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Research Article

MINI SACRAL HIATUS-ITS DEVELOPMENTAL CAUSES AND IMPLICATIONS

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A R T I C L E I N F O

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A B S T R A C T

The opening present 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 & 5th) sacral vertebrae. During routine osteology classes of undergraduate MBBS students of CSM Medical University, author came across a sacrum having very small sacral hiatus. Hiatus is present 0.3 cm below the 4th spine. It is 0.5 cm in length. There are two rounded tubercles on either side of the hiatus. Sacral hiatus is utilized for administration of epidural anaesthesia in obstetrics as well as in orthopedic practice for treatment and diagnosis .The knowledge of exact topographical anatomy of sacral hiatus is important for such procedures. Thus reliability and success of caudal epidural anaesthesia depends upon anatomical variations of sacral hiatus. This knowledge is of paramount importance to anaesthetists, surgeons and radiologists

INTRODUCTION

The sacrum is wedged between two innominate bones and forms the postero-superior boundary of the pelvic cavity. An arched sacral hiatus is present below the fifth or fourth sacral spine on the dorsal aspect of the sacrum. On the surface the hiatus lies about two inches above the tip of coccyx beneath the skin of natal cleft (Standring, 2000). In recent state the hiatus is covered by superficial posterior sacrococcygeal ligament which is attached to the margins of the hiatus and the deep posterior sacro-coccygeal ligament attached to the floor of sacral hiatus.The sacral hiatus gives passage to the 5th pair of sacral and coccygeal nerve and filum terminale. It is utilized for administration of epidural anaesthesia in obstetrics (Edward *et al*., 1942) as well as in orthopedic practice for treatment and diagnosis (Sekiguchi *et al*., 2004). Moreover sacral hiatus functions as an important landmark when analgesia is given in urology, proctology, general surgery and obstetrics and gynaecology (Letterman and Trotter, 1944). The knowledge of exact topographical anatomy of sacral hiatus is important for such procedures. One of the factors of caudal epidural block failure is anatomic variation of sacral hiatus as it is most important landmark for caudal block. Thus reliability and success of caudal epidural anaesthesia depends upon anatomical variations of sacral hiatus as observed by various authors (Sekiguchi *et al*., 2004; Trotter *et al*., 1945 and 1947; Vinod Kumar 1992). We report a rare case of ultra-small sacral hiatus.

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We have also tried to elucidate the genetic cause of this mini hiatus. This knowledge will be of paramount importance to anesthetists, radiologists and orthopaedic surgeons.

Case report

During osteology demonstration classes of the undergraduate medical students of CSM Medical University, we came across a sacrum with very small sacral hiatus (Fig.1). This sacral hiatus is present 0.3 cm below the 4th spine. It is 0.5 cm in length. There are two rounded tubercles on either side of the hiatus. The distance between the sacral cornua is 2cm.

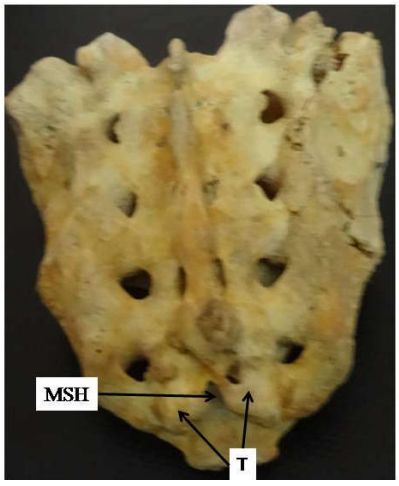

Figure 1 shows mini sacral hiatus on dorsal aspect of male sacrum

MSH= Mini sacral hiatus, T= Tubercle

DISCUSSION

The sacral hiatus is generated due to incomplete fusion of laminae of sacral vertebrae leading to midline gap. The size of sacral hiatus varies from agenesis to complete failure of fusion of laminae of all sacral vertebrae leading to midline gap along entire sacrum right from S1 to S4/5. These variant sizes of sacral hiatus provide variant surface area for the attachment of extensor muscles of back. Consequently, larger open gap i.e. larger is sacral hiatus and smaller the surface area for extensor muscle attachment. These variant conditions of muscle attachment may lead to painful conditions of the back (Brailsford, 1929). Besides this, sacral hiatus is an important landmark to administer anesthesia. Variations in the opening of sacral hiatus are important cause of anesthesia failure. In our case the sacral hiatus is very small which may be an important cause of anesthesia failure in various surgical procedures. Clear understanding of normal anatomy and anatomical variations of sacral hiatus and surrounding structures may improve the success of caudal epidural anaesthesia.

Embryogenesis of sacral hiatus

Formation of sacrum is due to expression of Hox 11gene in mice ((Wellik and Capecchi, 2003)) so absence of this gene may result in absence of sacrum. Thus it can be postulated that over expression of Hox 11 gene depending upon its degree might have led to formation of mini sacral hiatus observed in present study. Pax1 is expressed in sclerotome cells which form body and intervertebral disc and the cells which migrate dorsal to neural tube forms neural arches stops expressing Pax1 and starts expressing Pax9 gene (Monsoro-Burq and Le Douarin 2000). Hence it can be speculated that Pax9 is responsible for the formation of neural arch. Over expression of Pax9 might have resulted in the fusion of laminae below S4 spine creating small hiatus. Over activity of chondrocytes and osteocytes resulted in fusion of laminae and formation of tubercles on either side of mini hiatus. Pax9 is also responsible for cell proliferation. Due to its over expression, there will be increased degree of proliferation of cells in this region. This probably has caused formation of tubercles observed in the present case. The morphological features of the sacrum in the present case are suggestive of male sex as width of the base was more than the width of the ala. In the caudal block the drug is injected into the epidural space through the sacral hiatus to provide analgesia.

The length of hiatus varied from 5mm to 6.9mm and in about 2/3 of sacra (65.8%), it was 11-30 mm as reported by some authors (Nager *et al*., 2004). Kumar *et al* (1992) observed mean length of hiatus as 20 mm in males and 18.9 mm in females. Trotter *et al* (1945) have reported 24.8mm hiatus length in American males and 19.8 mm in females. Similar results were noted by earlier studies of Trotter *et al* (1944) in which the length of hiatus varied from 60 mm with a mean of 22.5 mm. Lanier *et al* (1944) reported mean length of hiatus being 25.3±9 mm. In the present case length is 5mm in male sacrum which is rare finding. Thus understanding of the variations may improve the success of caudal epidural anaesthesia. In the present study, mini hiatus with 5mm length may be one of the reasons for caudal block anaesthesia failure. Ultrasound guided epidural block is recommended which may decrease epidural block failure.

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