CT EXAMINATION OF PATIENTS WITH OSTEOFLUOROSIS

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SUMMARY: This paper reports CT (Computerized Tomography) scan findings of the examination of the vertebral canals of 12 patients with severe osteofluorosis diagnosed by X-ray and with typical signs of spinal nerve damage. The examination showed various degrees of ossification of the rear longitudinal ligament (RLL) (aka *posterior longitudinal ligament*) in all 12 cases and of the yellow ligament (YL) (aka *ligamentum flavum*) in 3 cases. Stricture of the intervertebral foramen was found in one case. These results suggest that neurological findings indicative of spinal cord compression in patients with osteofluorosis are chiefly created by vertebral canal stricture caused by ossification of the RLL and YL rather than stricture of the canal by bone overgrowth. The CT scan clearly reveals the shape of the vertebral canal and the RLL and YL. Reconstruction of sagittal pictures may be used to localize the site of compression of the dural sac and nerve root, thereby obtaining results that can not be found by any other technique.

Key words: CT scan; Osteofluorosis; Vertebral canal.

Introduction

The clinical manifestations of osteofluorosis patients with nerve damage has been reported previously. Previous reports of the findings of Computerised Tomography (CT) scanning of the vertebral canal (VC) in these cases have not been found. To investigate the relationship between CT findings of examination of the vertebral canal and the clinical symptoms and signs found in patients with osteofluorosis, patients were selected with typical manifestations of nerve damage and subjected to CT scan in an attempt to identify the location of damaged nerves and the clinical significance.

Materials and Methods

The subjects examined in this study are residents of Bingzhuang Village, Jiaxiang county, Shandong province in China. Twelve patients, 6 male and 6 female aged 51-70 years of age, all had osteofluorosis, diagnosed by X-ray, and manifestations of nerve damage. The concentration of fluoride in drinking water to which they had been exposed for more than 30 years was 4.5-9.95 mg/L.

The vertebrae of these patients were examined by CT scan using a Siemens Somatron DR_3 machine. The patients were examined in the supine position with the scanning plane parallel with the axis of the vertebral canal. The major scanning site was C_2-C_7, with some patients scanned from C_2-T_{10}. Scanning slice was 5-8 mm in thickness at intervals of 5-10 mm. The sagittal picture was reconstructed for further observation according to need. The window width was 1400~2046 and its center 300~500. Intravenous contrast medium was not used.

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Results and Analysis

The CT pictures of the *normal* osseous canal of cervical vertebrae show round obtuse isosceles triangularity at transversal scan, its base side is the rear (posterior) edge of the vertebral body and its base angle is the side crypt. The normal sagittal diameter (SD) of the vertebral canal is not less than 11.5 mm.

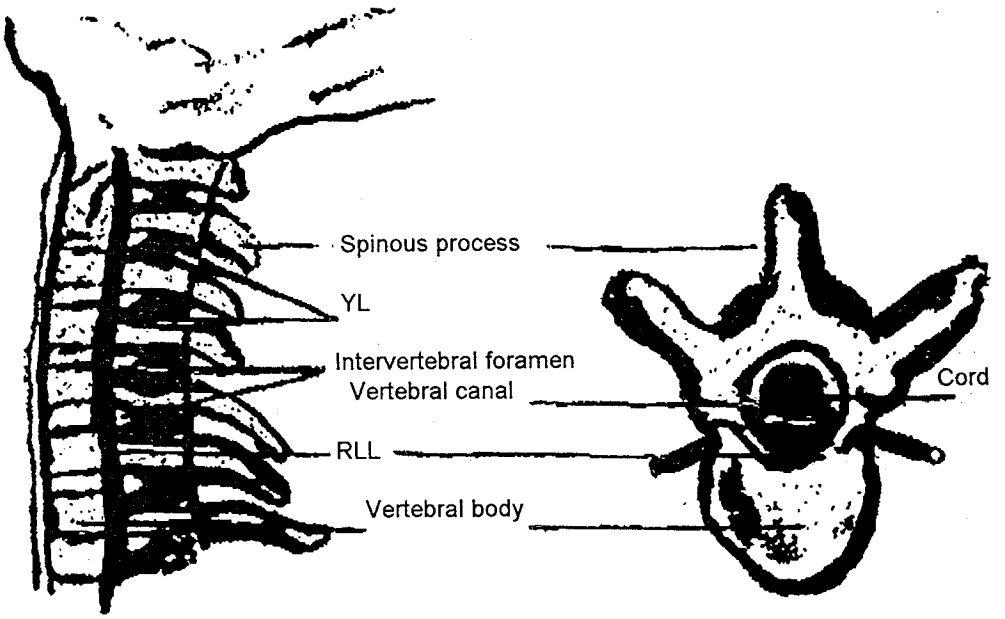
The 12 patients studied suffered from different degrees of ossification of the RLL (posterior longitudinal ligament). CT pictures revealed that osteoid high density reflection protruded into the vertebral canal at the center or side rear (posterior) edge of the vertebra. The transversal section showed different shapes: small round lump; transversal strip; semi-round; and triangles. On bone window observation a narrow line-like low density gap could be found between the high density reflection and the rear edge of the vertebra in some patients. The degree of ossification of the RLL varied so that the shapes on various CT scan slices differed. The appearance of the ossified reflection on the scan confirmed the constitution and extent of the ossification of the RRL. The major ossified portion was mainly of the continuous type at the rear centre of the vertebral canal and extended from C_3 to T_8. In 10 patients, ossification of the RLL was confined to the cervical vertebrae (C_3 - C_7); in two patients, this extended to the thoracic vertebrae (C_4-T_4).

