A Study of Total Spina Bifida of the Sacrum in Western India

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Research Article

Abstract: **Background:** Spina bifida is the generic term for a range of discrete defects of neurulation and subsequent vertebral formation. Numerous anatomical variations of the sacrum have been reported. However, total spina bifida of the sacrum has never been reported in Gujarati population of Western India. These variations may be found in the patients of low back pain and neurological symptoms during radiological investigations or during caudal epidural anaesthesia in labour and lower abdominal surgeries or on post mortem examination or even during dissection of human body and osteology class for medical students. **Objective:** The study was designed to know the prevalence of total spina bifida of the sacrum in Gujarati population of Western India .Considering the variation; we conduct this study as a prelude to any type of work for diagnostic and therapeutic purposes in low back pain, spinal surgery and for interventional procedures like epidural anaesthesia. **Materials and Methods:** 302 intact dry human sacra of unknown sex were studied from the Department of Anatomy, B.J. Medical College Ahmedabad; Government Dental college, Ahmedabad; Medical college, Vadodara and Government Medical College, Surat in Gujarat. The specimens were carefully examined and total spina bifida of the sacrum if found was recorded. **Results:** We found 5(1.65%) out of 302 specimens of sacrum with total spina bifida of the sacrum. **Conclusion:** The present study shows that the incidence of sacrum with total spina bifida of the sacrum in Gujarati population of Western India is 1.65%. This developmental defect must be considered for the sake of patient safety before undertaking caudal epidural block.If not serious complications such as dural puncture may easily occur. It is also important for the accurate diagnosis of patients with low back pain. It may be associated with spina bifida occulta or spina bifida cystica. The knowledge of this anatomical variation is of paramount importance to spinal surgeons, anaesthetists, radiologists, forensic experts, morphologists and clinical anatomists.

Key Words: Anomalies of sacrum; agenesis; spina bifida; epidural anaesthesia. Low back pain.

Introduction

The sacrum is a large, triangular fusion of five vertebrae and forms posterosuperior wall of the pelvic cavity, wedged between two hip bones. Its blunted, caudal apex articulates with coccyx and its superior base with the 5th lumber vertebra at the lumbosacral angle. The posterosuperior aspect of the dorsal surface bears a raised, interrupted median sacral crest with four (sometimes three) spinous tubercles which represents fused sacral spines (Figure -1). Below the fourth (or third) tubercle, there is an arched sacral hiatus in the posterior wall of the sacral canal. This hiatus is produced by the failure of the laminae of the fifth sacral vertebra to meet in the median plane and, as a result, the posterior surface of the body of that vertebra is exposed on the dorsal surface of the sacrum[(1,2)] If the laminae of all the sacral vertebra are not fused, then there will be a gap in the dorsal wall of the sacral canal result in the exposure of all the structures in the sacral canal[(1,3)] (Figure-2).The attachments of the muscles like erector spinae and multifidus may also be altered in case of any anomaly involving dorsal surface of the sacrum leading to low backache. The sacral canal is formed by sacral vertebral foramina, and is triangular in section. Its upper opening, seen on the basal surface, appears to be set obliquely. Each lateral wall presents four intervertebral foramina, through which the canal is continuous with pelvic and dorsal sacral formina. Its caudal opening is the sacral hiatus. The canal contains the cauda equine and the filum terminale, and the spinal meninges. Opposite the middle of the sacrum, the subarachnoid and subdural spaces close: the lower sacral spinal roots and filum terminale pierce the arachnoid and dura mater at that level. The filum terminale with its meningeal coverings emerges below the sacral hiatus and passes downwards across the dorsal surface of the fifth sacral vertebra and sacrococcygeal joint to reach the coccyx.[(1)] Spina bifida is the generic term for a range of discrete defects of neurulation and subsequent vertebral formation. The spectrum of neural tube and vertebral defects includes a range of open neural defects: craniorachischisis (non-fusion of the entire neural tube and no vertebral arch development); anencephaly (non-fusion of the rostral

portion of the neural tube with no calvarial or occipital development); and myelocele (non-fusion of caudal portion of the neural tube and local failure of vertebral arch development.[1,2] If there is non - fusion of the laminae of all the sacral vertebrae, there will be a midline gap.[2,4,5,6,7] This kind of anatomical variation in the dorsal wall of sacral canal may lead to painful condition of the back.[2,4,6], some clinical procedural failures[2,8,9,10], and also trans-pedicular and lateral mass screw placement failure.[2,4,11] Thus the knowledge of this anomaly should be kept in mind especially by anaesthestists who perform epidural anesthesia and orthopaedicians while performing surgical procedures. In the current study we report total spina bifida of the sacrum which is of interest because there have been no published reports in the Gujarati population in Western India. The prevalence rate of such total spina bifida of the sacrum is poorly reported in anatomy literature in general. So such a study of total spina bifida of the sacrum becomes all the more important for anaesthetists, orthopaedicians, radiologists, anthropologists and medico legal experts. Clinical incidence of the failure of epidural anaesthesia and its correlation to total spina bifida of the sacrum is important. This study is to know the prevalence of total spina bifida of the sacrum in Gujarat in Western India that in turns help in analgesic management during labour and lower abdominal and spinal surgeries.

Materials and Methods

After obtaining permission from the institutes, we examined 302 dry human sacra from the Department of Anatomy, B. J. Medical College, Ahmedabad; Government Dental College, Ahmedabad; Medical College, Vadodara and Government Medical College, Surat, Gujarat, Western India. Dry human adult intact sacra numbering 302 were studied for total spina bifida of the sacrum. Information about the sex of the specimens was not available. Total spina bifida of the sacrum were observed, recorded analyzed and photographed.

