FROM THE SURGICAL DEPARTMENT (HEAD: PROFESSOR JOHN HELLSTRÖM) AND THE ROENTGEN DEPARTMENT (HEAD: PROFESSOR KNUT LINDBLOM), KAROLINSKA SJUKHUSET, STOCKHOLM

DESTRUCTIVE AND OSSIFYING SPONDYLITIC CHANGES IN RHEUMATOID ANKYLOSING SPONDYLITIS

(Pelvo-spondylitis Ossificans)

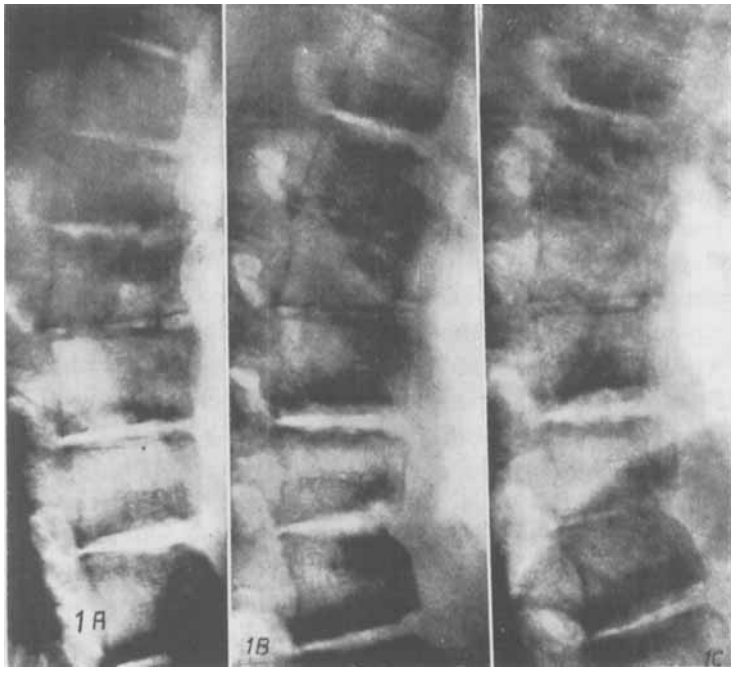
By

RAGNAR ROMANUS & SVEN YDÉN

In connection with an urological examination of 114 men with clinically and roentgenologically typical ankylosing spondylitis (Romanus, to be printed in Acta med. Scandinav., 1953) we have studied these patients' x-ray pictures. A number of cases are of relatively recent date, but the majority have been under observation for many years with frequent x-ray examinations. The results will be published as a supplement to Acta radiol., 1953. On account of an article in J. Bone & Joint Surg., July 1952, by Baggenstoss, Bickel & Ward,– "Rheumatoid granulomatous nodules as destructive lesions of vertebrae"–we intend in the present paper to discuss only the character of the spinal changes, in particular the occurrence of destructive spondylitis. In agreement with Hench, Slocumb & Polley (1947), Boland (1949), Forestier et al. (1951) and others, we take the term ankylosing spondylitis to mean a condition which starts with characteristic arthritic changes in the sacroiliac joints developing into synostosis

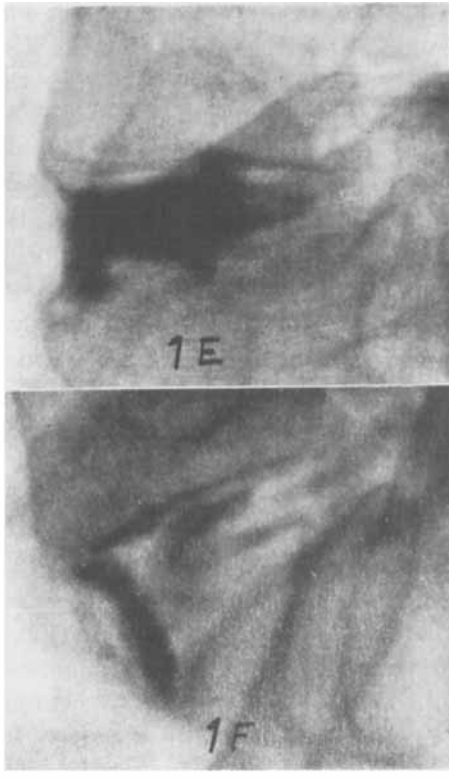
Figs. 1 A–F.