The reduction of the SD of the vertebral canal by the ossification of the RLL can be seen clearly on the CT image. Each was less than 11.5 mm. The most obvious osseous narrow position was located at C_6. The SD of 3 patients was only 2 mm. Three patients showed an ossification of YL which presented as a semi-round shape protruding to the front inside the canal; thereby, causing a reduction in the SD. One patient had a stricture of the intervertebral foramen caused by the ossification of the RLL which protruded to the left. Three patients exhibited osteohyperplasia and ossification of the appendages. Three patients had dural compression and one patient showed herniation of the intervertebral disk. The vertical distance between the ossified rear edge of RLL and the front edge of the vertebral plate was 2-9 mm, mean 5.8 mm.

The ossification of the RLL and YL cause the cervical and thoracic vertebral canal, normally concave, to assume a rhomboidal shape, or a horse-shoe shape in severe cases. The obvious stricture of the side crypt at the level of the upper articular process was not found because of the central location of the ossification of RLL. There was no obvious thickening of the YL and no obvious hypertrophy of the small articular process.

The maximum ossified thickness of RLL was 9 mm on CT scan in this group. The stricture rate of the vertebral canal was 69% (ratio of the ossified thickness to SC of the vertebral canal). The total stricture rate of the vertebral canal in each patient ranged from 29% to 69%.

CT transversal scanning can reveal clearly the shape of the vertebral canal, the RLL and YL and can permit observation of the changes in side crypt, intervertebral foramen and lower and upper articular processes. The reconstruction of sagittal pictures show a longitudinal section image of the vertebral canal. It is possible, sometimes, to find the compression of the dural sac and nerve root. These results could not be determined by any other method. Therefore, CT scanning is superior to other methods in determining the pathological location and details required in the selection of a treatment program.



Sagittal section, cervical vertebrae

6th cervical vertebra

Discussion

Most patients in this group exhibited sensory deficits in "glove" and "stocking" distribution and atrophy of small muscles of the hands. This was considered to be an indication of damage to nerves supplying the areas affected. These clinical findings are similar to those found in infectious multiple neuritis; but the pathological changes in the cases under investigation were assumed to be caused by damage to the nerve root by osteofluorosis.

Singh[1] found that osteofluorosis caused muscle atrohpy, sensory deficits in arms and legs and pain distributed along nerve pathways. Singh interpreted this to mean that a pathological process was taking place at the nerve root as it leaves the spinal cord.

Zhao[2] examined six patients with osteofluorosis by means of spinography and found that the contrast medium showed a marked "honeycomb" appearance and flowed slowly. The spinogram and pathological examination demonstrated that hypertrohpy of the YL was present and causing stricture of the vertebral canal. Zhao found that the concentration of fluoride in ligaments was much above the normal limit. CT scanning of this group demonstrated that spinal damage caused by osteofluorosis was chiefly related to the ossification of RLL and YL in cervical and thoracic vertebrae. This caused a stricture of the vertebral canal which resulted in the compression of the spinal cord to various degrees to produce spinal nerve symptoms and signs. These results are identical to the findings of our present study.

This may be generalised as indicating that spinal stricture was mainly in the vertebral canal, the side crypt and the intervertebral foramen.[3] Ossification of the RL was found to be 100% and YL 25%. It is can readily be seen that compression of the spinal cord in this way can produce all of the presenting neurological signs and symptoms.

The neurological symptoms and signs produced by stricture of cervical vertebrae are related closely to the location and the degree of stricture. If the stricture occurs above the brachial plexus, where the SD of the vertebral canal is large, clinical symptoms may be minor or absent. If the stricture is in the lower cervical vertebrae, even slight compression of the cord produces symptoms and signs.[4] Major stricture at the C_6 level produces severe symptoms.

Conclusion

This study confirms that signs and symptoms of nerve damage found in this group of osteofluorosis patients are caused by ossification of ligaments in cervical and thoracic vertebrae, especially in the RLL and YL. This ossification of ligaments results in stricture of the vertebral canal and the compression of the spinal cord and nerve root.

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