THE THORAX IN ANKYLOSING SPONDYLITIS

BY

F. DUDLEY HART, ANDREW BOGDANOVITCH, and W. D. NICHOL

From the Rheumatism Clinic, Westminster Hospital, London

One of the most interesting and characteristic findings in the condition known in Great Britain as Ankylosing Spondylitis, and in the U.S.A. as Rheumatoid Spondylitis, is the diminution in thoracic, i.e. intercostal, expansion due to involvement of the costo-transverse and costo-vertebral joints. This finding is not seen as a common or characteristic feature in any of the other rheumatic diseases; it is one of the characteristic and pathognomonic physical signs in ankylosing spondylitis. While the vital capacity in any febrile active locomotor disease may be reduced, figures in uncomplicated cases do not descend to the low level seen on occasion in ankylosing spondylitis, nor is the reduction in thoracic expansion as marked. For this reason, although some attention has been devoted to thoracic changes in ankylosing spondylitis (Hamilton, 1949; Hart, 1950), we have paid particular attention to this finding. It is a useful diagnostic pointer; in our series of cases the majority of patients had reduced thoracic expansion on their first attendance at the clinic. This particular finding is prominent and frequent enough to be taken as a cardinal early diagnostic sign. Under treatment by various methods the vital capacity and chest expansion may improve and even return to normal. This has been observed by us by the use of deep x-ray therapy and general body and breathing exercises, and by Swaim (1939) by the use of light jacket supports for the prevention and correction of kyphotic thoracic deformity. Restriction of intercostal respiration is therefore an early sign as well as a late one. It may disappear or lessen in the intermediate phase on therapy, though in many instances vital capacity and chest expansion remain subnormal throughout the course of the disease.

Symptomatology

The presence of joint changes in spine and/or hips may prevent the patient from taking sufficient exercise, but on occasion exertional dyspnoea is a complaint made spontaneously by patients with ankylosing spondylitis. This symptom is usually part of a more complex symptomatology. The dyspnoea complained of is quite unlike that noted in cardiac or pulmonary disease. Difficulty is experienced in moving the chest wall; tightness is noted in the ribs and muscles of the thoracic cage, more particularly anteriorly, but also in the flanks; the chest aches and feels stiff and immobile and the patient cannot fill his chest satisfactorily on deep inspiration. There is no bronchial spasm and the picture is quite unlike that seen in asthma or chronic bronchitis. On forced inspiration the chest wall aches, particularly after sharp inspiratory efforts as after coughing or sneezing, but the ache is not due to repeated coughing as it is in chronic bronchitis, for cough
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is rarely complained of in this disease unless there is a co-existing chronic bronchitis or chronic pharyngitis. On exertion the patient finds that his chest will not expand sufficiently to allow of deep inspiration; his dyspnoea is secondary to the feeling of thoracic stiffness which predominates.

On going through the notes of the last 65 cases of ankylosing spondylitis who attended our Rheumatism clinic we find recorded the following symptoms: pain over the sternum in three cases, tenderness in the angle of Louis in two additional cases, intercostal pain in two cases, and pains confined to the lower ribs in one case.

Our impression has been that these symptoms are vastly commoner in our day to day experience than the above figures would suggest. Minor symptoms are frequently omitted from histories which extend over long periods, often of many years. In a routine questionnaire sent out, the following question was asked: "Since the onset of your back condition have you at any time experienced tightness and/or discomfort in the chest wall preventing the taking of a deep breath, or noticeable on taking a big breath?" For what they are worth the 65 answers returned included "No" (10); "Definitely yes" (47); "Occasionally and slight" (8). To the question "Have you since the onset of your back condition noted tenderness in the breast-bone area or ribs?" the answers were "No" (17); "Yes" (42); "Slight or doubtful" (6). While leading questions may elicit too many positive answers there is little doubt that thoracic symptoms are much commoner than is apparent in the ordinary hospital records.

Case Histories:—The following histories are of interest:

Case 1. E.B., young man with spondylitis of six years' duration. A simple bilateral pneumonia three years ago took three months to clear up. This is probably an example of the delayed resolution of respiratory infection seen in three cases.

