

Study of Sacral Hiatus in Dry Human Sacrum in North Indian Population And Its Clinical Implication in Caudal Epidural Block

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ABSTRACT

Introduction: The sacrum is triangular bone formed by fusion of five sacral vertebrae and form postero superior wall of pelvic cavity. The opening at the caudal end of sacral canal is known as sacral hiatus, variations in sacral hiatus are important clinically as well as surgically.

Aims and Objective: Aim is to do morphological analysis of sacral hiatus in dry human sacrum in North Indian population and objective is to assess its clinical implication in caudal epidural block (CEB).

Materials and Methods: 31 complete and undamaged dry human sacrum of unknown sex collected from Department of Anatomy, SGT Medical College & Hospital Research Institute, Gurugram. Parameters such as Shape, level of apex, level of base sacral hiatus, length of sacral hiatus, transverse width of sacral hiatus, and depth of sacral hiatus at the level of apex were taken.

Results: Inverted U shaped (41.5%) is most common shape, location of apex commonly found on 4th sacral vertebrae (70.96%), location of base is on 5th sacral vertebrae (90.32%). The sacral hiatus exhibits many variations in length, transverse width at base of cornua, anteroposterior depth at apex. Mean of length of sacral hiatus is 20.54, mean of transverse depth of

sacral hiatus is 12.32 and mean of anteroposterior depth at apex is 4.61.

Conclusion: Anatomical variation in the sacral hiatus and understanding of these variations may improve the success of caudal epidural block. These observations can provide a guideline for CEB.

Keywords: Sacral Hiatus (SH), Sacral Vertebrae, Caudal Epidural Block (CEB), Sacral Hiatus Apex.

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Article History:

Received: 12-07-2017, Revised: 10-08-2017, Accepted: 22-09-2017

| Access this article online | |
|-------------------------------------|--|
| Website: www.ijmrp.com | Quick Response code  |
| DOI: 10.21276/ijmrp.2017.3.5.034 | |

INTRODUCTION

The sacrum is a triangular bone which is formed by fusion of five sacral vertebrae and forms the postero-superior wall of the pelvic cavity. The bone is wedged between two hip bones.¹ The opening at caudal end of sacral canal is known as sacral hiatus, which is formed due to failure of laminae of fifth sacral vertebra (occasionally fourth) making it arc shaped gap. The sacral hiatus contains lower sacral and Coccygeal nerve root, filum terminale externa and fibrofatty tissue. The shape and extent of sacral hiatus is proved important because in caudal epidural anesthesia (CEB), the approach is made through sacral hiatus. The laminae of the entire sacral vertebra may fail to fuse resulting in incomplete bony dorsal wall of sacral canal or may fuse in midline giving rise to absent hiatus. This inverted U or V shaped sacral hiatus is covered by sacrococcygeal membrane and forms an important landmark to perform caudal epidural block. There are considerable variations in the size and shape of sacral hiatus which cause difficulty in localization of hiatus during CEB (Sekiguchi et al., 2004).² So the purpose of this study was to

explore the variation of sacral hiatus among north Indian population to increase the success rate of CEB. Caudal anesthesia has also been recommended for various surgical procedures performed below the level of umbilicus including inguinal hernia repair, urinary and digestive tract surgery, orthopedic procedures on pelvic girdle and lower limbs.³

Aims and Objectives

Aim is to do morphological analysis of sacral hiatus in dry human sacrum in North Indian population and objective is to assess its clinical implication in caudal epidural block (CEB).

MATERIALS AND METHODS

The present study was conducted in the department of Anatomy, SGT Medical College & Hospital Research Institute, Gurugram, Haryana. 31 dry human sacrum collected from Department of anatomy. Bones with wear and tear, fractured were excluded from study. Only bone with clear sacral hiatus was studied. All the measurements were taken with the help of vernier caliper and

divider. Following parameters of sacrum taken for this study:

- (1) Shape of hiatus
- (2) Level of apex of hiatus
- (3) Level of base of hiatus
- (4) Length of hiatus- measured from apex to midpoint of the base.
- (5) Transverse width of sacral hiatus at the base: Distance between the inner aspects of sacral cornua.
- (6) Transverse width of sacral hiatus at the base: Distance between the inner aspects of sacral cornua.

