Incidence of Ankylosing Hyperostosis of the Spine (Forestier's Disease) at Autopsy

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In a series of 75 spines studied at autopsy, the authors found 21 (28%) affected by ankylosing hyperostosis. The 21 cases included three in the cervical spine, 12 in the thoracic spine, and five in the lumbar spine. One case had both thoracic and lumbar spine disease. The average age was 65 years (range, 50–90 years). The mean weight was 85 kg, which was 20 kg more than the mean weight of the nonaffected subjects. Four cases had adult onset diabetes mellitus. No other endocrine or arthritic disease was noted either clinically or at autopsy. No abnormalities of calcium or phosphorus metabolism were found. The cause of death was unrelated to their spine disease, and clinical records were devoid of any major complaints referable to the spine. [Key words: ankylosing hyperostosis, diffuse idiopathic skeletal hyperostosis, autopsy incidence]

SINCE THE FIRST HALF of the 19th century, it has been recognized that ankylosis of the spine may occur without significant disc disease. Various names have been proposed for this ankylosing disease, including "spondylitis ossificans ligamentosa" by Oppenheimer[8] and "physiologic vertebral ligamentous ossification" by Smith and his colleagues,[14] who thought it was due to degenerative changes and immobility in older patients. Bechterew recognized this form of ankylosis, which is sometimes called by his name, and which he considered to be a variant of ankylosing spondylitis in which the sacroiliac joints were spared.

Forestier and collaborators[2,3] delineated both the anatomic and clinical findings and proposed the name "senile ankylosing hyperostosis" of the spine. In a later article, after identifying the condition in young adults, they eliminated "senile."

Because there is in addition to spinal involvement frequent extraspinal ligamentous ossification around the shoulder, elbow, knee, hip, and around the small joints of the hands and feet, which may be extensive and clinically significant, the recently proposed nomenclature by Resnick and Niwayama,[10] "diffuse idiopathic skeletal hyperostosis" may be more appropriate.

Based on anatomic studies of the thoracic and lumbar spine obtained at a Veterans Administration hospital, Resnick and Niwayama[10] reported an incidence of 12% in men. The current study investigated the incidence of the disease in 75 consecutive autopsies at the New York Hospital, a large medical, surgical, and tertiary care center in New York City.

MATERIALS AND METHODS

Seventy-five consecutive adult spines from 45 men and 30 women, ages 45 to 90 years (median age, 70 years), were removed whole at autopsy using Schmorl's method.[12] All spines were studied in the fresh state making note of abnormal external features, such as curvatures and bony protuberances. The spines were then radiographed in the anteroposterior, lateral and oblique projections. Computed tomographic scans were performed where it seemed appropriate to further elucidate the form and nature of the bony outgrowths. The specimens were sectioned in the sagittal and parasagittal planes and fine grain radiographs were taken to visualize the anatomy more clearly.

The hospital charts on the patients whose spines were removed were reviewed especially for any history of rheumatologic disease, back disease, diabetes or obesity, and for any associated laboratory abnormalities.

We used Forestier's criteria for the diagnosis of ankylosing hyperosteoses, which are divided into the following three stages. *Stage I* is characterized by ligamentous calcification and ossification at the anterior vertebral body margins but without ankylosis. *Stage II* is characterized by ligamentous calcification and ossification at the anterior vertebral margins with "flame-like" ossification of the anterior longitudinal ligament in front of the disc. *Stage III* usually found in the thoracic segment, is characterized by vertebral ankylosis with a thick layer of new bone over the surface of the vertebral bodies and the intervertebral discs. This ligamentous ossification has been likened to armor plating and is characteristic of ankylosing hyperostosis; it is not seen in ankylosing spondylitis.

RESULTS

Twenty-one (28%) of the spines fulfilled Forestier's criteria (14 men and seven women), three (4%) had cervical disease, 12 (16%) thoracic, and five (7%) lumbar. One spine (1%) showed thoracolumbar disease. None of the spines had involvement at all levels.

The three cervical cases (14% of the affected spines) were all in Stage II (Figure 1).