Case 2. W.S., man aged 54. Symptoms started during the first world war. His progressive thoracic stiffness and exertional dyspnoea were put down to bronchitis and emphysema for many years. His chest expansion of 1 in. was attributed to emphysema. Only this year, 32 years after the onset of his condition, was the correct diagnosis made.

Case 3. T.C., man aged 51. Pain in the back commenced in August, 1948. Ankylosing spondylitis was diagnosed and he was put on strict bed-rest in hospital. There a right spontaneous pneumothorax developed suddenly. He was kept on strict bed-rest. When admitted to our wards his vital capacity was 38 per cent. of normal (1,700 ml.), chest expansion at nipple level was 1 1/2 in. After a course of deep x-ray therapy and exercises, including breathing exercises the vital capacity improved to 2,300 ml. (54 per cent.) and chest expansion to 1 1/2 in. As a result of this improvement the patient's speech, previously jerky through dyspnoea, became normal. At the onset he was unable to give his history without a pause as he became too breathless in the telling of it.

Case 4. J.R.Y., man aged 26. In the course of his history he stated that he had been having pains in the front and back of his chest for three years and he was unable to take a deep breath. He was also tender over the left side of the sternum.

Case 5. D.W., man aged 50. This patient was admitted into the general medical ward undiagnosed. His main symptoms consisted of acute generalized pains and stiffness. He was in extreme discomfort and could not lie comfortably in bed. He was noted to be extremely tender in the intercostal muscles, especially on the left side. Radiographs showed the changes of ankylosing spondylitis. He received a course of deep x-ray therapy to his spine, and breathing exercises. The chest expansion at nipple level rose from 1 1/2 in. to just over 1 in. Symptoms abated under treatment. From a bedridden case
in extreme pain he was walking the wards fairly comfortably two weeks later. During his stay of a month he developed a minor respiratory infection, but was allowed to go to the Convalescent Home of base, though no radiological pulmonary changes were present. He returned a month later for reassessment and at that time developed a more severe respiratory infection which again settled at the left base, which was the less mobile side. Scattered rales developed throughout the chest and he became dyspnoeic and cyanosed. Oxygen was given in addition to routine therapy. His recovery was rather slow and thoracic symptoms persisted unduly long. This was attributed to his poor respiratory excursion and inability to clear his chest by coughing. He was discharged home for further convalescence with moist sounds still present at his left base. These took several weeks to clear. He is now in excellent health.

Case 6. J.M., man aged 30. In December, 1947, he was reputed to have had pleurisy, but full history-taking suggests that the chest pains may well have been due to the ankylosing spondylitis which was diagnosed subsequently. Further, there was no radiological evidence of any lung or pleural changes. In the month following this so-called pleurisy he had a tight feeling in the chest with difficulty and pain in sneezing and taking a deep breath.

In addition to routine x-ray therapy to the spine he was given 900 r. to the manubriosternal junction. This resulted in marked improvement and he was able to take a deep breath more easily. Chest expansion increased from 1¼ in. to 3 in.

Case 7. B.A., man aged 28. This patient said that his chest appeared to be changing shape, and that although his exercise capacity seemed diminished the size of his chest seemed to be increased. He complained of occasional bouts of sternal tenderness which prevented him from taking a deep breath as the pain then became sharp in character.

Case 8. J.S., man aged 40. This man, a medical orderly in the R.A.F., noted that in 1944 he became dyspnoeic on going up hills in Burma. He had been having bouts of lower back pain at this time and was developing a stoop which was noticeable to his friends. On examination it was noted that he had practically no respiratory expansion, but it was not until several months later that the diagnosis of ankylosing spondylitis was made while he was suffering from an acute attack of bronchitis.

At his last attendance he complained of occasional pains in the lower part of the front of the chest on taking a deep breath and of tenderness over the lower end of the sternum. He stated that he had to adjust his walking pace to prevent his getting breathless. During treatment his vital capacity increased from 2,860 (68 per cent.) to 3,240 ml. (75 per cent.), the chest expansion from ¾ in. to 1¼ in.

Case 9. L.P., man aged 28. Thirteen years ago at the age of 15, bilateral "synovitis" of the knees came on. No other symptoms occurred until July, 1949, when he found that he could not take a deep breath, cough, or sneeze without considerable pain, this was chiefly in the upper sternum which was tender. He later developed generalized stiffness and pain all over the trunk and the muscles seemed to ache. Radiological investigations showed him to be a case of ankylosing spondylitis; his chest expansion was 1¾ in. and his vital capacity 3,600 ml. (77 per cent.).

