A study of variations of sacral hiatus of dry human sacra in north interior Karnataka region

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Abstract

Background and aims: The shape of sacral hiatus is known to show a number of anatomical variations. The shape and extent of sacral hiatus is important because in caudal epidural anaesthesia, the approach is made through sacral hiatus. The detailed anatomical knowledge of variations of sacral hiatus is very helpful to the anaesthetists to increase the success rate of caudal anaesthesia. The present study is an attempt to find out variations of sacral hiatus in north interior Karnataka region.

Materials and methods: For the present study, one hundred dry human sacra obtained from north interior Karnataka region were used.

Results: The inverted U shaped sacral hiatus was most common (56%). Inverted V shaped sacral hiatus was found in 24% of sacra. The other variations like irregular shaped hiatus (10%), bifid hiatus (2%), dumbbell shaped hiatus (5%), complete spina bifida (1%) and absent hiatus (2%) were also found.

Conclusion: Abnormal shapes of sacral hiatus like irregular, bifid, dumbbell, complete spina bifida and absent hiatus were seen in 20% of total 100 sacra belonging to north interior Karnataka.

Key words: spina bifida, caudal epidural anaesthesia, absent hiatus, dumbbell hiatus, inverted V type

Introduction

The os sacrum is composed of five fused vertebrae which is triangular in shape with base above and apex below. The sacrum is considered to be sacred because it occupies the lowest part of back which is invariably covered as a mark of respect. The median part of the dorsum of the sacrum is formed by the fused laminae of sacral vertebrae. The laminae of the fifth sacral vertebra, sometimes also fourth are deficient leaving an inverted U shaped or V shaped gap called sacral hiatus. The U shaped sacral hiatus provides a means of entrance into the caudal canal. There is normally a significant anatomic variation of sacral hiatus.

The shape and extent of sacral hiatus was proved important because in caudal epidural anesthesia, the approach is made through sacral hiatus. The laminae of all the 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. The present study in an attempt to find out variations of sacral hiatus in north interior Karnataka region.

Materials and methods

Source of data

For the present study, one hundred dry human sacra were obtained from north interior Karnataka region.

Inclusion criteria

Dry human sacra which were well formed and fully ossified were included in the study.

Exclusion criteria

Fragmented, deformed bones were excluded from the study.

The external appearance of sacral hiatus was studied in one hundred human sacra regarding the shape and there were many variations found. The different types of shapes of sacral hiatus looked for were inverted U, inverted V, irregular, bifid, dumbbell, complete spina bifida and absent hiatus. (Fig. 1 to 5).
Results

The inverted U shape of sacral hiatus was the most common and was found in 56 cases (56%) in which the margins of sacral hiatus was present in Inverted U manner. Inverted V type of sacral hiatus was found in 24 cases (24%).

In 10 cases (10%), shape of sacral hiatus was irregular. Here the margin of sacral hiatus did not resemble any specific shape. Bifid type of sacral hiatus was found in two cases (2%). Dumbbell shaped sacral hiatus was found in five cases (5%). In this case a nodular bony growth of margins of sacral hiatus was found projecting medially giving rise to a dumbbell shape appearance. The complete spina bifida was observed in one case (1%). In two cases (2%), absent hiatus was found in which their was absence of sacral hiatus.

Discussion

In 1900, caudal epidural anesthesia was performed for the first time which involved injection of a drug into the epidural space through sacral hiatus for many clinical procedures as analgesia.

In 1901, Cathelin and Sicard in Paris, developed technique of caudal epidural injection, which was further improved and applied in different fields. In 1909, Stoeckel of Marburg Germany used caudal injection in obstetrics. Further scope was its use in painless deliveries. In 1910, Lawen used caudal injections in surgery.

Continuous caudal epidural anesthesia was introduced for the first time in 1942 in the field of Obstetrics for painless deliveries and the prerequisite for this was the proper anatomical knowledge of the sacral hiatus.

The fifth sacral vertebra is not fused posteriorly giving rise to a variably shaped opening, the sacral hiatus. Occasionally other sacral vertebrae do not fuse posteriorly giving rise to a much larger sacral hiatus.

The sacral hiatus may be almost closed, symmetrically open or widely open with secondary anomalies in the pattern of fusion of the laminae of the sacral arches.

