

Morphometric study of Sacral Hiatus for Caudal Epidural Block

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Abstract— Study of variation of sacral hiatus in dry bone is important as it determines access of sacral hiatus for caudal epidural anaesthesia and analgesia. So this descriptive observational study was conducted on 80 adult sacrum bones were studied at department of Anatomy, SMS Medical College, Jaipur with the aim to examine Morphometry of Sacral hiatus including shape, length, A-P diameter at apex and transverse width at base. Most commonly found shape of sacral hiatus in this study was inverted U/V shape. Length of sacral hiatus ranged 6 to 43 mm with more than half cases having length between 10-20 mm. Most sacrum (81.25%) had antero-posterior diameter of 4 to 8 mm. Half of the sacrum had transverse width at sacral cornua between 9-13 mm. It can be concluded that anatomical variations in sacral hiatus are cause of caudal epidural anaesthesia failure and procedure related complications. Understanding these variations may improve success of caudal epidural anaesthesia and decrease incidence of complications. So this study will be useful to increase success rate of epidural anaesthesia.

Keywords— Sacrum, Sacral hiatus.

I. INTRODUCTION

Study of variation of sacral hiatus in dry bone is important as it determines access of sacral hiatus for caudal epidural anaesthesia and analgesia. The incomplete fusion of the posterior elements of the 4th or 5th sacral vertebra, results in the formation of sacral hiatus (SH)^{1,2}. The SH is important landmark to perform caudal epidural block (CEB) for treating patient with low back pain³. The lower sacral nerve roots, coccygeal nerve roots, filum terminale and fibro-fatty tissue forms the content of this sacral hiatus. This hiatus is covered by superficial posterior coccygeal ligament which is attached to the margins of the hiatus and the deep posterior sacro-coccygeal ligament attached to the floor of sacral hiatus⁴.

Success rate of CEB is based on determination of the landmarks by clinician, even though CEB has a wide range of clinical caudal epidural space, especially in adults⁵. In interest of patient care, to circumvent the failure of CEB which depend on anatomic basis¹, Previous Studies indicate that, Lots of variations are found in anatomy of sacral hiatus (SH), which lead to failure of CEB.

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.⁶

Caudal epidural block (CEB) involves the injection of anaesthetic medications into the epidural space through the sacral hiatus to provide analgesia and anaesthesia for different clinical conditions⁷. It is useful when anaesthesia of the lumbar and sacral dermatomes is needed¹. Bony landmarks of the CEB

are sacral hiatus and sacral cornua⁸. The sacrum articulates with the fifth lumbar vertebra above and the coccyx below. On the dorsal surface of the sacrum there is a raised median sacral crest, with four, sometimes, three tubercles which represent the fused sacral spines. So, understanding the anatomic variations of sacral hiatus using bony landmarks may improve the reliability of CEB.⁹

This present study was aimed to assess the Morphometry of Sacral hiatus including shape, length, antero - posterior diameter at apex and transverse width at base to better understand anatomy of sacral hiatus.

II. METHODOLOGY

This case series type of descriptive observational study was conducted in Department of Anatomy, SMS Medical College, Jaipur (Rajasthan) India in year 2015 with due permission of Institutional Research Review Board and Ethical committee.

Study Population: Sacrum bones present in Department of Anatomy, SMS Medical College, Jaipur (Rajasthan) India, were included in this study. Sacral bones having any fracture, pathology or wear and tear and Sacra with total posterior closure and agenesis of dorsal wall were excluded from study. Finally 80 Sacrum bones were studied.

After obtaining ethical clearance from Research review board of SMS medical college, Jaipur, the measurements were taken using Digital vernier calliper. The following linear measurements were recorded to the nearest millimetre -

- Length of sacral hiatus: from middle of base of sacral hiatus to the apex of sacral hiatus. (Figure 1)
- Width of sacral hiatus: between the inner aspects of inferior limit of sacral cornua
- Antero-posterior diameter at the apex of sacral hiatus
- Shape of sacra hiatus

Figure 1
Measurement of Length of Sacral Hiatus of Sacral bone



All above observations were entered in a predesigned proforma. Data was collected were entered into Microsoft Excel spread sheet.

Statistical analysis: Qualitative data were expressed in proportion and percentage and quantitative data were expressed in terms of mean and standard deviation. Data were analyzed using the 'Primer' software.