A. Lateral view of the lower thoracic spine of a 58 year old man with ankylosing spondylitis. Marked spondylitic changes with multiple areas of destruction, sclerosis and narrowing of intervertebral spaces. B. shows the same patient 2¾ years later: the spondylitic changes are more marked. C. A year later again two of the disk spaces are almost completely obliterated, forming block vertebrae. D. A-p view of the lumbar spine of the same patient with changes typical of advanced ankylosing spondylitis. E–F show diskograms of the fourth and fifth lumbar disks. Both disks show marked degeneration in spite of the relatively normal width of the intervertebral space. Cavities are filled with contrast medium and in F one large cavity is seen immediately behind the bony bridge uniting L 5–S 1.



Figs. 1 A, B and C.

Fig. 1 D.



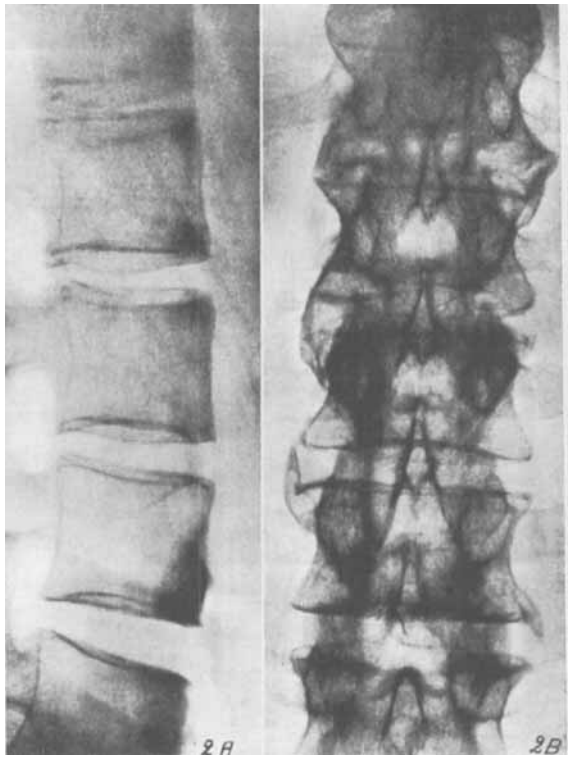
Figs. 1 E and F.

and then, as a rule, advancing up the back with paravertebral calcification which bridges the intervertebral spaces. It usually causes destruction of the apophyseal joints and costovertebral joints and, in pronounced cases, results in bamboo spine.

A few years ago the x-ray changes shown in Fig. 1 A of a man then 58 years old (F. T. 1891), with a long record of physical signs and symptoms of ankylosing spondylitis, were interpreted as multiple septic spondylitis of the thoracic spine + bilateral sacro-iliac synostosis. The marked vertebral body destruction was, at that time, regarded as excluding the possibility of ankylosing spondylitis, in spite of the fact that much pointed to this diagnosis. During the following course of development the destruction advanced (Fig. 1 B) with the appearance of partial block formation (Fig. 1 C). Paravertebral calcification, which more and more resembled bamboo spine, appeared both at the sides of the lumbar vertebrae (Fig. 1 D) and anteriorly between L 5 and S 1 (Fig. 1 F). The diagnosis of ankylosing spondylitis was, however, not accepted until we had found several similar cases, e.g. S. B. 1917, Figs. 2 A–B. The sacro-iliac joints in this case were synostotic. The lateral view (2 A) shows destruction and marked sclerosis of the anterior vertebral body margins L 3–4, similar but less pronounced changes with wearing away of sclerotic anterior margins of the upper lumbar bodies, where the A. P. view shows typical bridging paravertebral calcification (2 B).

Our systematic investigation of a total of 114 men with ankylosing spondylitis enabled us to demonstrate varying stages of destructive lesions in practically all the cases with spinal changes. In several cases, e.g. A.G.P. 1928, Figs. 3 A–C, these anterior spondylitic changes were, in fact, the earliest symptom of spinal spread (apart from the initial sacroiliac arthritis), earlier even than the typical syndesmophytes which, as a rule, can be found first in the lower thoracic and upper lumbar spine.

