

Case Report**Fusion of Typical Thoracic Vertebrae: A Case Report****Mohd Nazeer*¹, Surender M Rao⁴, Simmi Soni², Sreekanth T⁵, Ravinder M³, Ramakranthi T⁶**¹Associate Professor, Department of Anatomy, Ayaan Institute of Medical Sciences, Teaching Hospital and Research Centre, Kanakamamidi (V), R.R. District-501504, Telangana, India²Associate Professor, Department of Anatomy, Dr V. R. K. Women's Medical College, Telangana, India³Professor and HOD, Department of Anatomy, Dr V. R. K. Women's Medical College, Telangana, India⁴Assistant Professor, Department of Forensic Medicine, Dr V. R. K. Women's Medical College, Telangana, India⁵Associate Professor, Department of Anatomy, Shadan Institute of Medical Sciences, Telangana, India⁶Assistant Professor, Department of Physiology, Dr V. R. K. Women's Medical College, Telangana, India***Corresponding author**

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Abstract: Inappropriate fusion of vertebrae results in block vertebrae or vertebral synostosis or spinal fusion. Fusion of the vertebrae may be congenital or acquired. The fusion may be complete or incomplete involving the bodies of the vertebrae alone or along with vertebral arch. It affects most commonly the cervical region, followed by thoracic and lumbar regions. During the formation of vertebral column, in the fourth week of intrauterine life the sclerotome part of the somites migrate around the notochord and the neural tube and undergoes a process called re-segmentation. Any defect in such a process can lead to vertebral anomalies causing neurological signs and symptoms. The condition is acquired in trauma, tuberculosis and juvenile rheumatoid arthritis. This can lead to wide complication affecting different systems of the body. The fusion of thoracic vertebrae can present many clinical signs including formation of abnormal curvatures of the spine like scoliosis, etc. The incidence of fused thoracic vertebrae varied from 1.6% to 4.16% in literature. The aim of the study is to present a case of thoracic vertebral fusion. During an inspection of the osteological collection of Anatomy Department of Shadan Institute of Medical Sciences, Hyderabad, one specimen of fused vertebrae in which there was fusion between three typical thoracic vertebrae was found. The features of this block vertebra were analysed in detail and the specimen was photographed from different aspects. The embryological and clinical significance of fused vertebrae is been discussed in this paper.

Keywords: Block vertebra, Vertebral synostosis, Spinal fusion, Somites, Vertebral anomaly, Thoracic vertebrae.

INTRODUCTION

Congenital anomalies are common in the vertebral column. Awareness of vertebral anomalies are of interest not only to Anatomist but also to clinicians as these anomalies may result in pain, decreased mobility, muscular weakness of limbs and sensory deficits [1, 2]. Various vertebral anomalies of Anatomic interest have been reported viz.; occipitalisation, sacralisation, lumbarisation, absence of posterior elements of vertebral arch and vertebral synostosis. Fusion of vertebra at single or multiple levels is referred to as block vertebrae or spinal fusion or vertebral synostosis [3]. The fusion of two or more vertebrae can be congenital or acquired. The fusion may be congenital due to failure of segmentation of sclerotomes at certain levels at the time of organogenesis, manifesting into Klippel Feil Syndrome or other associated spinal deformities such as scoliosis [3]. Though rare, the acquired fusion of vertebrae is secondary to trauma, tuberculosis or other infections and juvenile rheumatoid

arthritis [1]. The surgical fusion of two vertebrae is known as spondylodesis or spondylosynostosis [3].

Congenital fusion of vertebrae most commonly involves cervical region, followed by thoracic and lumbar regions [4, 5]. The fusion of thoracic vertebrae can present clinical signs like congenital scoliosis early in life and shortening of trunk with scoliosis and / or lordosis in older children [6]. The block vertebrae may cause restricted movements, premature degenerative changes and associated neurological deficits [5, 7]. The symptoms may vary according to the extent and level of vertebral fusion.

In the present case report, we observed one specimen of fusion of three typical thoracic vertebrae. The incidence of fused thoracic vertebrae varied in literature from 1.6% to 4.16%. The prevalence of vertebral synostosis in Lithuanian population was reported as 1.6% of the thoracic vertebral fusion [8]. In

one study done on 48 adult dried vertebral columns, the incidence was found to be 4.16% in thoracic region [9].

The thoracic vertebral fusion is often seen associated with ossification of anterior longitudinal ligament in Diffuse Idiopathic Skeletal Hyperostosis (DISH), ankylosing spondylitis, osteochondritis, etc. [10]. Previous authors named the fusion of vertebrae as Klippel Feil Syndrome in cervical region, synspondylism in thoracic region or block vertebrae in lumbar region [3]. Awareness of this anomaly is important for correct diagnosis.

CASE REPORT

During an inspection of the Osteology section of Anatomy department of Shadan Institute of Medical Sciences, Hyderabad, we came across one specimen of fusion between typical thoracic vertebrae. The features of the fused typical thoracic vertebra were analyzed and the specimen was photographed from anterior, posterior, right lateral, left lateral and superior aspects. The measurements of the fused vertebral specimen were taken with the help of a standard ruler. The parameters measured were height of fused vertebral bodies [(Right+Left)/2], diameter of intervertebral foramina.

Observations

We are presenting the details of an abnormally fused three typical thoracic vertebrae. The features and measurements of the fused vertebral specimen are given in Table 1 and shown in Fig. 1-5.

Fusion of three typical thoracic vertebrae

The bodies were completely fused on right side and partially fused on left side. The articular processes, laminae and spinous processes were unfused (Fig. 1-5).

T4-T5 Fusion

The height of fused vertebral bodies was 3.8 cm on right side and 3.6 cm on left side. The intervertebral foramen measured 1.0 cm on right side and 0.8 cm on left side (Table 1).