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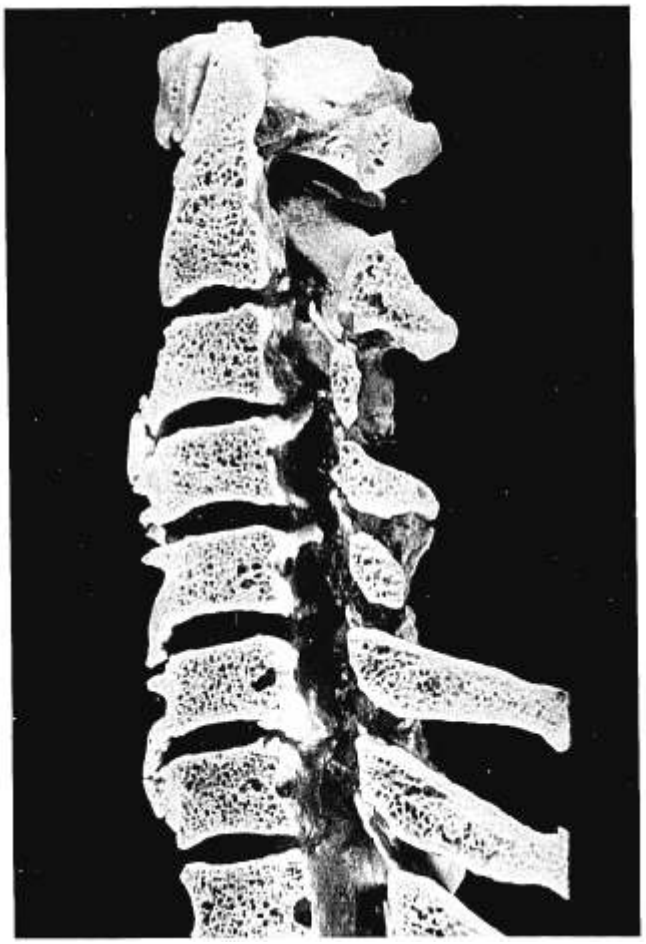

Fig 1. A sagittal section through a macerated preparation of the cervical spine in a 72-year-old man. Note the bony thickening along the anterior vertebral cortices especially of C4–7 and the prediscal ossification, which extends beyond the margins of the disc but is without obvious fusion at this time (Stage II).

In the thoracic spine all 12 cases (representing 57% of the affected spines) were Stage III and showed ossification of the anterior longitudinal ligament with ankylosis of more than four adjacent vertebral bodies (Figures 2 and 3). As is typical, the lesion was more prominent on the right side (Figure 4).

The five affected lumbar spines (24% of the affected cases) all showed Stage II disease with symmetrical right- and left-sided involvements (Figure 5).

On the basis of gross examination and fine-grain radiographic examination of the bone texture as well as on observed absence of end-plate fractures, vertebral body collapse or Schmorl's nodes, the affected spines showed no associated osteopenia of the cancellous bone such as is seen in cases of ankylosing spondylitis.

Review of the medical records of the 21 patients indicated no laboratory abnormalities that could be attributed to the ankylosing hyperostosis. Endocrine and arthritic conditions such as acromegaly, hypoparathyroidism, rheumatoid arthritis, gout, or chondrocalcinosis were absent. There were four patients (19% of the affected cases) with adult-onset diabetes mellitus.

The average weight among the 21 patients was 85 kg. The average weight of the non-involved patients was 65 kg.

DISCUSSION

The radiographic criteria for the diagnosis of ankylosing hyperostosis proposed by Forestier include the presence of focal spinal ankylosis, intact vertebral end plates, normal intervertebral disc height, and most importantly, flowing ossification of the anterior longitudinal ligament, especially along the right side of the thoracolumbar region. He also noted the absence of sacroiliac or facet joint sclerosis or ankylosis.

Clinical symptoms are rare. However, patients with severe involvement of the cervical spine may develop dysphagia because of the bony protuberances behind the esophagus.

