Case Report

Spina Bifida of fifth lumbar vertebrae associated with absence of spinous process, laminae and inferior articular processes –A case report

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Abstract

Knowledge about any deviation from the normal anatomy of our vertebral column is very essential especially for an orthopedician, neurologist, forensic pathologist and clinical anatomist for diagnosing the patients with such vertebral anomalies. The vertebral disorders lead to disability and lot of health problems. In congenital anomaly of lumbar vertebrae it hampers the weight transmission and movement of the vertebral column leading to instability in early age. A dry fifth lumbar vertebrae of unknown sex was found from a undergraduate student in NRS Medical College in which spinous process and both sided lamina and inferior articular processes were absent leading to a wide spina bifida.

Key words: fifth lumbar vertebrae, spina bifida, inferior articular process, spinous process.

Introduction

A vertebrae has a ventral body, a dorsal vertebral (neural) arch, consisting of pedicle ventrally, lamina dorsally, paired transverse process, paired superior and inferior articular processes, a median dorsal spinous process and vertebral canal. Among the five lumbar vertebrae fifth is atypical. The fifth lumbar vertebrae has a substantial transverse process which is continuous with the whole of the pedicle and encroaching on the body. The body is usually the largest and markedly deeper anteriorly, so contributing to the lumbosacral angle The fifth spine is the smallest, and its apex is often rounded and down-turned. The superior articular processes have concave articular facets facing posteromedially, with a rough mammillary process on their posterior borders. The facets of inferior articular processes are convex and faces anterolaterally. A small accessory process marks the posteroinferior aspect of the root of each transverse process.[1]

The vertebrae develop from the sclerotome parts of the somites of paraxial mesoderm during fourth week of gestation. During the precartilagenous stage of development, the mesodermal cells of the sclerotomes spread around notochord, around the neural tube and near the body wall. Each pair of sclerotomes consists of a cranial loosely arranged and caudal densely arranged mesenchyme. Some part of densely arranged cells merges with the loosely arranged cells to form the centrum of the vertebra which is the primordium of the vertebral body. Chondrification begins in the mesenchyme present around the neural tube to form the neural arch which gives rise to laminae, pedicles, articular processes, transverse processes and spinous process. At the time of birth the vertebra consists of three parts, - a centrum and two halves of the neural arch are connected by a cartilage forming neurocentral joint, which afterwards fuses to form single vertebra.[2,3]

A typical vertebra is ossified from three primary centres- one in each half vertebral arch and one in

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the centrum and five secondary centres - one in the apex of each transverse and spinous process and two for body. Centres in arches appear at the roots of the transverse processes, and ossification spreads backwards into laminae and spines, forwards into pedicles and posterolateral parts of the body, laterally into transverse processes and upwards and downwards into articular processes. The major part of the body, the centrum, ossifies from a primary centre dorsal to the notochord. Suppression of one of these produces vertebral anomaly.[1]

The anterior segment of vertebrae consists of body of the vertebra, pedicles, transverse processes and superior articular processes. Deformity and bony deficiency may occur at several sites within the posterior segments which consist of the spinous process, laminae and inferior articular processes . Spina bifida is a term for neural tube defect consisting of a splitting of the vertebral arches and may or may not involve underlying neural tissue. In spina bifida occulta the nonfused portion of vertebral arches is covered by skin and usually does not involve underlying neural tissue. It commonly occurs in the lumbosacral region (L4-S1) and affects about 10% of otherwise normal people. Spina bifida cystica is a severe form of neural tube defect in which neural tissue and/or meninges protrude through a defect in the vertebral arches and skin to form a cyst-like sac.[4]

Case report

During the routine medial undergraduate osteology class on lumbar vertebrae, in NRS Medial College and Hospital, Kolkata, an anomalous dry bone of fifth lumbar vertebrae of unknown sex was found from an undergraduate student. There was absence of spinous process, both laminae and both inferior articular processes in this fifth lumbar vertebra. The bone was identified as fifth lumbar vertebra by the attachment of transverse processes to the pedicles and it encroaches towards the vertebral body. The transverse processes were also substantial in nature. (Fig: 1,2)