Case 10. J.F., man aged 30. This patient came into hospital with extreme pain and stiffness in the chest. His whole back and chest ached and was tender. Vital capacity was reduced to 56 per cent. of normal, chest expansion to under 1 in. He was unable to find a comfortable position in bed, but was quite unfit to be out of it. On deep x-ray therapy to the thoracic spine symptoms abated and within a fortnight he was able to leave his bed. On the completion of the course of treatment his vital capacity was 80 per cent., subsequently it rose to 110 per cent. of normal. He is leading a fit, normal life, and is able to play tennis.

Case 11. F.R., man aged 50. In 1943 shooting pains around the lower ribs and intercostal muscles began. These were sometimes right-sided only. Since 1947 he has experienced a feeling of constriction in the chest as though he cannot take a full breath. When
he does attempt full inspiration he experiences pain in the lower part of the chest. When the pains are bad he experiences some dyspnoea. The over-breathing caused by exertion also produces this pain. On examination his chest expansion was found to be $\frac{1}{2}$ in. at nipple level and vital capacity was 2,400 ml. (55 per cent.). Examined radiologically no pulmonary lesion of any kind was found. Diaphragm showed extensive excursion on each side. Rib movement was nil.

Case 12. C.S., man aged 25. In 1944 this patient was diagnosed as a case of ankylosing spondylitis and invalided out of the services, complaining of low right-sided backache. In the summer of 1949 he first noted pain in the right side of the chest in the region of the fourth and fifth intercostal cartilages, and also on the left side though much less severe. His doctor referred him to the Tuberculosis clinic as a possible case of pleurisy, but the chest physician noted no clinical or radiological signs in the lungs and referred him to the Rheumatism clinic with a diagnosis of ankylosing spondylitis. This diagnosis was confirmed. His chest expansion was 1$\frac{1}{2}$ in., vital capacity 3,320 ml. (82 per cent.). He stated that in the painful area the costal cartilages were slightly painful to touch, but that the main difficulty was in taking a deep breath as then the pain became quite violent, especially on sneezing. There were no radiological abnormalities in the thorax.

Physical Signs

In 58 cases of ankylosing spondylitis we found the initial chest expansion at nipple level to be as shown in Fig. 1. It will be noted that 31 cases had an expansion of 1 in. or less; forty of 1$\frac{1}{2}$ in. or less; and only eleven of one greater than 2 in. Simpson and Stevenson (1949) give similar figures; 52 out of 126 patients having a chest expansion of less than 1 in. Thirty-four of our cases have been followed up for periods up to 3$\frac{1}{2}$ years, and in this time measurements have diminished in four cases, and remained unchanged in seven, but 23 have increased on the therapeutic measures detailed below. The increase in all but four cases, however, was slight, being 1 in. or less.

Repeated vital capacity recordings have been made; at first attendance, again
after a course of deep x-ray therapy and breathing exercises, and subsequently
as indicated (see Figs 2 and 3). It will be seen that three patients have vital
capacity readings between 35 and 49 per cent., 24 between 50 and 74 per cent.,
eighteen between 75 and 99 per cent., and ten between 100 and 119 per cent.
Twenty-seven cases had a vital capacity below 75 per cent. as compared with 28
above that figure. Over the observation period noted above, 21 out of 38 cases
have improved their original vital capacity figures, three have remained unchanged,
and fourteen have deteriorated (see Fig. 4).

As stated above, sternal and rib tenderness has sometimes been present. In

![Figure 2: Initial vital capacity in 51 cases of Spondylitis Ankylopoietica.](chart1)

![Figure 3: Average vital capacity as percentage of normal.](chart2)
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Fig. 4.—Change in vital capacity expressed as a percentage of normal in 38 cases observed during the period of this survey. Increase in 21 cases, no change in three cases, decrease in fourteen cases.

65 case records, swelling at the angle of Louis was noted in four cases, and tenderness without swelling in three others. Costal cartilages were tender to the touch in four cases and the sternal edge in two. Diffuse tenderness over ribs and intercostals was an outstanding and predominating symptom in two cases (Nos. 5 and 10).

