RESEARCH PAPER | MEDICAL SCIENCE | Volume : 4 | Issue : 2 | Feb 2014 | ISSN - 2249-555X

A Morphological Study of Sacral Hiatus with its Clinical Implications

KEYWORDS: Sacral hiatus, variations, caudal epidural block, dural sac.

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ABSTRACT *This study to know the variations in the morphology of sacral hiatus was carried out on 194 sacral bones in Dakshin Kannada region. Various shapes of sacral hiatus were observed which included inverted U(62.37%) ,inverted V(22.16%) , Irregular (8.76%) ,dumbbell (3.09%) ,non canalized (2.06%) and bifid (1.54%). Level of apex and base of sacral hiatus were most commonly seen at 4th sacral vertebra in 74.21% and at 5th sacral vertebra in 96.84% respectively. The knowledge about the anatomical variations and structural modifications of sacral hiatus is necessary for the reliability and success of caudal epidural block and to prevent dural sac puncture.*

Introduction

Sacral hiatus is the opening at the caudal end of sacral canal which is formed due non 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 contains fifth sacral nerve, coccygeal nerve roots, filum terminale externa and fibro fatty tissue. The dural sac terminates at the level of S2 sacral vertebrae within the canal. The sacral hiatus is covered by superficial posterior sacrococcygeal ligament, which is attached to the margins of the sacral hiatus.[1]

The approach to the epidural space through sacral hiatus is used for giving analgesia and anaesthesia for various operations, treatment of lumbar spinal disorders and for management of chronic back pain. The success of caudal epidural block depends upon accurate localization of sacral hiatus for optimal access into sacral epidural space. Hence it is necessary to have a detailed knowledge of the anatomical variations in sacral hiatus which results in discrepancies in its shape and size.[2]

In this current study we aim to find out the anatomical variations of sacral hiatus by non metric method as the reliability and success of caudal epidural anaesthesia depends upon anatomical variations of sacral hiatus.

Material and methods

In the present study 194 dry human sacra were collected from the students of the 1st year MBBS and department of anatomy of A. J institute of medical sciences and Father Muller Medical College Mangalore. Selected for the study were completely ossified sacra with no deformity and Sacra having deformity or any pathology were excluded from the study.

Methodology

The different parameters of each sacrum were studied under the following headings and sufficient care was taken to avoid manual errors.

1. The shape of the sacral hiatus.
2. Level of apex of the sacral hiatus.
3. Level of base of the sacral hiatus.

Observations and results.

Table 1: Shape of sacral hiatus.

Sl.no	Shape	Number (194)	Percentage
1	Inverted-U	121	62.371
2	Inverted-V	43	22.164
3	Irregular	17	8.762
4	Dumbbell	6	3.092
5	Non canalized	4	2.061
6	Bifid	3	1.546

Table 2: Location of the level of apex and base of sacral hiatus in relation to sacral vertebra.

Sl.no			N= 190	Percentage	Range	Mean	SD
1	Level of apex	5th sacral vertebra	9	4.73	2-5	3.81	0.537
		4th sacral vertebra	141	74.21			
		3rd sacral vertebra	36	18.94			
		2nd sacral vertebra	4	2.10			
2	Level of base	5th sacral vertebra	184	96.842	4-5	4.97	0.175
		4th sacral vertebra	6	3.157			

Sl no = serial number, N=190 since 4 bones are non canalized

Volume : 4 | Issue : 2 | Feb 2014 | ISSN - 2249-555X

Inverted U and V are the most common types of sacral hiatus with 62.37% and 22.16% respectively. Level of apex and base of sacral hiatus are most commonly seen at 4th sacral vertebra in 74.21% and at 5th sacral vertebra in 96.84% respectively.

Discussion

The knowledge about the anatomical variations and structural modifications of sacral hiatus is necessary for the reliability and success of caudal epidural anaesthesia. [3]

In 1942 for the first time Edward introduced Continuous caudal analgesia in the field of obstetrics to maximize the comfort and minimize the risk of lobor pains of mother during delivery.[4]The technique of injecting medications into the epidural space via the sacral hiatus is called as caudal epidural block. It is practiced since 1952 to anaesthetise lumbar and sacral dermatomes and also for the symptomatic relief of low backache disorders in patients by injecting corticosteroids.[5]