Discussion

Fifth lumbar vertebra is positioned in between the vertebral column above and sacrum below forming lumbosacral angle , which maintain the normal lumbar lordosis. At an intersegmental level, the L4/5 junction exhibit the greatest mobility, approximately 13° , while at the lowest level (L5/S1) there is only 9°, and at the upper lumbar levels only 8° and 10° respectively.[5] The lumbosacral spine is important for protection of spinal cord and spinal nerve, for maintenance of posture, for various movements of vertebrae and for weight transmission. It is probable that the lumbar spine experiences more abuse from normal functions than any other part of the human skeleton.[6] Much of the stability of the vertebral column depends on dynamic muscular control, but there are also bony and ligamentous static stabilizers. The compressive force acting on the spine is shared between the vertebral bodies and the neural arch According to the'three-column concept' of spinal stability (Denis 1983), the posterior column consists of the neural arch and facet joints and the posterior ligamentous complex.[7] The posterior lamella of the thoracolumbar fascia, erectores spinae, spinales thoracis, multifidi, interspinal muscles and ligaments, and supraspinous ligaments are all attached to spinous processes.[1] So, jeopardy of this integrity, hamper the normal lumbar lordosis and will affect the stability of the spine and therefore its biomechanics. It increases the liability for a patient to develop low back pain and structural scoliosis with vertebral rotation.

Due to absence of inferior articular processes and posterior element of vertebrae there is increased risk of slippage of spondylolytics

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spondylolithesis.[8] The deformity of the vertebral canal resulting from severe spondylolisthesis may lead to neural damage.[1] The incidence of disc herniation is found to be statistically higher among anomalous lumbar vertebrae.[9] There were cases of congenitally absent pedicles and neural arch which required surgical correction.[10] According to the the study of Das S, rudimentary left inferior articular processes had an association of problem in the axial weight transmission and orientation in the movement which lead to low back ache and prolapse of intervertebral disc.[11] Kumar K in Bangalore found absent spinous process and bilateral absent lamina and inferior articular processes in fifth lumbar vertebrae with small vertebral body.[12]

During development signals from the notochord induce sclerotome, whereas signals from the dorsal neural tube, surface ectoderm, and adjacent lateral plate and intermediate mesoderm induce and pattern the dermomyotome. Notochord and subsequently the floor plate of the neural tube secretes Sonic hedgehog (Shh), which along with Noggin (a Bmp inhibitor), also secreted by the notochord, is required for induction and maintenance of the sclerotome. These factors are required for the expression of Pax1, a paired-box transcription factor, which initiates the cascade of cartilage and bone-forming gene for vertebral formation. Pax1 is mutated in several of the undulated mouse mutants, characterized by vertebral body and vertebral disc defects.[13] The genetic causes have been studied in mouse and are localised and absence or faulty genes Pax1 and Pax9 will lead to morphological abnormalities of axial skeleton during embryogenesis. Gradual loss of Sox 9 and collagen II expression later lead to apoptosis of the cells leading to the prevention of formation of vertebrae and intervertebral disc.[14] Open neural tube defects of the spinal cord result in an open spine in which the vertebral arches fail to form properly and form a spine like bony protuberance on either side of the open spinal cord.

Conclusion

The fifth lumbar vertebra transmits the axial weight of the body to the lower limbs and helps in movement of vertebral column. In the present study spina bifida of fifth lumbar vertebra was noted with absence of spine, both laminae and both inferior articular processes. This anomaly could be due to nondevelopment of the posterior segment or failure of fusion of the anterior and posterior segment of vertebrae and dissolution of the posterior segment leads to absence of spine, laminae and inferior articular processes. The cause of this anomaly is probably due to mutation of Pax1 and Pax 9 genes which lead to interference in the development and differentiation of sclerotomes. The deficient area in the bone leads to lesser area for muscle attachment and cause weakness and low back pain.

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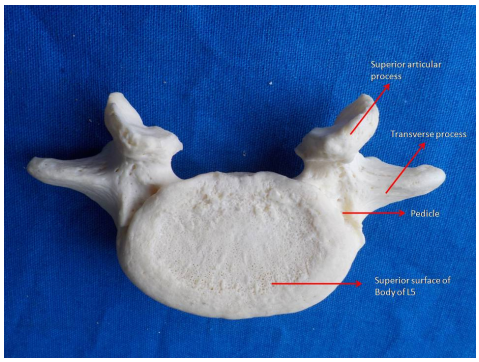

FIG 1: Superior view of L5 showing absence of vertebral arch

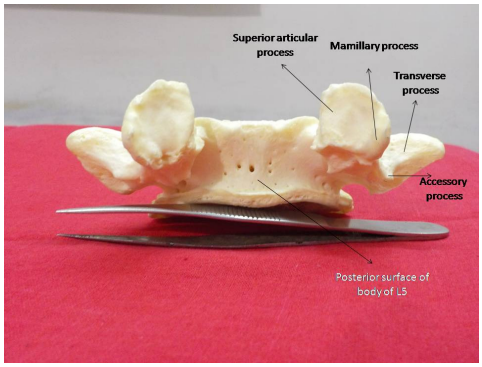

FIG 2: Posterior view of L5 showing absence of spinous process, laminae and inferior articular processes

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