Although involvement of the anterior longitudinal ligament is characteristic, a peculiar variant of cervical disease has been described in Japan in which posterior longitudinal ligament ossification is present and may lead to cord compression.[5–7]

According to Forestier,[2,3] the evolution of the disease may cover as much as three to four decades with end-stage disease becoming evident radiographically in the seventh decade. Despite the advanced age of most affected individuals, osteoporosis is not a common association in our experience.

This study showed that approximately one third of the elderly population (median age, 70 years) coming to autopsy in a general hospital had ankylosing hyperostosis. More than one half, using Forestier's criteria, had end-stage (Stage III) disease.

It should be noted that these were not patients admitted to either the orthopaedic service or the rheumatology service. For the most part they were a mix of patients from general medicine and surgery, with the remainder being from other specialty services.

The high incidence that we found suggests that in an elderly urban population ankylosing hyperostosis is a common condition that generally is relatively asymptomatic. Unless it is carefully looked for by appropriate radiographs, it is likely to be overlooked. Most autopsy examinations pay little or no attention to the osteoarticular system.

In our cases, the thoracic spine was involved twice as often as the lumbar spine, which in turn was involved twice as frequently as the cervical spine. Unlike the thoracic spine, where the right side is predominantly affected, probably because of the presence of the left-sided thoracic aorta, symmetrical right- and left-sided involvement is characteristically seen in the cervical and lumbar spine.

Disc calcification and slight narrowing may be seen occasionally, but the disease usually progresses independently of disc abnormality with minimal effect on the disc. Although the etiology of the disease is unknown, it has been associated with certain endocrine disorders, such as acromegaly, hypoparathyroidism, and diabetes mellitus.[4]

The incidence of abnormal glucose tolerance tests in patients diagnosed radiologically as having ankylosing hyperostosis and overt diabetes mellitus has been reported to be around 22% and 9%, respectively. These figures represent approximately twice the frequency of that of an age–sex- and weight-matched population.[15] In our limited autopsy study, the incidence of diabetes mellitus was 20%, which perhaps reflects the not surprising increased incidence in anatomic specimens as compared with clinical radiographic studies. This finding further supports the view that these conditions are related.

However, patients with ankylosing hyperostosis in general do not show any specific laboratory findings, although the erythrocyte sedimentation rate may be minimally elevated. It has been reported that there is an increased incidence of HLA B8 in patients with ankylosing hyperostosis occurring in approximately 42% of cases.[9] The finding that the patients showing ankylosing hyperostosis as a