RESULTS

Among the observed bones, shape of sacral hiatus is mainly inverted U (41.93%) and base of sacral hiatus is located on S₅ vertebrae in 90.32% cases. In present study the apex located at S₄ vertebrae in 70.96 cases. The length of sacral hiatus is found maximum in range from 11-30mm with mean 20.54. Transverse width of sacral hiatus of 21 bones measured in range of 11-15mm with mean 12.35 (67.74%). Depth of sacral hiatus at the level of apex is maximum in range 4-6mm with mean 4.61.

Table 1: Different shapes of sacral hiatus

| S no. | Shape of sacral hiatus | Number of bone(n=31) | percentage |
|-------|------------------------|----------------------|------------|
| 1 | U shaped | 13 | 41.93 |
| 2 | V shaped | 9 | 29.03 |
| 3 | Dumbell | 4 | 12.90 |
| 4 | Irregular | 3 | 9.67 |
| 5 | Bifid | 1 | 3.22 |
| 6 | Elongated | 1 | 3.22 |

Table 2: Location of base of sacral hiatus at different level

| S no. | Level of base | Number of bone(n=31) | percentage |
|-------|-----------------------------|----------------------|------------|
| 1 | Coccyx | 1 | 3.22 |
| 2 | At S ₅ vertebrae | 28 | 90.32 |
| 3 | At S ₄ vertebrae | 2 | 6.45 |

Table 3: Location of apex of sacral hiatus at different level

| S no. | Level of apex | Number of bone(n=31) | percentage |
|-------|-----------------------------|----------------------|------------|
| 1 | At S ₅ vertebrae | 1 | 3.22 |
| 2 | At S ₄ vertebrae | 22 | 70.96 |
| 3 | At S ₃ vertebrae | 8 | 25.86 |
| 4 | At S ₂ vertebrae | 0 | 0 |

Table 4: Length of sacral hiatus from apex to midpoint of base

| S no. | Length sacral hiatus | Number of bone(n=31) | percentage | Mean (mm) |
|-------|----------------------|----------------------|------------|-----------|
| 1 | 0-10 | 3 | 9.67 | |
| 2 | 11-20 | 12 | 38.70 | |
| 3 | 21-30 | 12 | 38.70 | 20.54 |
| 4 | 31-40 | 2 | 6.45 | |
| 5 | 41-50 | 2 | 6.45 | |

Table 5: Transverse width of sacral hiatus

| S no. | Transverse width | Number of bone (n=31) | percentage | Mean (mm) |
|-------|------------------|-----------------------|------------|-----------|
| 1 | 0-5 | 0 | 0 | |
| 2 | 6-10 | 8 | 25.80 | |
| 3 | 11-15 | 21 | 67.74 | 12.35 |
| 4 | >15 | 2 | 6.45 | |

Table 6: Depth of sacral hiatus at the level of apex

| S no. | A-P depth | Number of bone (n31) | Percentage | Mean (mm) |
|-------|-----------|----------------------|------------|-----------|
| 1 | 0-3 | 7 | 22.58 | |
| 2 | 4-6 | 20 | 64.56 | |
| 3 | 7-9 | 4 | 12.90 | 4.61 |
| 4 | >9 | 0 | 0 | |

DISCUSSION

Study on the various parameters of sacral hiatus (SH) is related to its clinical application in caudal epidural block (CEB).

Shape of Sacral Hiatus

The present study shown that the shape of SH are variable with the most common being the inverted - U (41.93%), followed by inverted - V (29.03) and this result is very close to result of Nagar

et al⁴ (2004)in Gujarat region. U shaped sacral hiatus is predominant in North Indian population and this finding supported by Seema et al⁵(2013), Jeewanjot et al⁶ (2016) where the authors reported the same type of hiatus among identical population. In present study 12.90% shape of sacral hiatus is dumbbell, while in 9.67 it was irregular, Bifid and elongated are seen in 3.22% each.