The sacral hiatus is the detail of interest, this results in a variably shaped and sized V shaped bony defect. Needle insertion through this defect may be difficult because of frequency of anatomic variation like longitudinal slit like sacral hiatus, second midline hiatus, transverse hiatus, large hiatus with absent cornua. The sacral hiatus may vary from slit like to a wide based, inverted V, and one in twenty patients the bony defect may be absent.

In a study of the sacral hiatus in 120 apparently normal skeletons, in 26% of cases, the sacral hiatus reached to the third sacral segment and in 4% even to the second one. The entrance to the sacral canal was barred by a bony bump in the region of the sacral hiatus in 3% cases.

Spina bifida with a higher position of sacral hiatus was reported in dried specimen of sacrum with prominent S1 spine. The higher position of this sacral hiatus is clinically important for anesthetists.

Sacral hiatus is commonly an inverted U or V shaped foramina with significant anatomical variations. The needle for caudal epidural block is inserted parallel to the posterior aspect of the upper vertebral bodies. A transsacral approach becomes impossible only when the sacral hiatus is absent in 8% of patients. Sacral hiatus provides an alternative approach during myelography when standard approaches are unavailable.

Standiford Helm et al. describes a novel technique to deal with stenosis of sacral hiatus preventing caudal blocks. Sacral hiatus can be narrowed by cartilagenous or bony overgrowth. In a study of 16 sacra, the position and size of sacral hiatus were examined. The cranial margin of the sacral hiatus was located caudal to the level of the fourth sacral vertebra in 75% of sacra. Thus this level is considered to be the representative border for the formation of vertebral arch. The developmental significance of sacral hiatus plays a role in it.

In another study of sacral hiatus carried out on 181 sacra in Aurangabad to know the shape, apex, base, length, width and hiatal index of sacral hiatus. The shape
of hiatus included inverted U (98, 54.1%), inverted V (68, 37.6%) and others (10, 5.5%). In 3 cases (1.7%) complete sacral spinabifida and in 2 cases(1%) absence of sacral hiatus was seen. The level of apex varied between S2 and S5 with maximum against S4 (109, 60.2%). While the level of base between S4 to coccyx with maximum against S5 (154, 85%). It may perhaps be explained as an evolutionary change where sacrum may be in process of loosing its dorsal wall\textsuperscript{19}.

In an another study which was conducted on 92 sacra belonging to Japanese, types of sacral hiatus, apex, sacral cornua, distance between bilateral cornua were studied, of which forty two percent of the cases have both hiatus and cornua. Four percent of cases showed absent hiatus. The apex of sacral hiatus existed at the level of S4 vertebra in 64% cases\textsuperscript{20}.

As in the present study, the inverted U and inverted V type of shapes of sacral hiatus were also found commonly by previous workers. Hence these are considered to be normal. Inverted U shape was found in 29.70% cases and 41.5% cases in the studies done by Vinod kumar et al\textsuperscript{21} and Nagar\textsuperscript{22} respectively.
Inverted V shape was found in 46.53% cases and 27.0% cases in the studies carried out by Vinod kumar et al and Nagar respectively. Irregular type of sacral hiatus was found in 10 (10%) cases in the present study whereas it was found in 14.1% cases in study carried out by Nagar. Bifid type of shape was found in two (2%) cases which is similar with study carried out by Nagar (1.5%). The dumbbell type of shape was found in significantly low values in five (5%) cases which is found to be 13.3% in study carried out by Nagar.

The nodular bony growth of margins of sacral hiatus towards median plane gave this dumbbell appearance of sacral hiatus. The complete spina bifida was found in one (1%) case which was similar to the studies done by Vinod kumar et al (1.49%) and Nagar (1.5%). In two (2%) cases, absence of sacral hiatus was observed which was 0.99% in study carried out by Vinod kumar et al and 0.7% in study carried out by Nagar.

**Conclusion**

In the present study, the 20 (20%) sacra showed abnormal shapes of sacral hiatus like irregular, bifid, dumbbell, complete spina bifida and absent hiatus. The rate of impossible caudal epidural anesthesia through sacral hiatus is 2% as the sacral hiatus was closed leading to absent hiatus.

**References**


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