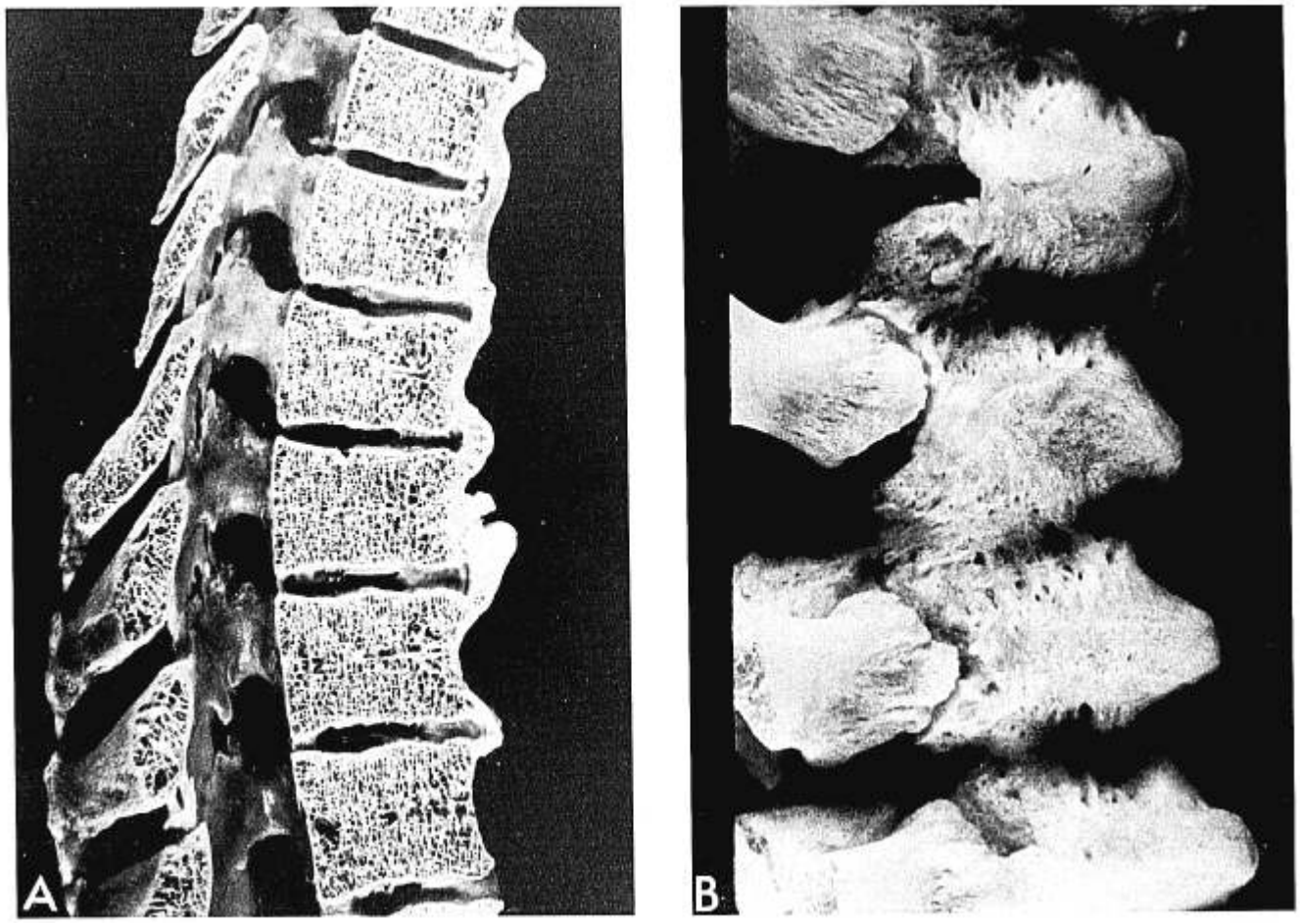

Fig 2. A, A sagittal section through a macerated preparation of the midthoracic region in a 65-year-old man. Note the extensive ossification anterior to the vertebral bodies, which continues across the disc spaces. Note also the intact end-plates and normal disc heights, which is characteristic of Stage III disease. This severe ossification of the anterior longitudinal ligament gives rise to a "bumpy" contour and has also been likened to "armor plating." **B,** Surface of a portion of the specimen shown in Figure 2A. Note that the ribs show no evidence of fusion as they would in ankylosing spondylitis.