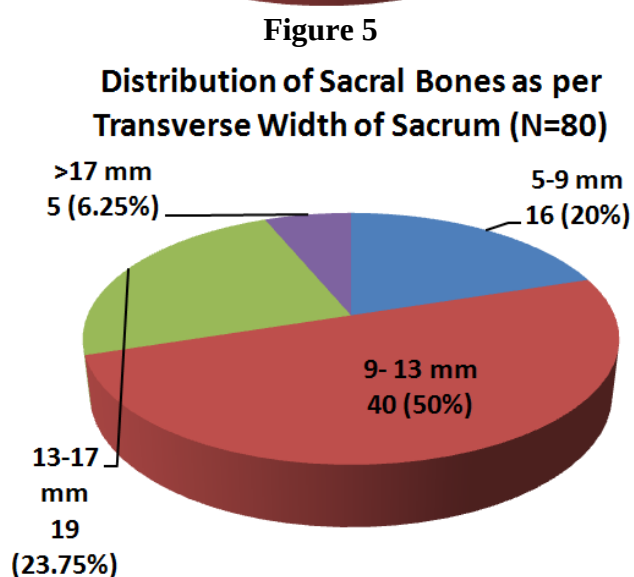
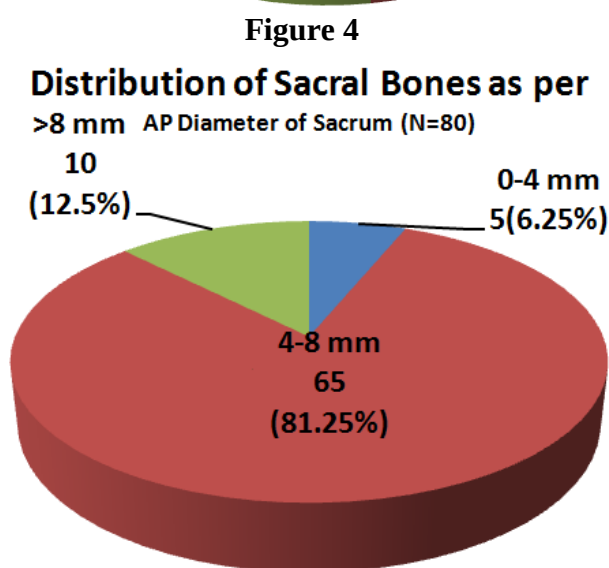
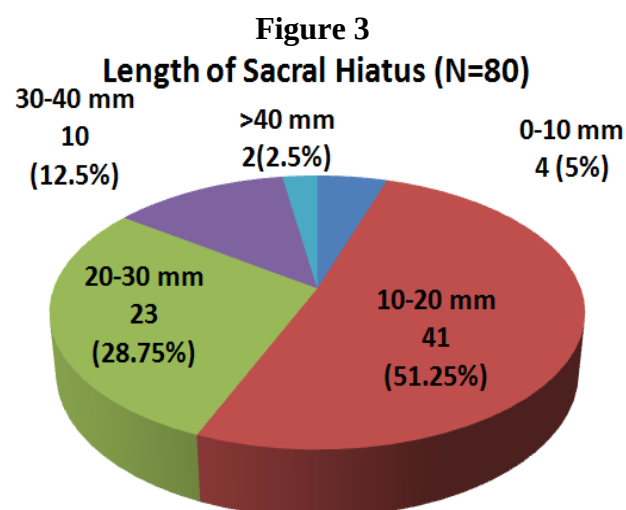
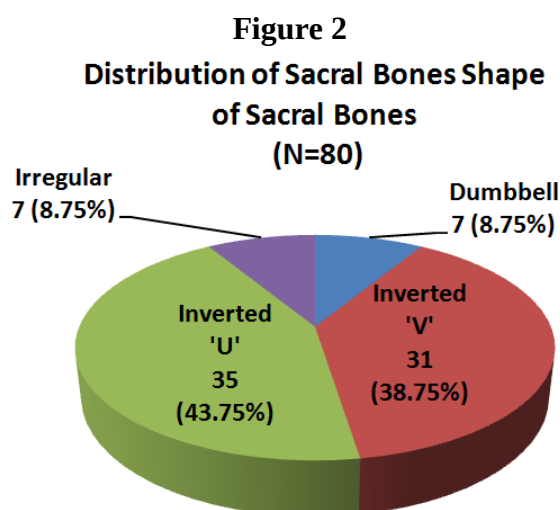
III. RESULTS

Out of total 80 Sacral bones, maximally i.e 35 (43.75%) had inverted U shape of sacral hiatus followed by inverted V shape (38.75%), Dumb bell (8.75%) and Irregular (8.75%). (Figure 2)

Length of sacral hiatus of sacral bones, majority (80%) of sacral bones has 10-33 mm of length of sacral hiatus including with more than half cases (51.25%) having length between 10-20 mm. (Figure 3)

Out of total 80 sacral bone studied, majority (65 i.e. 81.25%) had antero-posterior diameter of 4 to 8 mm. (Figure 4)

Regarding transverse width at sacral cornua of sacral bone studied, majority (59 i.e. 73.75%) were in between 9-17 mm including 50% of sacrum with its transverse width 9-13 mm. (Figure 5).