We re-examined films taken at an earlier date, and previously interpreted as normal, so that we could study the very earliest stage of a syndesmophyte. A minute examination of the areas in which syndesmophytes appeared later revealed similar, though very slight, signs of a superficial destructive process on the vertebral bodies in the form of a blurring of the corticalis contour, a disappearance of the extreme outer layer of bone (Fig. 4 A). This initial stage is followed by calcification which often appears first at some little distance from the site of the original bony contour (Fig. 4 A), then by a cloudy calcification which fills up the space to the vertebral body (Fig. 4 B) and, finally, by ossification and structural alteration the typical syndes-



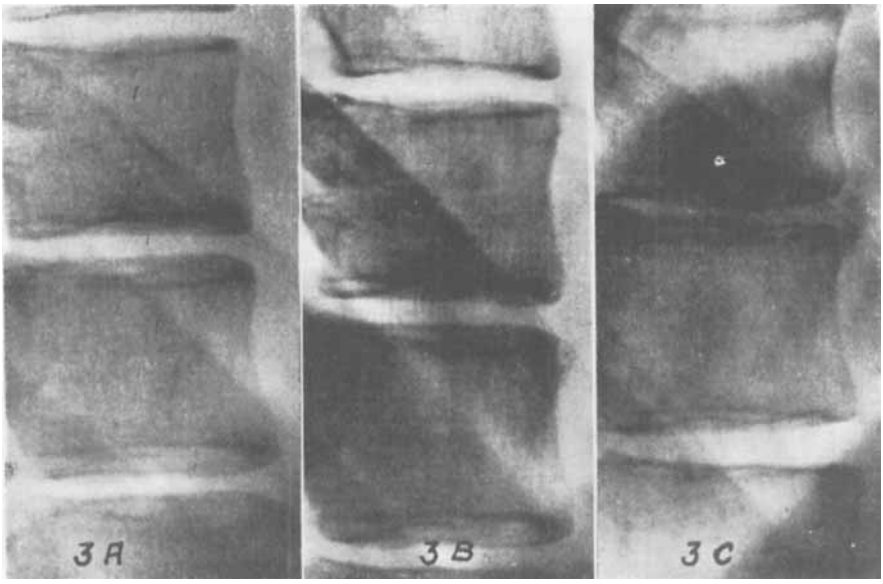
Figs. 2 A–B.

A. Lateral lumbar spine shows intervertebral disk space of normal width. Areas of sclerosis are seen in the upper and lower corners of the anterior parts of the vertebral bodies associated with cortical erosions and irregularities. B. A-p view of the same patient showing the typical changes of ankylosing spondylitis.

mophyte is formed, the bony structure of which appears to be directly connected with that of the vertebral body.

Against the background of these findings there can be no doubt that ankylosing spondylitis is a true spondylitis–not only a spondylarthritis = rheumatoid arthritis of the spine in the apophyseal joints. The spondylitis causes changes in the vertebral bodies ventrally, as in Figs. 1–3, 5; on its lateral parts with secondary formation of syndesmophytes, Fig. 4; on different processes, e.g. the articular process, attacking the apophyseal joints, the spinous and transverse processes, and the laminae.

The region attacked varies in different cases–sometimes the ventral attack dominates, as in Figs. 1–3, 5, sometimes the lateral and sometimes the dorsal, but in the majority of cases the changes develop gradually in all these regions. Anterior spondylitis has been studied



Figs. 3 A, B and C.

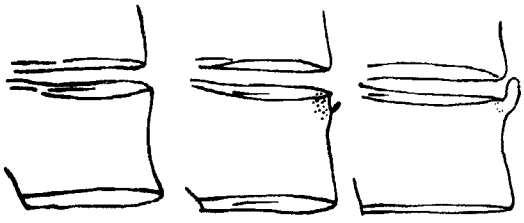


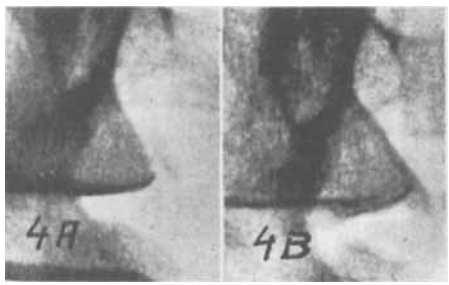
Fig. 3 D.