T5-T6 Fusion

The height of fused vertebral bodies was 4.2 cm on right side and 4.4 cm on left side. The intervertebral foramen measured 1.0 cm on right side and 1.2 cm on left side (Table 1).

Table 1: Showing features and dimensions (in cm) of fused typical thoracic vertebrae

Feature	T4-T5 Fusion	T5-T6 Fusion
Vertebral bodies Height [(Rt+Lt)/2]	CF-Rt side; PF-Lt side	CF-Rt side; PF-Left side
Pedicles	UF	UF
Laminae	UF	UF
Articular processes	UF	UF
Spinous processes	UF	UF
Vertebral foramen	Regular	Regular
Intervertebral foramen	Rt-Oblique, 1.0; Lt-Arcuate, 0.8	Rt-Arcuate, 1.0; Lt-Oblique, 1.2

Note: CF: Complete fusion, PF: Partial fusion, UF: Unfused, Rt: Right, Lt: Left



Fig. 1: Anterior view of fused vertebrae



Fig. 2: Posterior view of fused vertebrae



Fig. 3: Right lateral view of fused vertebrae



Fig. 4: Left lateral view of fused vertebrae



Fig. 5: Superior view of fused vertebrae

DISCUSSION

Vertebral synostosis is the hallmark of KFS, a triad of short neck, low posterior hairline and restricted neck mobility [1]. Acquired fusion of vertebrae may be

differentiated from congenital anomalies by a history of trauma or infection and by x-ray evidence of degeneration of the involved functional spinal unit [11]. Whereas, congenital fusions are characterized by absence of the intervertebral disc, or its replacement by a radio opaque line; the ‘Wasp-Waist’ appearance; smooth intervertebral foramina; a single spinous process for two vertebral bodies; and maintenance of vertebral body height on x-ray examination [12].

Block Vertebrae results in disturbance in postural biomechanics causing degenerative changes and disc prolapse at the adjoining segments in advance age [5]. Fusion between the typical thoracic vertebrae and lumbar vertebrae were reported by Vadgaonkar *et al.* which can cause low back pain [13]. Early diagnosis of these anomalies will be helpful in documenting the change due to an injury, ageing or progression of a degenerative process and also motivates the patients to change their life styles to lead a normal life [7].

Radiologically three types of vertebral fusion have been described: Single fused cervical segment seen in 25% of patients, multiple contiguous fused segments seen in 25% patients and multiple, non-contiguous fusion seen in 50% patients [14].

In the congenitally fused vertebrae, the AP diameter of the vertebrae is decreased and the individual measurements of the two vertebrae’s bodies height is equal to the two fused vertebrae’s height including the inter-vertebral disc.

Embryological Significance

The vertebrae develop from sclerotome part of the somites, derived from paraxial mesoderm of intra-embryonic mesoderm. Migration of sclerotome cells around the neural tube and notochord occurs during the fourth week of the intrauterine life. In due course, the sclerotome part of each somite undergoes a process called re-segmentation. This leads to the formation of definitive vertebra being derived from adjacent sclerotomes. Any defect in the above process can lead to congenital anomalies.

Normal segmentation of the sclerotomes is important for the development of a vertebral column. But in certain cases due to decrease blood supply during 3rd to 8th week of intrauterine life the block vertebrae results [2, 15]. Vertebral fusion anomalies are likely to be associated with disturbance of Pax-1 gene expression in the developing vertebral column [16]. A combination of environmental and genetic factors mainly during the 3rd week after conception is thought to be the main causative factor for this anomaly [17].

Clinical Significance

Anatomically, the intervertebral discs form 1/5th of the vertebral column [18]. Therefore, absence of intervertebral disc leads to shortening of the column and

subsequently shortening of the trunk. The thoracic vertebrae and the intervening disc along with the ribs help in maintaining the shape and length of the thorax. Fusion of the vertebrae and the absence of the disc will narrow the thorax that can lead to respiratory distress. Asphyxiating thoracic dystrophy is caused by narrow thorax and short ribs [19, 20].

Clinical Complications

Congenital block vertebrae maybe associated with other systemic anomalies that include abnormal spinal curvatures (scoliosis, etc), Sprengels deformity, hemivertebrae, platybasia, basilar impression, spina bifida, clubfeet, anomalies involving kidney (Unilateral horse shoe kidney, duplicated kidney, etc) and the ribs (cervical rib), cleft palate, respiratory problems, deafness or hearing impairment and cardiac anomalies (congenital heart disease) [21, 22].

Various syndrome associations of vertebral fusion are segmentation syndrome with laryngeal malformations, VACTERL (S) (Vertebral, Anal, Cardiovascular, Tracheo-Esophageal, Renal and Limb abnormalities \pm single umbilical artery), MURC, (Mullerian duct aplasia, Renal apalasia, Cervico-thoracic somite dysplasia), diabetic embryopathy, Trisomy 18, Joubert, Jarcho-Levin, syndrome, etc [23].

Pathological causes of fusion of vertebrae are fibro-dysplasia, progressive Juvenile Rheumatoid Arthritis, post infectious, post surgical, post traumatic, etc [24]. The differentiation and re-segmentation of vertebrae occurs at the time of organogenesis. It explains the association of vertebral synostosis with cardiac, renal, musculoskeletal and neural abnormalities [25].

CONCLUSION

The study has provided additional information on the anatomy and morphology of thoracic vertebral fusion with their embryological basis and clinical implications. These details are clinically important as they might be associated with genitourinary, neurological and musculoskeletal abnormalities.

Thoracic vertebral fusion usually results due to congenital or acquired causes and vertebral fusion can be helpful feature for identification.

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