Research Paper Anatomy

Morphometric Study of Sacral Hiatus For Caudal Epidural Block (Ceb) in Adult Human Dry Sacrum in Central India.

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ABSTRACT

Aim:. sacrum is one of the bone which exhibit variations and the variation of sacral hiatus. The opening at the caudal end of sacral canal is known as sacral hiatus, variation in the sacral hiatus is of great clinical significans. Sacral hiatus has been used for administration of caudal epidural anesthesia in obstetrics as well as in orthopedic practice for diagnosis and treatment of lumbar spinal disorders.

Materials & Methods : This study was performed in Department of Anatomy of N.S.C.B. medical college Jabalpur M.P. during the period of august 2015 to January 2016. This study consists of 66 dry, undamaged human sacrum of unknown sex was used. Anatomical measurements were performed on these specimens by using vernier calipers with accuracy of 0.1 mm. To interpret the data was analyzed statistically.

Results: The dorsal wall of sacral canal was entirely incomplete (known as complete Spina bifida) in 2 cases which were excluded from our study. there were many variations in the shape ,the level of apex, the base, the average length, the average width and average depth of SH was measured .

Conclusion: There are anatomical variations in the sacral hiatus and the understanding of these variations may improve the success of caudal epidural Block

KEYWORDS sacral hiatus; sacral apex; caudal epidural block.

Introduction:

Sacrum is a large triangular bone forming the posterosuperior wall of the pelvic cavity, wedged between the two pelvic bones. It is formed by the fusion of five sacral vertebrae and forms the caudal end of the vertebral column. The sacrum consists of trabecular bone enveloped by a shell of compact bone of varying thickness. [1] The opening at the caudal end of sacral canal is known as sacral hiatus. It is formed due to the failure of fusion of laminae of the fifth (occasionally 4th) sacral vertebra. It is located inferior to the 4th (or 3rd) fused sacral spines or lower end of median sacral crest. The sacral hiatus is identified by palpation of the sacral cornua the remnants of the inferior articular process elongate downwards on both sides of the sacral hiatus. These two bony processes are called the sacral cornua (horns) and define important clinical landmarks during CEB. [2] Sacral cornua are felt at the upper end of the natal cleft 5 cm above the tip of the coccyx. Alternatively, the sacral hiatus may be identified by constructing an equilateral triangle based on a line joining the posterior superior iliac spine: the inferior apex of this triangle overlies the sacral hiatus. The sacral hiatus contains fifth sacral nerve, coccygeal nerve roots, filum terminale externa and fibro fatty tissue. In recent state the sacral hiatus is covered by superficial posterior sacrococcygeal ligament which is attached to the margins of the sacral hiatus and the deep posterior sacrococcygeal ligament attached to the floor of sacral hiatus.[1]

Sacral hiatus has been used for administration of caudal epidural anaesthesia in obstetrics[3] as well as in orthopedic practice for diagnosis and treatment of lumbar spinal disorders.[4] It has been proposed that "The fundamental knowledge of the anatomy of the sacral area is prerequisite for success in continuous caudal epidural analgesia". Sacrum is one of the bones which exhibit variations. Therefore the importance of the normal sacral hiatus and its variations is of great clinical significance.[5] Caudal Epidural Block involves injection of a drug into the epidural space through the sacral hiatus to provide analgesia and anesthesia in various clinical settings.[6] Caudal analgesia is used during surgical procedures in urology, proctology, general surgery, obstetrics and gynecology and orthopedics. It is also used for three dimensional colour visualization of lumbosacral epidural space.[7] Anesthetic agents are injected through the sacral hiatus in caudal epidural anesthesia to act on the sacral and coccygeal nerves and these are often employed to relax the perineal musculature for painless child birth.[8] It has now been noted that, the anatomical variations of sacral hiatus may also be one of the important cause for mechanical low back pain in the middle age.[9]

Even though CEB has a wide range of clinical applications, it is sometimes hard to determine the anatomical location of the sacral hiatus and the caudal epidural space, especially in adults. The determination of the landmarks by the clinician enables the sacral hiatus to be ascertained and may increase the success rate of CEB.[10] The reliability and success of caudal epidural anesthesia depends upon anatomical variations of sacral hiatus. Over the years different authors had carried various types of measurements on human sacra of different races and regions. Central India Region has remained virgin enough of such work.

Materials and method:

This study was performed in Department of Anatomy of N.S.C.B. medical college Jabalpur M.P. during the period of august 2015 to January 2016. This study consists of 66 dry, undamaged human sacrum of unknown sex was used. Anatomical measurements were performed on these specimens by using vernier calipers with accuracy of 0.1 mm. To interpret the data was analyzed statistically. The different parameter of each sacrum was studied under the following headings:-

1. ***The shape of sacral hiatus.***
2. ***The level of apex of sacral hiatus in relation with sacral vertebra.***
3. ***The level of base of sacral hiatus in relation with sacral vertebra.***
4. ***The length of sacral hiatus was measured from*** mid point of base to apex (in mm).
5. ***The depth (Antero posterior) of the sacral hiatus at the level of Apex*** (in mm).
6. The width of sacral hiatus (between the inner aspects of

inferior limit of sacral cornua) (in mm).
7. The distance from apex to the level of S 2 foramina (in mm).
8. The distance from base to level of S2 foramina. (in mm).
9. Distance between two superolateral sacral crest(in mm).
10. Distance between right superolateral sacral crest and apex (in mm).
11. Distance between left superolateral sacral crest and apex. (in mm).