Figs. 3 A–D.

A–C. Serial films taken at intervals of 12 and 6 months respectively, showing phases of the development of an anterior spondylitis and secondary syndesmophyte. D. Schematic drawing of Figs. 3 A, B and C.

in the lateral projection, Figs. 1–3, 5; as a rule the initial changes appear in the upper and lower part of the anterior surface of the vertebral bodies. First, a slight roughening of the contour can be seen, and a decreased calcium density which progresses to a true destruction (Figs. 3 B, 5 B). The more compact rim of the body is then sometimes left (see Figs. 2 A, 5 B) like a spike undermined by the lytic defect which, in the lateral view, extends over one third of the anterior edge of the vertebral body. The same changes are often seen on two vertebrae on either side of a disk (e.g. Figs. 1, 2, 5). Later the spike of the rim also disappears, and the edge of the vertebral body appears to be worn away.

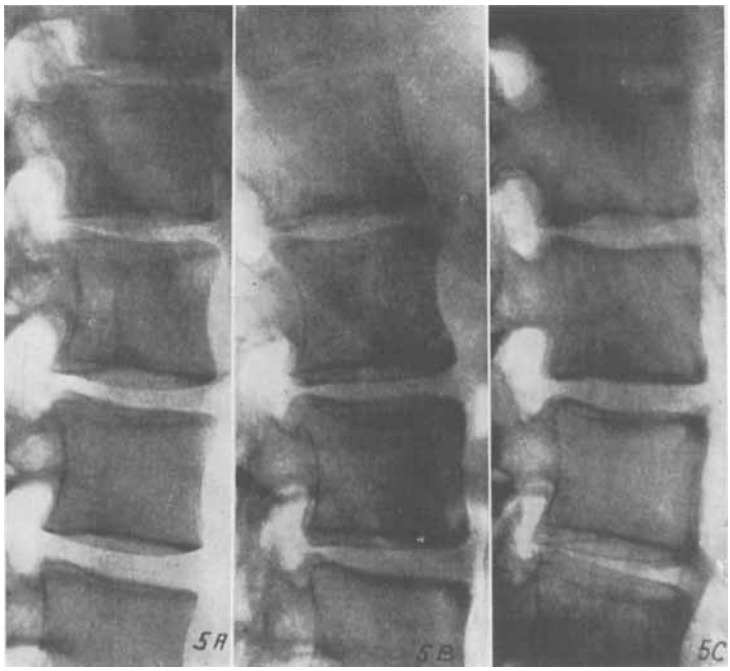
In this way the anterior contour of the vertebral body, normally concave, becomes straight (Figs. 2 A, 5 B–C) or even convex (Figs. 1 A–C). The straight front edge corresponds to what has been called the "square vertebrae", described by several authors for many years. But the origin of these "square vertebrae" has not been explained before. At the same time an increased calcium content is often seen in the lateral picture, sclerosis of the vertebral body margin (see Figs. 2 A, 3 B,



Figs. 4 A–B.
Localised a-p views of a lumbar vertebra of a man suffering from ankylosing spondylitis for 4 years, showing in A corticalis destruction at the lateral lower margin with adjacent hazy paravertebral calcification. In B, 4 years later, a typical syndesmophyte is developing.

5 B–C). This is often extremely pronounced, so much so that the edges really "shine" in the original x-ray film–but it is difficult to reproduce well in a copy. As mentioned above, all the degrees of changes are found here; from advanced cases as in Figs. 1 B–C, to very mild forms with only slight sclerosis and a suggestion of blurring of the contours. In these cases it is not possible to diagnose spondylitis with certainty, but the further course of the disease will determine the diagnosis. After 3, 6 or 12 months there will be progress or transition to the next stage with ossification (Figs. 3 C, 5 C).