Complaints such as "I cannot fill my lungs properly"; "My chest won't expand to let me fill the lungs"; "My chest feels stiff"; "I cannot exert myself"; or "I have to adjust my pace to my chest", are not uncommon.

Pathology

In the thorax, changes occur in the intervertebral articulations, the adjacent soft tissue structures, and the costo-transverse and costo-vertebral joints. Deep pain from all these structures may be referred to points lower down and further anteriorly. In addition, changes may be seen in the manubrio-sternal cartilage.
Connor noted in 1691 that in this disease ribs were fixed to bodies and articulations were ossified. Hilton Fagge (1877) found ribs ankylosed to vertebrae from head to tubercle. Schmorl and Junghanns (1932) state:

“The spaces of the smaller joints have completely disappeared. The inter-spinous foramina become narrowed as a result of the extensive ossification of the ligaments and become oval in shape. This frequently explains the very severe pain which occurs with the onset of spondylo-arthritis ankylopoietica. Ehrlich, however, points out that the narrowing of the foramina is not extensive enough to account for the symptoms and that there is sufficient space for passage of the nerves. It is more likely that there are inflammatory changes in the smaller joints which also affect the nerves. Furthermore, since the pains receded when the rigidity had become complete it may be concluded that the narrowing of the foramina is not responsible for the pain . . . In addition the costo-vertebral joints and their ligaments take part in the generalized ossification and as a result there develops a rigid thorax during respiration.”

These authors also point out that the differential diagnosis of such pains includes neuralgia, angina pectoris, pneumonia, pleurisy, the girdle pains of tabes, and disease of the abdominal viscera. Güntz (1933) writes as follows:

“Of greatest value are the investigations made by Sivén on the chronic ankylosing disease of the vertebral column. The joints between the articular processes were completely ossified and microscopically were seen to be filled with spongy bone with no trace of the joint surfaces left . . . He also investigated the costo-vertebral and costo-transverse joints which were in part already stiffened, in part still mobile. He could see that in some of these joints the whole space was filled with fibrous tissue. Small bony spicules were invading this tissue. In places the tissue was thickly strewn with cells, thickest at the edge of the spongy bones and around the small bony spicules and islands. Many blood vessels were present in the areas of these infiltrations.”

In our own series we have had no deaths and we are, therefore, not qualified to make any statements on the pathological changes in the thoracic cages of these patients. It has seemed to us, however, that the relation of pathological findings to symptoms quoted so freely in past works is in most cases unproven. Root or girdle pains from pressure on nerve roots may occur, but it seems to us that a more satisfactory explanation would be deep pain reference from the inflamed joints in the affected areas of the thoracic spine. To test this point we have injected seven volunteers with 0·1 ml. 6 per cent. saline in the manner suggested by Lewis and Kellgren (1939). A small pain-point against the transverse process in the region of the costo-vertebral joint was found to give a reference three to five ribs lower down, with a tendency to radiate anteriorly in half the cases. While root compression may occur in some cases it seems likely that, in the early cases at least, pain reference from spinal and costal joints is perhaps the commoner cause.

Therapy

In our view the most important factor in therapy is full mobility as early as possible, avoidance of the prolonged rest and immobilization which has been the treatment in the past, early active breathing exercises and, of greater importance, maximal freedom of movement of the patient so that he may use his lungs as fully as he desires. Encouragement in the performance of simple active functions
all day long is productive of better results than a few minutes of organized inspiration and expiration each day. The patient is usually a young male anxious for as much freedom and bodily activity as may be allowed him. This freedom in our opinion should be granted. In our case histories we have several records where symptoms first appeared during enforced rest for other conditions. In acute episodes, where thoracic stiffness and pain is extreme, full mobility is impossible and the patient, though uncomfortable in bed, has to remain there. In our experience deep x-ray therapy is the most satisfactory weapon in these cases. Under treatment they are usually able to commence breathing and body exercises after a fortnight. As soon as rib movement becomes less painful and thoracic expansion improves, the patient is encouraged to leave his bed, and is given the freedom of the ward or of the hospital and the grounds around it. In the more advanced cases response to x-ray therapy is less satisfactory, but even so some improvement may be obtained even in relatively advanced cases with diffuse costal fusion.