Results

Examination of 302 intact dry human sacra revealed that 5(1.65 %) sacra had total spina bifida of the sacrum.The posterior laminae of all sacral vertebrae were totally unfused.The space in the sacrum were more likely a groove rather than a canal. No other unusual features of the sacrum were found.

Discussion

Total spina bifida of the sacrum is described as a failure of induction from the roof plate of the neural tube during development which may involve expression of Pax-9, Msx-1 and Msx-2 genes[2,12] In dry bones, it is not possible to predict whether it was spina bifida occulta (SBO) or spina bifida cystica during life. Failure of the halves of the embryonic neural vertebral arch to fuse results in a major defect – spina bifida. The incidence of this vertebral defect ranges from 0.04% to 0.15%, and it occurs more frequently in girls than boys. Most cases of spina bifida (80%) are “open” and covered by a thin membrane. A “closed” spina bifida or SBO is covered by a thick membrane or skin. SBO is commonly observed in radiographs of the cervical, lumbar and sacral regions. Frequently only one vertebra is affected. SBO is a relatively minor and insignificant anomaly of the vertebral column that usually causes no clinical symptoms. It can be diagnosed in utero by sonography. It occurs in approximately 20% of vertebral columns that are examined radiographically.The spinal cord and spinal nerves are usually normal and neurologic symptoms are commonly absent. The skin over the bifid vertebral arch is intact, and there may be no external evidence of the vertebral defect. Sometimes the anomaly is indicated by a dimple or a tuft of hair. A severe type of spina bifida involving protrusion of the spinal cord and/or meninges through the defects in the vertebral arches are referred to collectively as spina bifida cystica because of the cystlike sac that is associated with these anomalies. Spina bifida cystica occurs approximately once in every 1000 births. Neurological symptoms are present in these cases.[2,13] Many authors have published data on the incidence of spina bifida occulta, with varying results. The reported frequency varies greatly among researchers and populations. The reported clinical significance of sacral spina bifida occulta ranges from an anatomical variant of little or no importance on its own to a very important cause of meningomyelocele or neurological deficits.[3,14] Especially, if not associated with any external manifestation, this abnormality is suggested to be linked with a variety of conditions including posterior disc herniation, backache, enuresis and neurological abnormalities of the feet, and functional disorders of the lower urinary tract.[3,14,15,16,17] In the presence of spina bifida would the planning of screw fixation certainly pose a challenge for the neurosurgeons.[3,18] This abnormality is clinically important for the caudal epidural block (CEB), which is usually performed in the diagnosis and treatment of lumbar spine disorders[3,5] and also for the management of chronic back pain.[3,21,24,25]

The knowledge of exact topographical anatomy of the sacrum is important for such procedures. Presence of anatomical variations may possibly contribute to the failure rate of caudal epidural block, transpedicular and lateral mass screw placement.[3,5,18]

Presence of spina bifida may increase the likelihood of damage to the sacral nerves and create difficulty in internal fixation via screws.[3,18] An important point in CEB is awareness of the distance between the sacral hiatus and dural sac, anatomically in relation with the risk of dural puncture. A bony septum in the sacral hiatus, hiatal agenesis or complete agenesis (spina

bifida) causes failure of CEB in 7% of cases. Total spina bifida and detection of the dura mater just beneath the hiatus have been reported in 1% of cases.[3,5]
There are research reports of 74% success rate without the use of fluoroscopy.[18,22] The success rate of CEB increases to 100% by using ultrasonography guided needle placement.[18,23] We as anatomists would certainly advocate the use of skiagram as an important tool for investigation prior to any operative procedure. [18] Total spina bifida of the sacrum were seen in 1.65% in our study.Shilpa Nilesh Shewale et al(2012),Vinodkumar et al(1992) and Sekiguchi et al(2004) reported total spina bifida of the sacrum in 0.98%, 1.49% and 1.0% cases, respectively[26,28,30] which is slightly lower than our study.Trotter et al(1944), Kiran V Padeyappanavar et al(2011) and Zarna patel et al(2011) reported total spina bifida of the sacrum in 1.8%, 2.0% and 2.0% respectively[19,29,31] which is slightly higher than our study. Suma H Y et al(2011) and Anjali aggarwal et al(2009)reported absent median sacral crest in 4.0% and 3.5% of cases respectively.[21,27] These figures being significant and should be kept in mind while giving caudal epidural anesthesia and analgesia.

Table: Showing incidence of total spina bifida of the sacrum by various authors

Previous authors	Total spina bifida of the sacrum (%)
Trotter et al(1944)	1.8
Vinodkumar et al (1992)	1.49
Sekiguchi et al (2004)	1.0
Zarna patel et al (2011)	2.0
Kiran.V.Padeyappanavar(2011)	2.0
Shilpa Nilesh Shewale et al(2012)	0.98
Present study	1.65

Effective management of epidural analgesia in patients with spina bifida relies on the understanding that the spinal defect, by distorting and in some cases obliterating the epidural space, can seriously influence the spread of the local anaesthetic solution.[12,13,15] The identification of skeletal remains is one of the classic problems faced by forensic experts.Congenital and acquired malformations can prove to be an important tool for identification.[2,20] A total spina bifida of the sacrum is one such anomaly that has clinical and medicolegal implications and helps in forensic identification of the deceased,if antemortem medical records exist.

Conclusion

Total spina bifida of the sacrum must be considered before undertaking caudal epidural block. If it is overlooked, serious complications may easily occur.A comprehensive awareness and understanding of the lesion and its signs and symptoms will help the orthopaedicians dealing with the case of low back pain and spinal surgeries.

Figure 1: *Posterior view- Normal sacrum.*

Figure 2: *Posterior view of a sacrum showing total spina bifida of the sacrum.*

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