This healing phase with calcification and ossification sometimes appears earlier in cases with only slight and superficial destruction, as in Figs. 3 and 5, and later in cases with more marked destruction, as in Fig. 2. In very advanced cases, in which the disk is also seriously diseased, block formation can sometimes occur (Fig. 1 C). This secondary calcification and ossification is often so marked that the vertebral body is rebuilt in the destroyed area (Figs. 3 C, 5 C distally). It regains, then, to a certain extent its former shape. The newly formed bone tissue is later structurally altered, both that which has been deposited on the vertebral bodies and that at the periphery of the disks. Its structure finally becomes one with that of the original bone.



Figs. 5 A–C.
Three films of lumbar spine taken at five-yearly intervals. In A the appearances are normal. In B fairly early spondylitic changes are seen at the upper and lower corner and the anterior margins of the vertebral bodies are beginning to lose their normal concavity. In C there is definite squaring of vertebral bodies and partially bridging syndesmophytes have formed.

In advanced cases of bamboo spine there is, then, nothing in the vertebral bodies' shape or structure to suggest the preceding destructive stage.

As we have pointed out in a paper published in Acta radiol. (1952), a comparison of the height of the intervertebral spaces in repeated radiograms shows that, in many cases of ankylosing spondylitis, these do not, as was formerly believed, remain unchanged but that they decrease. By means of diskography, performed with Lindblom's method, on 30 patients with ankylosing spondylitis, we could demonstrate the fact that this can sometimes be explained by "ordinary" disk ruptures. In 6 more advanced cases we found changes in the disk of quite another type, as illustrated by Figs. 1 E–F, with irregular cavities in the anterior portion of the disk.

This suggests that the anterior spondylitis in ankylosing spondylitis also attacks the disks. It has been possible to study in detail the nature of these changes in one case. The disk L 5–S 1 had decreased in

height and diskography showed marked degeneration. No certain spondylitis could be established in the surrounding vertebrae, but a histological examination of excised parts of this disk (biopsy at stabilising transperitoneal operation) revealed inflammatory changes in its peripheral part.

Thus the roentgenological characteristics of these spinal changes in ankylosing spondylitis are, first, destruction, to varying degrees superficial or penetrating, but starting on the surface of the bone, followed by calcification and ossification with structural alteration and, as the end result, normal bone structure connected with the rest of the bone. In the intermediary stage one sometimes finds both destruction with erosions and calcification with bony proliferations. These spinal changes are wholly in agreement with the roentgenological changes elsewhere in ankylosing spondylitis: initially in the sacro-iliac joints; secondarily in the pelvis localised to the rami pubes, tuber ischii, crista ilii, trochanter major, and extrapelvically to the synchrondrosis sterni, the sterno-clavicular and acromio-clavicular joints and the calcaneal spurs. Histopathological studies in collaboration with B. Engfeldt (to be published in Acta path. et microbiol. Scandinav.) of excised material from the spinous processes, intervertebral disk, synchrondrosis sterni and an acromioclavicular joint show that the histopathological changes in these different regions are also similar. There are inflammatory changes in the early stages which, at a later stadium, when ossification is present, are less pronounced or absent.

DISCUSSION

Baggenstoss, Bickel & Ward (1952) found rheumatoid granulomatous nodules as destructive lesions of two vertebrae on necropsy of a 56 year old man with peripheral rheumatoid arthritis. A radiogram before death had shown pathological wedging (compression fracture) of the body of the twelfth thoracic vertebra with destructive and proliferative changes about its anterior portion. Ankylosing spondylitis is never mentioned in this case and no signs of symptoms are presented as indicative of this diagnosis. The authors then report three clinically and roentgenologically typical cases of ankylosing spondylitis, of 10–20 years' duration, in which the radiogram shows destructive lesions on the margins of the vertebral bodies in the lower part of the thoracic spine and the mid part of the lumbar spine respectively. The roentgenological changes in these three cases of theirs are in full agree-

ment with those demonstrated by us, but they show little similarity to the changes in their first case. The conclusion that the three cases of ankylosing spondylitis also involve rheumatoid granulomatous nodules in the vertebral bodies seems, therefore to have no justification in our view. We believe, instead, these changes to be typical of ankylosing spondylitis and–for reasons presented in detail in another paper (see Romanus in Acta med. Scandinav., 1953)–we consider ankylosing spondylitis to be a disease sui generis and not rheumatoid arthritis of the spine.