It is of interest to note that Swaim (1939) found, on evaluation of 45 cases treated by bed-rest, that chest expansion had become poor in many, 35 had completely fixed spines, 31 had poor posture, twenty had loss of hip movements and could hardly walk, and nine had died, usually from chest infections. These results were so unsatisfactory from a postural standpoint that a better method of preventing deformity had to be devised. Since that time he has used light supportive jackets and encouraged early mobilization and the results have been distinctly better.

In our own cases we have not used spinal supports of any sort, but have employed breathing exercises, and have encouraged full bodily function short of strain, and avoidance of prolonged immobility in one position. Deep x-ray therapy (Hart, Robinson, Allchin, and MacLagan, 1949) has given us good results. There is a real indication for surgical treatment, even though the disease may not be burnt out, in those cases where spinal kyphosis is such as to cause diminution in diaphragmatic excursion. After spinal osteotomy (Smith-Petersen and others, 1945) vital capacity may be improved and diaphragmatic excursion made more efficient (Law, 1949).

Previous Respiratory Disease

The following thoracic diseases were noted in the case histories of our 65 patients: haemoptysis (1), active pulmonary tuberculosis (2), bronchitis (2), asthma (1), chronic spontaneous pneumothorax (1), pleurisy (2, one with effusion), pneumonia (2).

Sixty-five patients were asked whether since the onset of their spinal condition they had suffered more or less from coughs or colds of all sorts. Forty-five replied that there was no appreciable change, fifteen that coughs and colds had been more frequent and three that they were less frequent, and two were uncertain. From cases No. 8, 5, 4, and 1, it will be seen that ankylosing spondylitis and chest disease co-exist not infrequently.

Prognosis in ankylosing spondylitis is said to depend very largely on freedom from pulmonary infections (Comroe, 1944; Steinbrocker, 1941). The association
of ankylosing spondylitis with chest disease is generally well known (Dunham and Kautz, 1941; Swaim and Kuhns, 1930). One of us, F.D.H., has seen pulmonary tuberculosis co-exist with ankylosing spondylitis in five cases. In each case ankylosing spondylitis preceded the pulmonary tuberculosis. It is a difficult combination to treat as immobility is indicated for the one condition, mobility and exercise for the other. Case 3 reveals the slow re-expansion of a collapsed lobe which occurs when a patient with a fused thoracic cage is kept on strict resting conditions. Patients kept on continuous rest complain that they can feel stiffness and immobility progress remorselessly, the thoracic kyphosis worsening as they are kept in bed propped forward on a pile of pillows. The co-existence of pulmonary tuberculosis and ankylosing spondylitis calls particularly for joint action between chest physician and rheumatologist.

Radiological Appearances

As ankylosing spondylitis involving the thorax usually first manifests itself in the small joints of the spine, namely, the posterior intervertebral articulations, the costo-transverse and costo-vertebral joints, it is in these joints that the changes are first visible radiologically. Changes involving the sterno-clavicular and manubrio-sternal joints are seen in most cases at a later stage, as are also changes in the vertebral bodies themselves.

The radiological investigation of the small joints of the dorsal spine is a difficult procedure owing to the varying degrees of obliquity at which the joint spaces lie. To investigate every joint as a routine procedure in every patient would be a time-consuming and expensive task, and it is doubtful if it is warranted. The routine antero-posterior view shows many of the costo-vertebral joints reasonably well and also the costo-transverse joints of the first rib, although this latter in some patients is better demonstrated in an oblique view (see Fig. 5). For the costo-transverse joints oblique views at 45° are satisfactory, and for the posterior intervertebral articulations views at 70° (i.e. 20° from the true lateral position), as recommended by Oppenheimer (1938), are the most useful. The angles at which these joints lie vary a good deal, however, from patient to patient, and much depends on the degree of dorsal kyphosis or the presence or absence of a scoliosis.

The main features in ankylosing spondylitis are that the articular margins lose their sharp outlines because of irregular osteoporosis, and joint spaces become narrowed due to the destruction of the articular cartilage; the final stage is one of complete bony ankylosis. The distribution of these changes is very haphazard and there is no orderly sequence in a cephalic direction as has sometimes been suggested. In an advanced case there may be complete bony ankylosis of all the small joints.

