caudal epidural steroid injection, accidental puncture of subdural or subarachnoid space at S2 level can result in drug toxicity and hemodynamic changes leading even to death.

**Base of sacral hiatus:** According to Nagar S K, base is at the level of S4 in 1.03%, S5 in 98.96%, coccyx in 16.3% of cases [9]. Vijaykumar et al stated that base is at the level of S4 in 1.03% of cases and at S5 in 98.96% of cases [2]. In the present study, base is at the level of S5 in 68% of cases, S4 in 16% of cases, and at coccyx in 16% of cases[Table 3]. The results are parallel to the previous studies.

**Length of sacral hiatus:** According to Nagar S K, length is at the level of 0 to 10 mm in 10.3% of cases, 11 to 20 mm in 35% cases, 21 to 30mm in 30.8% of cases, 31 to 40 mm in 17.1% of cases, 41 to 50 mm in 4.9% of cases and more than 51mm in 1.9% of cases [9]. In the present study also the length of sacral hiatus is found to be 11 to 20 mm in maximum number of sacra [Table 4]. The minimum length of sacral hiatus is 9mm in our study. In one sacrum the length of 56mm is observed which is not been reported in any other previous studies. Knowledge of elongated sacral hiatus prevents faulty puncture of subdural or sub arachnoid space.

**Width of sacral hiatus:** According to Nagar S

K., width of the sacral hiatus is between 0 to 5 mm in 8% , 6 to 10 mm in 30% , 10 to 15mm in 54% and more than 16 mm in 8% of sacral specimens [9]. In the present study, the width is between 11 to 15mm in maximum number of sacra which is parallel to that of Nagar S K [Table 5]. The minimum width of sacral hiatus observed in the present study is 4mm.

**Anteroposterior diameter of sacral hiatus:**

According to Nagar S K, the anteroposterior diameter is between 0 to 3mm in 16.6%, 4 to 6mm in 64.2%, 7 to 9 mm in 19.8% and more than 9 mm in 0.4%[9]. In the present study, the maximum number of sacra has anteroposterior diameter between 5 to 6 mm [Table 6]. Decreased anteroposterior diameter can cause difficulty in caudal epidural block.

## CONCLUSION

Caudal epidural procedure is impossible in persons with absent sacral hiatus. Completely unfused sacrum and abnormally elongated sacral hiatus can result in accidental subdural injection and subarachnoid injection of drugs leading to shock and even death. The size and shape of sacral hiatus varies considerably. The awareness of such anatomical variations is essential for the clinicians during caudal epidural approaches.

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**Conflicts of Interests: None**

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