Interest in the spinal changes in ankylosing spondylitis has, up to the present, been concentrated on the ossification stage–and in recent years on, for instance, the demonstration of the fact that this calcification is not situated in the anterior longitudinal ligament itself, but in the periphery of the intervertebral disk. However, if one examines a large material of ankylosing spondylitis in which the cases have been subjected to frequent x-ray controls, one finds destructive lesions on the surface of the vertebral bodies and processes in those places at which ossification appears later. Ossification is, then preceded by a destructive phase–a true destructive spondylitis which has been given but little attention as yet. In mild or moderate cases this destructive phase is often of relatively short duration, if measured against the slow development of the disease, but in pronounced cases it can take a long time. Marked changes resembling those in our material (see Figs. 1–2), and in cases Nos. 2–4 in Baggenstoss, Bickel & Ward's have been described by a few authors. Guest & Jakobson (1951) found "osteopathic lesions of vertebrae" in 7 of their 90 cases of ankylosing spondylitis. They were of the same nature as other extrapelvic skeletal changes in this disease, but the authors do not go into the spinal changes in detail; they only discuss the pelvic and extrapelvic lesions. In a monograph by Forestier et al. on ankylosing spondylitis (1951) there is also a similar picture (Fig. 37) showing pronounced destruction. These authors found such changes in 2 of 200 analysed cases, and propose the coincidence of tuberculosis and ankylosing spondylitis.

Our examination of 114 cases shows, however, that this type of spondylitic destruction is no unique phenomenon in ankylosing spondylitis. Varying degrees of penetration from the outside by inflammatory destruction of the vertebral body, processes and disk constitute the initial phase in the spinal development of the disease: a precursor and a prerequisite of ossification and possible development to the final stage of bamboo spine.

This destructive stadium of the spinal changes in ankylosing spondylitis corresponds to the first phases of the sacro-iliac arthritis

which always initiates ankylosing spondylitis. Equally, the ossification stage of spondylitis corresponds to the later development of sacroiliac arthritis to synostosis. Essentially similar changes with, first, destruction–decalcification–erosion, followed by calcification–ossification–bony proliferation, are also found in the pelvis (e.g. the tuber ischii, rami, symphysis, crista ilii), and extrapelvically and extraspinally in, for instance, the synchrondrosis sterni and the clavicular joints.

With a view to stressing the fact that the disease is first and most clearly manifested in the pelvis (in the sacroiliac joints) and then spreads along the spine with true spondylitic changes, and at the same time wishing to point out its marked ossification tendency, we suggest that instead of being called rheumatoid arthritis of the spine, ankylosing spondylitis, Morbus Bechterew-Marie-Strümpell, et cetera, it be termed *Pelvo-spondylitis ossificans*.

As regards the etiology of these inflammatory changes in Pelvospondylitis ossificans, we would like to point out that in all but 2 of the 114 men examined a chronic non-specific urogenital infection was present, in particular, chronic vesiculitis and perivesiculitis; in 2 cases proctocolitis. A detailed argument in support of the probability that Pelvo-spondylitis ossificans is caused by a chronic non-specific infection in the pelvic organs will be published in Acta med. Scandinav. by R. Romanus.

SUMMARY

A preliminary report is presented on the spinal changes in 114 men with varying degrees of ankylosing spondylitis, most of whom have been subjected to frequent x-ray examinations. The initial phase of the disease in the spine which, up to the present, has been given but little attention, is shown to be constituted by more or less penetrating inflammatory destruction from the outside of the vertebral body, processes and intervertebral disk. This has been demonstrated by plain x-ray, by diskography and by biopsy of different skeletal parts. The next stage is that well-known condition of calcification and ossification, when destroyed areas are layered with new bone and bony bridges appear between the vertebral bodies at the periphery of the disk. After structural alteration has taken place one cannot differentiate between the newly formed bone and the original. The destructive stage has, therefore, almost entirely escaped notice up to the present.

These two stages, primary destruction and erosion and secondary calcification, ossification and bony proliferation are also to be found

in the sacroiliac joints and in the rest of the disease's pelvic localisations (symphysis and the so-called periosteal changes on the surface of the bones such as, for instance, the tuber ischii), and extrapelvically and extraspinally in, for example, the synchondrosis sterni and the joints of the clavicle.