Apex of Sacral Hiatus

The apex of SH is usually present at the level of 4th sacral vertebra as per standard textbook (Peter L William et. al.2000).⁷ In the present study apex was seen most commonly at the level of 4th sacral vertebra is (70.96%), at the level of 3rd sacral vertebra is (25.86%) and at the level of 5th sacral vertebra is (3.22%).

Kumar et al⁸ (1992) found level of apex at 4th sacral vertebra in 76.23%. Nagar et al⁴ found in 55.9%, Seema et al⁵ found in 56.67% and Mustafa et al⁹ found in 70% in Egypt at level of 4th sacral vertebra. All studies including present study noted that location of apex can vary from upper end 2nd sacral vertebra to 5th sacral vertebra.

Base of Sacral Hiatus

The base of sacral hiatus was seen at the level of 5th sacral vertebra in 90.32%, at 4th sacral vertebra in 6.45% and coccyx in 3.22%. This observation is very close to Parashuram R et al¹⁰ (2015) to 93.3% and Mustafa et al⁹ (2012) in Egypt to 91%. The value of our study is higher when compared to Nagar et al⁴ (2004) 72.6% and Seema et al⁵ (2013) 71.6%.

Length of Sacral Hiatus

The length of SH is variable in present study and most commonly found in between 11- 20mm (38.70) and 21- 30mm (38.70) with mean 20.71mm. It is near to Nagar et al⁴ (2004) which show 65.8% in between 11-30 mm and in present study 77.40% in between 11-30 mm. Mean length of sacral hiatus was 20.71mm and similar results were also noted by earlier studies Kumar et al⁸ (1992) 20mm, Trotter et al¹¹ (1944) 22.5, Dona saha et al¹² (2016) is 20.21, Seema et al⁵ (2013) 22.69. While Bhattacharya et al¹³ (2013) reported 35.92mm, which is much higher than present study.

Transverse Width of Sacral Hiatus

Sacral cornua were considered as important landmark for identifying sacral hiatus. Variation in sacral cornua ranging from well-defined projection to flattening may greatly affect their utility for locating hiatus. In present study width of base varied from 7mm to 25 mm, in 67.74% cases it was 11-15mm and in 25.8% cases it was 6-10mm. Mean value is 12.32mm. It is similar to Seema et al⁵ (2013) 10-15mm in 52% cases, Nagar et al⁴ (2004) 11-15 in 54% cases. Aggarwal et al¹⁴ (2009) reported 11.95mm, Sekiguchi et al² have reported a lower figure of 10.2mm.

Antero-Posterior Depth of Sacral Hiatus at Apex

Antero-posterior depth of SH is important as it should be sufficiently large to admit a needle for subcutaneous deposition of anesthetic drug. In present study A-P depth ranged from 2mm to 8mm with mean value of 4.61mm. Whereas maximum values were found in 4mm to 6mm (64.51%). Narrower SH at apex less than 3mm is reported in 22.58%. Which is near to Singh et al¹⁵ (2016) is 24.5% and much more high than earlier studies Trotter et al¹⁰ (1945) is 4%, Nagar et al⁴ (2004) is 15%. Mean depth as observed by various worker are Seema et al⁵ (2013) is 4.70, Kumar et al⁸ (1992) is 4.8mm.

CONCLUSION

The present study reports significantly higher percentage of abnormal shapes of SH (dumbbell, irregular) and A-P depth at apex (<3 mm) was 22.58%, where needle insertion may lead to CEB failure in North Indian population. These parameters and its variation form the basis for improving the overall success rate of CEB.

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Source of Support: Nil. **Conflict of Interest:** None Declared.

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Cite this article as: Singh H, Saxena AK, Aneja PS. Study of Sacral Hiatus in Dry Human Sacrum in North Indian Population And Its Clinical Implication in Caudal Epidural Block. *Int J Med Res Prof*. 2017 Sept; 3(5):174-76. DOI:10.21276/ijmrrp.2017.3.5.034