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Case Report

Anatomical variation: T1 spina bifida occulta. Radiological findings

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ABSTRACT

We report a 26-year-old male patient who was admitted to our emergency department after a traffic accident and who suffered from neck pain. We have found accidentally a dorsal spinous process schisis, a very rare vertebral abnormality, that we recognized in the X-rays imaging performed for the study of the lung parenchyma.

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Introduction

Human vertebral spine could be affected by a wide range of anatomical variants of the body and/or the neural arch as well as accessory bones. These anatomical variants include hemivertebra, block vertebra, fused vertebra, unfused vertebra, butterfly vertebra, hyperplasia or hypoplasia of laminae and spinous processes. They usually affect the cervical and lumbar spine, as reported in literature, and frequently they are correlated with neural elements abnormalities. The physiopathology describes a migration failure of sclerotomi cells during embryogenesis because of several chromosomal alterations or specific microenvironmental influences (as radiations, teratogenic substance, drugs).

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Case presentation

A 26-year-old Caucasian male was admitted to our emergency department after a car accident. At the time of admission, he was hemodynamically stable (BP: 130 systolic pressure over 75 diastolic pressure mm Hg; heart frequency: 84 BPM), dyspneic (SpO₂: 80% pO₂), swollen face, referred headache, and neck pain, with no evident skin deformities or subcutaneous masses. According to standard protocols for head injury, we performed a head computed tomography (CT) scan to rule out brain hemorrhages (no sign of brain lesion was discovered).

The neck pain was investigated through x-ray examination of the cervical spine in anteroposterior and laterolateral projections. Even the chest was evaluated by x-ray to study

the lungs and verify a probable pneumothorax and rib fracture. On the anteroposterior projection, we noticed an oblique radiotransparent line in correspondence of the spinous process of the first thoracic vertebra (Fig. 1). No signs of pneumothorax were found, but the alterations of the IX and X costal arch led us to perform a CT scan of the chest. The chest CT scan showed minimum bilateral lung contusions and confirm the lack of fusion of the T1 spinous process (Fig. 2). Hence, we repeated the examination following the specific CT protocol for the cervical spine study (scan type: helical, rotation time: 1, start location: C7, end location: L1, detector rows: 16*0.625, pitch: 0.938:1, speed [mm/rot]: 9.37, beam collimation [mm]: 10, axial thickness [mm]: 1.255, int [mm]: 0.6, Digital Field Of View [cm]: large-20, kV 1400, mA: ACE [100-380], recon type: std [250;40] bone plus [3000;500]).

The patient was monitored for 3 days and treated only with anti-inflammatory drugs. There was no need of surgical intervention.

Discussion

Congenital anomalies of spine are quite common and most of these anomalies are localized at cervical and lumbar spine. Conversely, the localization of these anomalies at thoracic spine is rare. Usually, spine deformities can be divided into congenital and acquired forms. Congenital forms are mainly divided into 2 types: segmentation and development defects. Unilateral unsegmented bars and bilateral segmentation defects belong to the first group. On the other side, developmental defects include hemivertebrae and failure of fusion of neural tube which includes, in turn, the simple cleft of the posterior arch of the vertebrae (*spina bifida occulta*) and *spina bifida* [1]. The most frequent spinal anomalies are represented by synostosis, vertebral schisis or *spina bifida*, hemivertebrae, spondylitis, spondylolisthesis, sacralization of L5, cervical rib, congenital absence or hypoplasia of a cervical pedicle, vertebral hypoplasia, dysplasia of the vertebral arch, doubled spinous process, and unilateral hyperplasia of a spinous process [2–5]. Yun et al [6] observed a spinous process fusion at T11 and T12. Osseous formation had failed between the lamina and spinous process unilaterally at the T11 level and bilaterally at the T12 level. We performed a research on PubMed by using the following keywords: vertebral schisis, thorax schisis, cleft of the thoracic vertebrae, failure of fusion of thoracic spine, and *spina bifida occulta*. There are several works about *spina bifida occulta* in world literature, and the main results describe the occurrence of clefts in the posterior arch of cervical and lumbar spine; there is only one article published in 1972 by Levy et al [7], who reported an incidence of single failure of fusion of T1 in 47 of 5363 asymptomatic African patients who have undergone x-ray examination (0.01%).

Failure to close the neural tube, or a reopening after a physiological closure, can lead to various defects, which may involve, individually or *in toto*, the neural tissue, the meninges,



Fig. 1 – Cervical spine x-ray anteroposterior (AP) projection showing an oblique radiotransparent line in correspondence of the spinous process of the first thoracic (T1) vertebra.

bones, and the overlying soft tissues. The overall incidence of the closing neural tube defects, during pregnancy, has been estimated to be between 4% and 5% [8]. Several factors may contribute to determine these anomalies: environmental factors, heredity, toxic substances, food, and metabolic disorders (eg, folate deficiency seems to play a key role in the development of *spina bifida*).