If the chest is studied fluoroscopically there will be seen to be very full movement of the diaphragm on deep respiration, and diminished or sometimes absent movement of the ribs. To record these changes a double-exposure technique has been adopted. It has been found more satisfactory to have the patient supine on the
film rather than erect; this is because the posterior portions of the ribs record more sharply and any rise and fall of the chest due to straightening of the dorsal kyphos on respiration is obviated. The patient is instructed to take a full inspiration and one-third of the normal exposure for the chest is made; the patient then exhales completely and the remaining two-thirds of the exposure is made on the
same film. The resulting film shows well the excursion of the diaphragm and also the movement of the ribs; the elevation of the sternum is also shown by the movement of sternal ends of the clavicles (see Fig. 6). Patients with extensive involvement of the costo-vertebral and costo-transverse joints often show completely absent movement of the ribs, but full movement of the diaphragm (see Fig. 7).
important differentiation is from emphysema, where there may also be great diminution in movement of the ribs, but in emphysema (see Fig. 8) the diaphragm is depressed and shows considerable limitation in movement, and there are the other signs of emphysema such as widened rib spaces and increased translucency of the lungs. The simple double-exposure method is suggested as a substitute for the more
involved investigation of the small joints of the dorsal spine, and also as a record which may be of value in assessing the results of treatment.

Various other changes of ankylosing spondylitis may be seen in the thorax. Generalized osteoporosis is sometimes found in acute cases. Ossification of the spinal ligaments is usually a late feature, but commencing changes in the anterior
common ligament at its attachment to the bodies may cause obliteration of the rounded contours of the vertebral body as seen in the lateral view and give rise to "squaring" as described by Rolleston (1947). The "bamboo" spine is, of course, an advanced stage where there is very widespread ossification of the ligaments. Bony erosions and periosteal thickening at muscular attachments as seen at the ischial tuberosities, trochanters, iliac crests, etc., are not found in the thorax. Involvement of the manubrio-sternal joint sometimes takes place and a lateral view of this joint shows similar changes to those seen in other joints; swelling of the soft tissues around this joint may sometimes be demonstrated.

Discussion

The importance of recognizing that the thorax is involved in ankylosing spondylitis in most cases is apparent from what has gone before. It will be seen that all the components of thoracic expansion in this disease are affected except the diaphragm, and even this has been noted to be affected in one of our cases with marked dorsal kyphosis. This was the only case in our series where screening and x rays revealed sub-normal diaphragmatic excursion. In all other cases diaphragmatic movement was full or even apparently increased.

The enlargement of the thoracic cavity that occurs in the normal subject on full inspiration is as follows:

The thoracic lid or operculum, which consists of the first rib and manubrium sterni, moves up one to 16° like a lid, the manubrium moving forwards and upwards. The upper five ribs below this operculum with the exception of the second (Best and Taylor, 1945) assume a more horizontal position, the anterior portions moving upwards and forwards. Each rib rotates about an oblique horizontal axis parallel to its neck. The sternum is thrust forwards and upwards, executing a movement of the manubrio-sternal joint. The ribs rise, therefore, like a bucket handle, increasing the antero-posterior diameter of the chest. The 7th to 10th ribs have also a bucket handle movement. In elevation the ribs are rotated. As the thorax is raised, there is always some twisting of the costal cartilages (Evans, 1949). Extension of the spinal column also takes place on deep inspiration.

All the above movements, it will be seen, are affected by the pathological process in ankylosing spondylitis, the patient becoming virtually dependent on his diaphragmatic function.