MORPHOMETRIC MESURMENTS OF SACRUM

OBSERVATIONS:

Table 1 : Shape of the sacral hiatus (n = 66)

S.No.	Shape of the SH	No.	Percentage
1	Inverted U	22	33.33%
2	Inverted V	22	33.33%
3	Irregular	16	24.24%
4	Elongated	4	6.06%
5	Bifid	2	3.03%

Graph 1: Shape of the sacral hiatus

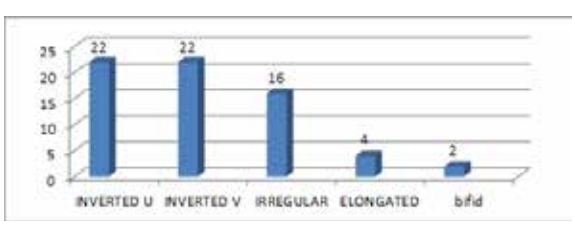

Table 2 : Level of Apex in relation with body of sacrum

S.No.	Level of apex	No.	Percentage %
1	2nd sacral vertebra	2	3.03%
2	3rd sacral vertebra	27	40.9%
3	4th sacral vertebra	34	51.51%
4	5th sacral vertebra	3	4.54%

Graph 2Level of Apex in relation with body of sacrum

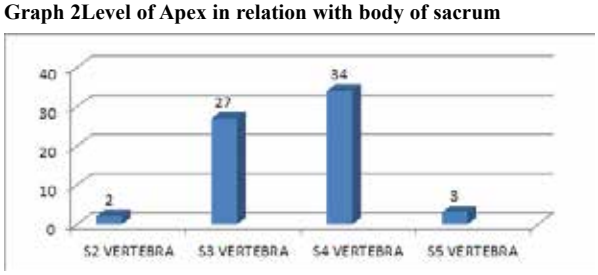

Table 3 : Level of Base in relation with body of sacrum

S.No.	Level of Base	No.	Percentage %
1	5th sacral vertebra	53	80.3%
2	4th sacral vertebra	9	13.63%
3	Coccyx	4	6.06%

Graph 3 : Level of Base in relation with body of sacrum

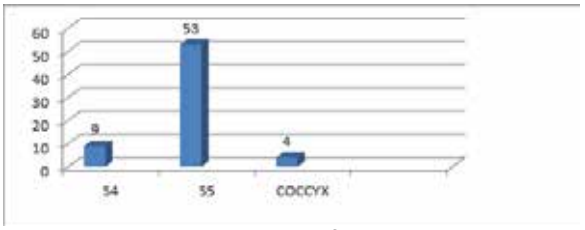

Table 4 : Measured parameters of sacral hiatus

S.No.	Measured parameter in mm	Mini-mum	Maxi-mum	Mean	Std devia-tion
1	***Length of sacral hiatus***	15.10	55.20	33.71	9.54
2	Width of sacral hiatus	10.00	24.10	18.38	2.81
3	Depth of SH at the level of its apex	4.00	8.10	6.08	1.19
4	Distance from apex to the level of S2 foramina	10.10	76.00	32.97	13.42
5	Distance from base to the level of S2 foramina	5.00	84.20	59.70	11.04
6	Distance between two supero lateral sacral crest	48.60	85.10	64.83	6.87
7	Distance between right superolateral sacral crest & apex	39.00	85.30	63.16	9.07
8	Distance between left superolateral sacral crest & apex	44.00	83.40	62.53	9.03

VARIOUS SHAPES OF SACRAL HIATUS

Figure1:Inverted U-shapedSH

Figure 2: Inverted V- shaped SH

Figure 3: Irregular SH

Figure4:Bifid shaped SH

Figure5: Elongated SH

Results:

The dorsal wall of sacral canal was entirely incomplete (Known as complete spina bifida) in 2 cases which were excluded from our study. There were many variations in the shape of sacral hiatus. out of 66 sacral bones in 22 (33.33%) cases the shape was inverted U and in 22 (33.33%) cases inverted V both the above types were considered as normal. There 16 (24.24%) cases were irregular and 4 (6.06%) cases were elongated and 2(3.03%) cases were bifid in shape (Table 1). The level of apex was quite variable and extended between middle of 2nd to the middle of the 5th sacral vertebra. The apex was present at the level of 4th sacral vertebra in 34 (51.5%) cases, 3rd sacral vertebra in 27 (40.9%) cases, 5th sacral vertebra in 3 (4.54%) cases and in 2 (3.03%) cases where sacral hiatus was much elongated the apex was found to be present against 2nd sacral vertebra (Table 2). The base of sacral hiatus was present between middle of 4th sacral vertebra middle of 1st piece opf coccyx. Out of 66 sacrum the base of sacral hiatus was most commonly present against the 5th sacral vertebra that is 53 (80.3%) cases, in 9 (13.63%) cases it was found against 4th sacral vertebra while only 4 (6.06%) had it base lying against the coccyx (Table 3). The average length of sacral hiatus was 33.7 (9.5) mm, the average width of sacral hiatus was 18.3 (2.8) mm, the average depth of sacral hiatus was 6.08 (1.1) mm . The distance between the right superolateral sacral crest and sacral apex was 63.1 (9.0) mm. The distance between the left superiolateral sacral crest and sacral apex was 62.5 (9.0) mm. and the distance between the 2 superolateral crest was 64.8 (6.8)was observed. (Table 4).

Discussion:

The knowledge of SH anatomy is imperative in clinical situations requiring CEB for various diagnostic and therapeutic procedures of the lumbosacral spine to avoid failure and dural injury.[11] The SH is variable in shape and size. The laminae of the entire sacral vertebra may fuse in the midline resulting in the absence of SH or it may fail to fuse resulting in incomplete bony dorsal wall of the sacral canal. Between these two extremities a number of variations in the SH have been observed.[12] In the present study the shapes of sacral hiatus were variable . Many authors have been mentioned various shapes of SH.[13] [14] There were five shapes of SH in our study : inverted U, inverted V, irregular, bifid and elongated .Nagar SK also noted that most common SH being inverted U in 41.5 % and inverted V in 27% sacrum . in the present study the most common shape of SH was in inverted U and inverted V both are 33.33% of sacrum . In 6.06 % its outline was elongated while in 24.24% it was irregular .present study was almost similar to Nagar S K. [15]

The apex of the sacral hiatus was seen most commonly (51.51%) at the level of 4th sacral vertebra in present study which is similar to the study of Ramamurthi KS et al.which was 50.8% at the level of s4.[16] Sekiguchi M et al(2002) noted the apex of sacral hiatus present at level of s4 sacral vertebra in 64% cases.[4] most of the authors including present study noted that most common site of apex of SH is s4 although it may vary from s2 to s5 vertebra.

Base of the sacral hiatus was seen at the level of fifth sacral vertebra in 83.3% of sacra in the present study which was almost similar when compared to the study conducted by Nagar SK and Ramamurthi KS et al.[15] [16] where he noted in 72.6% and 72.4% of sacra and very much similar to the study done by Vishal kumar et al seen in 83.17% of sacra.[17] Parashuram R found the width of SH (11.42mm) which was lesser than, and the depth of sacral hiatus (4.25 mm) which was slightly smaller than and length of SH (19.63mm) which was very much lower than our study.[5] Ramamurthi KS et al found the width of SH (16.2mm) which was lesser than and the depth of sacral hiatus (5.0mm) which was slightly lower than and length of SH (29.5mm) was also slightly lower than our study .In our study the width of SH was (18.3mm) depth of SH was (6.0mm) and the length of SH was (33.7mm).[16]

An important point in CEB is awareness of the distance between the sacral hiatus and dural sac anatomically because the dural sac was reported to terminate at the level of s2 foramina.. The dimensions of the sacral hiatus may vary with its apex, usually slightly

above the distal third of S4, and the distance between the tip of

dural sac and hiatal apex around 45mm.[2] In our study, The distance between the S2 foramen and the apex of the sacral hiatus was 32.9mm and the distance to the base of the sacral hiatus was 59.7mm. High level of SH apex (S3) is a dangerous site, because of its close relation to the level of dura mater termination at S2. Abd El-Monem *et al*. (2006) reported that the location of SH apex in Egyptian sacra was variable. So insertion of a needle into the SH for caudal block is suggested to be done at its base to avoid the anatomic variation of its apex.[18]

SH may be hard to palpate, particularly in obese patients. Hence other prominent anatomical landmarks may be of use, such as the triangle formed between the posterior superior iliac spines and the apex of sacral hiatus. Our measurements show this to be an equilateral triangle [7]. This practical guide will lead to the detection of sacral hiatus easily and increase the success rate of CEB. [19]

In the present study, the distance between the right and left superolateral crests was 64.8mm Whereas the distance between right superolateral crest and SH apex was 63.1mm and the distance between left superolateral crest and SH apex was 62.5mm forming nearly a equilateral triangle. This triangle can act as guide to the location of apex of sacral hiatus during CEB.

Conclusion:

Identification of the caudal epidural space is not always possible even for experienced clinicians, and Anatomical variation may be an influence. The apex of the sacral hiatus is an important bony landmark in the success of CEB. There are anatomical variations in the sacral hiatus and the understanding of these variations may improve the success of caudal epidural Block which was reported by various workers in the previous studies. Insertion of a needle into the SH for caudal block is suggested to be done at its base to avoid the anatomic variations of its apex.

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