During the end of the third week of pregnancy, the somitomeri begin to develop and from these ones, the somites followed by sclerotomi, myotomes, and dermatomes take shape. The vertebrae are derived by the evolution of sclerotomi, which is the closest portion of the somites to embryonic axis. The further differentiation of the sclerotomi cells depends on their position because of further migration in relation to the action induced by surrounding tissues. In fact, notochord cells induce the development of the vertebral bodies from sclerotomi, whereas the neural tube induces differentiation of sclerotomi in vertebral arches

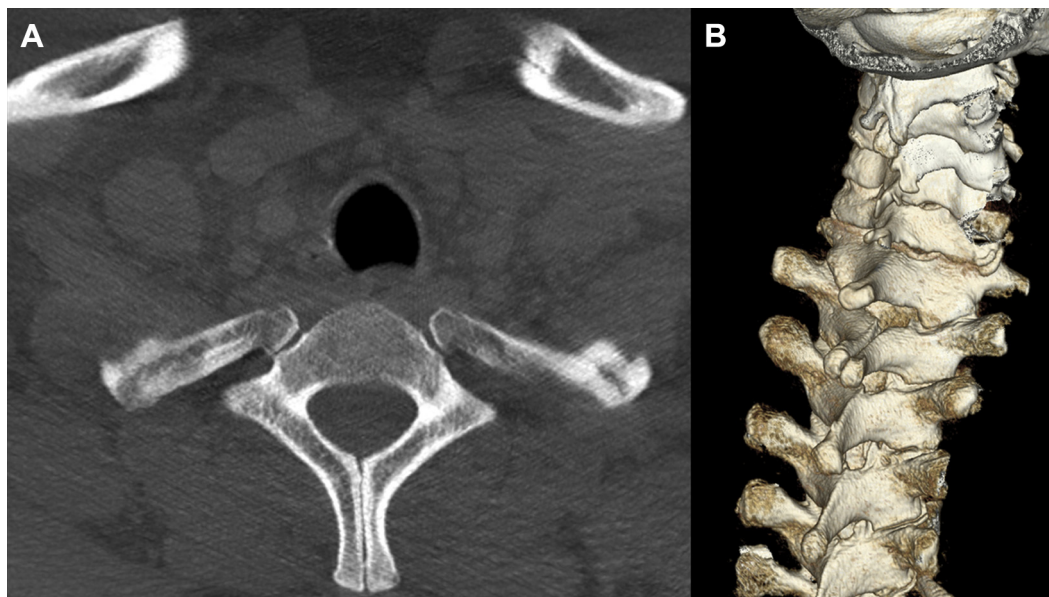


Fig. 2 – Computed tomography (CT) scan in the axial plane of the cervical spine showing the defect of fusion of spinous process of T1 (A). Volume rendering reconstruction of the CT scan study (B).

components. The first ossification centers appear from the second month of gestation. The spinous process has not an own ossification nucleus, with the exception of the tip, and appears during the first year of life for the fusion of the endochondral growth from both vertebral arches. The lack of fusion or defective closure of the neural tube on the median line, due to a defective growth of the blades of one or more vertebral arches, determines spinal dysraphism or *spina bifida*.

These anomalies can occur at any level of the spine, although it is more frequently found at the lumbosacral level and more rarely in the cervical area.

In this report, we describe a case of asymptomatic simple *spina bifida occulta*, most frequent type and the simplest neural tube defect, due to the lack of fusion, on the middle line of the two side laminae of the fetus's spine during the first month of pregnancy; the space between the laminae is usually filled by fibrotic tissue with a partial outline of the spinous process. The most affected vertebrae are mainly L5 and S1. This anatomic variant seems not to cause symptoms and it is often reported incidentally in patients who perform diagnostic examinations (x-ray, CT scan) for other reasons. CT scan allows the identification of this anomaly and, thus the best therapeutic decision, which may also include surgery. An important role is played by the evaluation of the interlaminar distance. If the interlaminar distance is small, the interlaminar gap is usually filled by fibrous tissue, and it rarely causes symptoms. If the gap is larger, due to a reduced growth of the vertebral laminae or by greater distance between them, it can develop a meningocele or myelomeningocele, which may give rise to symptoms and requires surgical repair. Sometimes this kind of anatomic variants could be associated with spinal cord anomalies and it might be helpful to perform a Magnetic Resonance study to recognize them.

Conclusion

We have described a rare case of thoracic vertebral failure of fusion at T1 level in a young Caucasian male, to describe the main radiological features pointed out by the CT-scan study associated with volume rendering reconstructions and x-ray examination. We think that this case report may be helpful to radiologists, orthopedists, neurologists, and neurosurgeons to consider this singular finding.

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