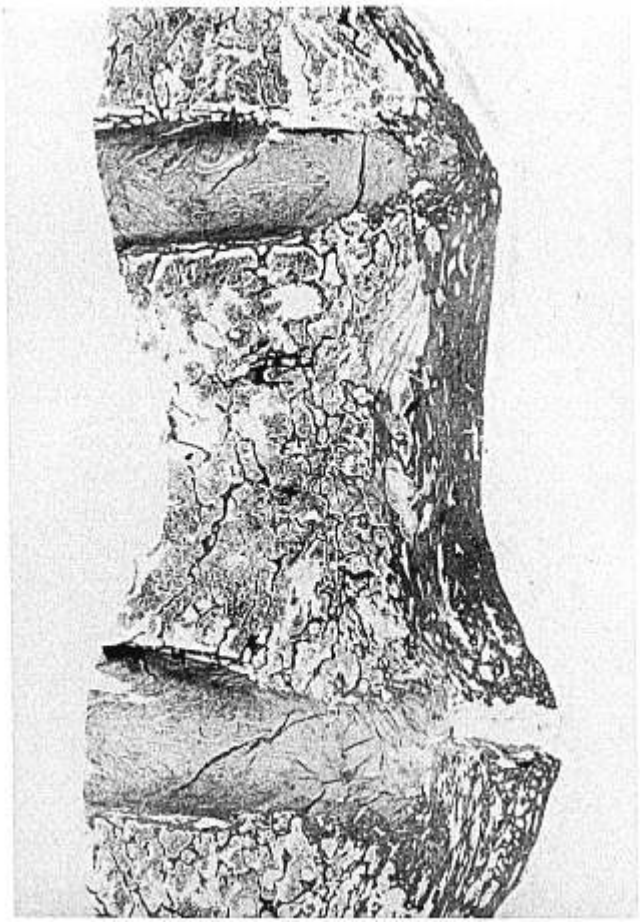

Fig 3. Photomicrograph to illustrate Stage III involvement in the case presented in Figure 2. This illustrates two vertebral body disc sections and the ossification of the anterior longitudinal ligament. Note the absence of any degenerative process in the intervertebral disc (hematoxylin–eosin stain; original magnification × 3.5).

Fig 4. Fine-grain radiograph in the lateral projection of the lumbar spine in a 70-year-old man with Stage II Forestier's disease. Note the thickening along the anterior vertebral cortex and the characteristic vertical "flame-like" ossification of the anterior longitudinal ligament in front of the discs. Also note the normal disc height and absence of any significant degenerative process.

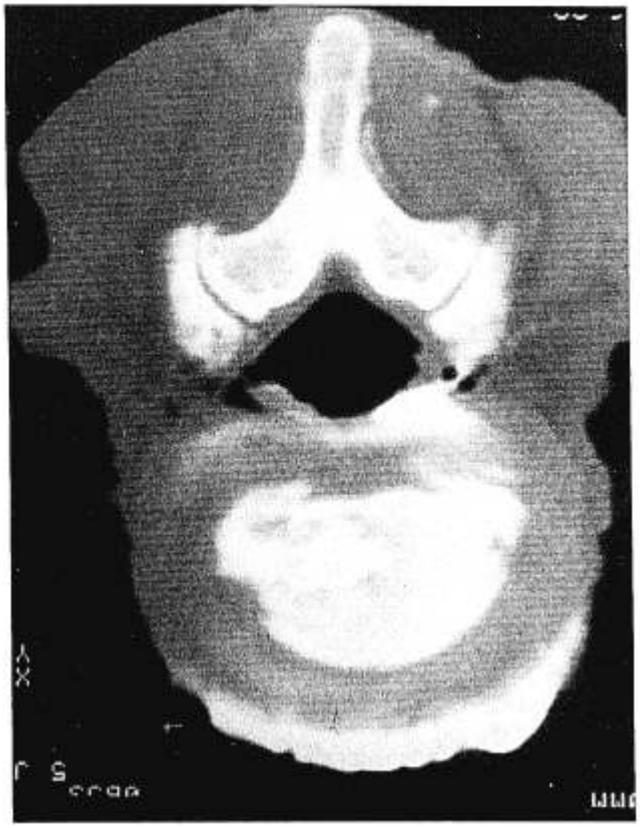

Fig 5. Computed tomography through the L2–3 disc of the case illustrated in Figure 4. This illustrates the symmetrical prediscal ossification of the anterior longitudinal ligament at disc level. The confines of the nucleus pulposus is outlined by injected contrast reagent, which is also extending posteriorly on the left side. Note the concentric appearing annulus fibrosus anteriorly and the normal facet joint posteriorly.

group weighed 20 kg more than those without suggests the presence of dietary influences.

The disease is generally regarded as a spinal manifestation of a more diffuse "ossifying diathesis" of the entheses, and has been shown to be associated with a higher incidence of heterotopic bone formation in patients after total hip replacement.[1]

The condition can be readily distinguished from several other spinal ankylosing processes. First, intact end-plates and relative preservation of disc height in the involved region are features of ankylosing hyperostosis but are not characteristic of intervertebral osteochondrosis.

Absence of facet joint and sacroiliac joint sclerosis and fusion, differentiate the disorder from ankylosing spondylitis. Fluoride intoxication may produce ligamentous ossification and ankylosis[13] mimicking ankylosing hyperostosis, but the clinical history and biochemical evaluation will identify the abnormality.

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