To emphasize this conception of the nature of the disease, its start in the pelvis and advance up the back, we suggest that such terms as rheumatoid arthritis of the spine, ankylosing spondylitis, et cetera, be replaced by a new name, *Pelvo-spondylitis ossificans.*

RÉSUMÉ

Rapport préliminaire sur les modifications de la colonne vertébrale chez 114 hommes souffrant à des degrés divers de spondylite ankylosante, la plupart d'entre eux ayant été soumis à de fréquents examens radiologiques. La phase initiale de la maladie dans la colonne vertebrale apparaît comme une destruction inflammatoire plus ou moins profonde entourant le corps vertébral, les apophyses et le disque intervertébral. Ceci s'est révélé aux rayons X, à la discographie et à la biopsie des différentes parties osseuses. Le stade suivant est celui bien connu de la calcification et de l'ossification, lorsque les régions détruites sont recouvertes de nouveau tissu osseux; il se forme alors des ponts osseux entre les vertèbres et la périphérie du disque. Lorsqu'il y a altération structurale, il est impossible de distinguer la nouvelle formation osseuse de l'os primitif. C'est pourquoi, jusqu'à maitenant, le stade destructif a presque toujours passé inaperçu.

Ces deux stades, destruction primaire, puis phase secondaire avec calcification, ossification et prolifération osseuse se rencontrent également dans les articulations sacro-iliaques et dans les autres localisations pelviennes de la maladie (symphise et modifications dites périostales sur la surface des os, telles par exemple la tuberosité ischiatique) ou dans les localisations extrapelviennes et extravertébrales, telles que la synchondrose sternale et les articulations claviculaires.

Pour souligner cette conception de la nature de la maladie, son point de départ dans le bassin et sa progression vers le dos, nous suggérons que des termes tels qu'arthrite rhumatoïde de la colonne vertébrale, spondylite ankylosante, etc. soient remplacés par une désignation nouvelle : *Pelvo-spondylitis ossificans.*

ZUSAMMENFASSUNG

Ein vorläufiger Bericht über Wirbelsäulenveränderungen in 114 Männern mit verschiedenen Graden von Spondylitis ankylopoetica

wird gegeben. In den meisten dieser Fälle wurde eine häufige Röntgenuntersuchung vorgenommen. Es wird gezeigt, dass der Beginn der Krankheit im Wirbelsäule, welchem bis jetzt nur wenig Aufmerksamkeit zugewendet worden ist, in einer von der Aussenfläche der Wirbelkörper, der Fortsätze und der Zwischenwirbelscheiben mehr oder weniger penetrierenden entzündlichen Zerstörung besteht. Dies wurde gezeigt mittels gewöhnlicher Röntgenuntersuchung, Diskographie und Biopsie von verschiedenen Skeletanteilen. Das nächste Stadium ist der wohlbekannte Zustand der Verkalkung und Verknöcherung, wo die zerstörten Gebiete verknöckert werden und knöcherne Brücken zwischen den Wirbelkörpern in der Peripherie der Zwischenscheiben auftreten. Nachdem die Strukturveränderungen stattgefunden haben kann man nicht mehr zwischen neu geformten und ursprünglichem Knochen unterscheiden. Das destruktive Stadium ist deshalb bis heute fast ganz der Aufmerksamkeit entgangen.

Diese beiden Stadien, primäre Zerstörung und Erosion und sekundäre Verkalkung, Verknöcherung und Knochenproliferation kann man auch in den Sakro-iliakal-gelenken und in den übrigen Becken-Lokalisationen der Erkrankung (Symphysis und die sogenannten periostalen Veränderungen an der Oberfläche von Knochen wie z. Bsp. Tuber ischii), und in denen ausserhalb des Beckens und der Wirbelsäule, wie z. Bsp. Synchondrosis sterni und Schlüsselbeingelenken, finden.

Um diese Auffassung der Natur der Krankheit hervorzuheben, ihres Beginnens im Becken und Weitergreifens auf den Rücken, vorschlagen wir dass Ausdrücke wie Morbus Bechterew, Spondylarthritis ankylopoetica und andere, mit dem neuen Namen *Pelvo-spondylitis ossificans* erstattet werden sollen.

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