Length of sacral hiatus of Sacral bone studied in this study had range from 6.6 mm to 42.8 mm with mean height 20.6 ± 8.8 mm (Table 1)

Likewise antero-posterior (AP) diameter of Sacral bone studied had range from 2 mm to 14.4 mm with mean diameter 6.2 ± 1.98 mm (Table 1)

Regarding transverse width at sacral cornua of Sacral bone studied in this study were ranging from 5.6 mm to 20.5 mm with mean width 11.8 ± 3.2 mm (Table 1)

Table 1
Measurements of Sacral bone Studied (N=80)

Parameter (mm)	Mean	Std. Deviation	Median	Minimum	Maximum
Length sacral hiatus	20.6	8.8	18.4	6.6	42.8
AP diameter	6.2	1.98	5.85	2	14.4
Transverse Width	11.8	3.2	11.5	5.6	20.5

IV. DISCUSSION

Sacral approach to epidural space produces reliable and effective block of sacral nerves. Study on the variations of sacral hiatus can help to identify the caudal epidural space in giving caudal epidural block by palpating the sacral cornua. Knowing the anatomical relations of the sacral hiatus would facilitate the procedure.

Present study found inverted V and U shape to be most common shape as was similarly found by Kumar et al, (2009)¹⁰, Seema singh et al[2013]¹¹ and Aggarwal et al¹². In present study length of sacral hiatus varied from 6.6mm to 42.8mm and the mean was 20.6mm. This was similar to that reported by Kumar et al.(2009)¹⁰, mean length 20 mm in males and 18.9mm in females. Trotter & Lanier¹³ reported sacral hiatus length as 24.8 mm in American males and 19.8 mm in females. This slight variation in length of Sacral Hiatus as observed in different studies could be due to difference in ethnicity or geographical area.

Antero-posterior diameter of sacral canal at apex of sacral hiatus is important as it should be of sufficient size to admit a needle while giving block. Varying diameters may lead to subcutaneous deposition of anaesthetic drug. In the present study the antero-posterior diameter ranged from 2 to 15 mm with a mean of 6.2 mm. Mean diameters reported by various workers were similar; Trotter & Letterman¹⁴ reported a range of 0-11 mm (mean -5.3 mm), Trotter & Lanier¹³ reported 5 mm in Whites and 6 mm in Negroes group, Kumar et al. (1992)¹⁵ found mean diameter to be 4.8 mm. In present study the width at base of sacral hiatus in more than half cases was 9-17 mm. This was similar to earlier studies by Kumar et al., (2009)¹² who reported 5-20 mm (mean -1.3 mm) and 8 -18 mm (mean - 1.25 mm) in male and female sacra respectively. Aggarwal et al.¹² reported width to be 11.95 ± 2.78 mm.

V. CONCLUSION

It can be concluded that inverted 'U' and inverted 'V' shape was most common shape of sacral bone and few cases had Dum-bell and irregular shape. Length of sacral hiatus ranged from 6.6 mm to 42.8 mm with mean height 20.6 ± 8.8 mm and majority (80%) of sacral bones has 10-33 mm of length. Antero-posterior (AP) diameter had range from 2 mm to 14.4 mm with mean diameter 6.2 ± 1.98 mm and majority (65 i.e. 81.25%) had antero-posterior diameter of 4 to 8 mm. Transverse width at sacral cornua had ranged from 5.6 mm to 20.5 mm with mean width 11.8 ± 3.2 mm and majority (59 i.e. 73.75%) were in between 9-17 mm.

These anatomical variations in the sacral hiatus may be the cause of failure of caudal epidural anaesthesia and procedure related complications. Understanding of these variations may improve the success of caudal epidural anaesthesia and decrease the incidence of complications and their manifestations. Further studies are needed to determine the factors responsible for such variations which could be taken into consideration during epidural procedures.

CONFLICT

None declared till date.

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