In the present study the shapes of sacral hiatus are variable(figure 1,table 1 and 3); most commonly found are Inverted-U in 62.37% and inverted-V in 22.16% cases similar to the studies of Anjali, Nagar and Suma [2, 6, 7] unlike the studies of Vishal ,who found inverted V more common than inverted U. [8] In the present study other shapes found are; irregular (8.76%), dumbbell (3.09%), non-canalized (2.06%) and bifid (1.54%) and Both inverted U and inverted V are considered normal and may be the most favourable shapes for caudal epidural block as they provide adequate space for introducing needle into epidural space without any obstacle. The other listed shapes due to its irregularity may obstruct needle insertion and even lead to needle breakage [2]. The non canalized sacrum also called 'spina bifida' which occurs due to failure in complete fusion of sacral vertebrae may lead to weakness of muscles and low backache as there is no bony area available for attachment of muscles.[9] In non canalized sacrum caudal epidural block is still possible as it is closed by sacrococcygeal ligaments [10] and may also be partially successful as the infiltrated anaesthetic agents penetrates the surrounding tissues and does not block the nerves.[11]

According to the standard text books the apex of sacral hiatus is present at the level of 4th sacral vertebra [1].In the present study (table 2 and 4) the apex of sacral hiatus was seen most commonly at the level of 4th sacral vertebra in 74.21% of cases, which is almost similar to studies of Suma.[7] The apex, is seen at the level 2nd sacral vertebra in 2.10%, which is almost similar to Anjali[2]. All studies including the present study noted that location of apex varied from upper part of second sacral vertebra to lower part of fifth sacral vertebra. [2,6,7,12] Willis in his book mentions that knowledge of the variable distances from the tip of the sac to the apex of the sacral hiatus should warn the possibility of dural sac puncture [9] and also the risk of intravascular and intrathecal spread of the anaesthetic drug [13], hence care should be taken while deciding the length of the needle to be introduced into the canal.

Location of base varies from S4 to coccyx.[14] In our study(table 2 and 5) base is seen most commonly at the level of S5 in 96.84% cases, whereas in Anjali's study it is 62 % cases, 72.6% in Nagar's study, 64.38% in Suma's study and 83.17% in Vinod Kumar's study. [2, 6,7,15] Incidence of base against S4 is 3.14% in our study, which is less than studies of Anjali and Suma.[2, 7]

Conclusion

The anatomical variations in the morphology of the sacral hiatus have implications in the clinical practice and understanding of these variations may improve both the reliability and safety of caudal epidural anaesthesia and prevent the hazard of dural sac puncture during caudal epidural block.

Inverted V

Inverted U

Bifid spine

Figure 1- Different shapes of sacral hiatus.

Volume : 4 | Issue : 2 | Feb 2014 | ISSN - 2249-555X

Dumbbell shape

Non canalized sacrum

Irregular shape

Table 3: Different shape of sacral hiatus in comparison with other studies.

Sl. no	Shape	Nagar[6] 1992	Vishal Kumar[8] 2008	Anjali[2] 2009	Suma[7] 2010	Present Study 2012
1	Inverted-U	41.5%	23.6%	40.35%	44%	62.37 %
2	Inverted-V	27%	39.6%	31.57%	28.27%	22.16%
3	Irregular	14.1%	30%	15.78%	10.1%	8.76%
4	Dumbbell	13.3%	--	7.01%	12.3%	3.09%
5	Non canalized	-		-	-	2.06%
6	Bifid	1.5%	7.2%	4.38%	5.33%	1.54%

Table 4 Level of apex of sacral hiatus in comparison with other studies.

	Nagar[6] 2004	Sekiguchi[12] 2004	Anjali[2] 2009	Suma[7] 2010	Present Study 2012
S5	3.4 %	15 %	14.9 %	11.57 %	4.73 %
S4	55.9 %	65 %	68.42 %	77.5 %	74.21 %
S3	37.3 %	15 %	14.03 %	4.67 %	18.94 %
S2	3.45 %	4 %	2.63 %	0.93 %	2.10 %

S= sacral vertebra, N=190 since 4 bones are non canalized.

Table-5: Level of base of sacral hiatus in comparison with other studies.

	Nagar[6] 2004	Vinod Kumar[15] 1992	Anjali[2] 2009	Suma[7] 2010	Present Study 2012
Number of bones	263	202	114	150	190
Coccyx	16.3%	-	27(16%)	25.62 %	-
S5	72.6%	83.17%	70(61.40%)	64.38 %	96.842%
S4	-	-	13(11.40%)	10 %	3.157%

S= sacral vertebra, N=190 since 4 bones are non canalized.

Volume : 4 | Issue : 2 | Feb 2014 | ISSN - 2249-555X

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