Each thoracic vertebra has eight articular surfaces; costo-transverse and costo-vertebral right and left, intervertebral articular facets superior and inferior right and left. A study of the articulated vertebral column will show what a great area may be involved in the pathological process in ankylosing spondylitis. The first eight rib-heads articulate with facets on the bodies of two adjacent vertebrae, that with which the rib is in numerical correspondence and the one above it. The fifth rib, for instance, articulates with the fifth and fourth thoracic vertebrae. The last four ribs articulate only with the bodies of vertebrae of corresponding numbers. Considering the involvement of these joints throughout the thorax with gradual bony fusion, soft tissue shrinkage, and extensive soft tissue calcification, it is not surprising that thoracic movement is grossly restricted in advanced cases.
It appears that intercostal movement is first restricted by pain. The patient cannot take a breath big enough to cope with a sudden exertion, because of actual discomfort. Sudden inspiratory efforts such as coughing and sneezing are particularly painful, throwing sudden strain on the various structures involved. Often there are no radiological signs, even with quite marked symptoms and physical signs of thoracic involvement. Later the earlier changes progress to bony fusion which, in advanced cases, extends throughout the thorax, fusing all the ribs with bodies and transverse processes of all the thoracic vertebrae. In such cases with ribs and vertebrae doubly locked together and the manubrium sterni fixed to the sternal body, all elasticity is gone from the thoracic cage. Such a complete picture, however, does not always occur, for even after thirty years involvement may be patchy and partial, and does not necessarily parallel changes elsewhere in the body. In one case hips may be markedly involved with apparently no thoracic changes; in another, changes appear to be confined largely to the sacro-iliac and thoracic regions; but as years go by there is an increasing tendency to bony fusion in all areas, including the thorax.

The presence of longitudinal ligamentous and peripheral intervertebral cartilaginous calcification (bamboo spine) does not necessarily render the thorax vastly worse. In our series one young man with disease of four years' standing and radiologically a complete bamboo spine is still playing tennis. Such "bambooing" does not parallel the length of history nor the therapy given.

It will be seen that in advanced cases the development of marked dorsal kyphosis, of lung and pleural pathological processes or the performing of abdominal operations may depress the already reduced vital capacity to a perilously low level. Wright (1945) points out that the vital capacity may be reduced 20 to 30 per cent. by physical weakness uncomplicated by physical disease. It is our opinion that this factor does not play a great part in patients with ankylosing spondylitis. Although sedimentation rate may be raised for many years the systemic upset is slight in most cases compared with that seen in rheumatoid arthritis, although there are exceptions. Most of the patients in our clinic are not C.3 subjects, and physical weakness is not a particular feature of the majority.

The importance of reduction of thoracic expansion is noted in cases of ankylosing spondylitis where operations, particularly laparotomies, have to be performed. We know of one case where anaesthesia had to be abandoned in a patient who until the administration of the anaesthetic for laparotomy had been undiagnosed as a case of ankylosing spondylitis. With appreciation of the factors involved, full anaesthesia may safely be given as in a Smith-Petersen osteotomy performed for this condition. But even so respiratory complications occur (Law, 1949).

Churchill and McNeil (1927) and Powers (1928) showed that an upper abdominal operation lowered the vital capacity on the first post-operative day to 25 to 30 per cent. of the original volume, and lower abdominal operations to 50 per cent. Operations on limbs had little effect. McCleery, Zollinger, and Lenahan (1948) noted that after upper abdominal operations an intercostal block six to eleven with Nupercaine in peanut oil only increased the vital capacity 16 to 17 per
cent. Pooler (1949) found that after upper abdominal operations the vital capacity was decreased to 35 per cent. of the pre-operative volume on the day after the operation. Intravenous procaine only increased this figure by 12 to 13 per cent. Lassen (1938) considered that the post-operative lowering of vital capacity was not entirely due to fear of pain, but probably also to a muscular reflex spasm.

As these patients are virtually dependent in many cases on their diaphragmatic movements, this factor should be fully appreciated by anaesthetist and surgeon before laparotomy is contemplated.

**Summary**

The main physical signs and symptoms referable to thoracic factors in ankylosing spondylitis are discussed and their importance stressed, not only in diagnosis but also in prognosis and treatment.

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**References**


**Thorax en la Spondilitis Ankylosante**

**Résumé**

On discute les symptômes et les signes principaux concernant les facteurs thoraciques dans la spondylite ankylosante et on souligne l'importance de ceux-ci en ce qui concerne non seulement le diagnostic, mais aussi le pronostic et le traitement.

**Torax en la Espondilitis Anquilosante**

**Resumen**

Se discute los síntomas y los indicios principales respecto a los factores torácicos en la espondilitis anquilosante y se subraya la importancia de estos en lo que se refiere no sólo al diagnóstico, sino también al pronóstico y al tratamiento.