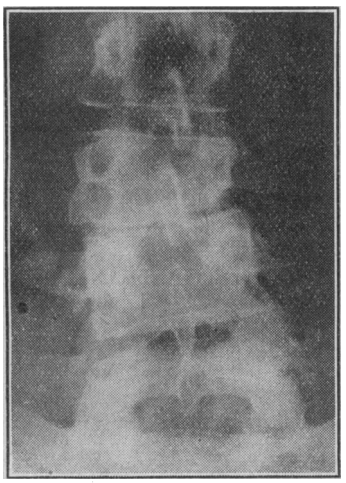
The appearance of the contiguous surfaces of the bodies of L3 and L4 and that of the intervening disk space is consistent with an old localized infective process at this level. The appearance is not that of tuberculous infection. The retention of some degree of disk space, the absence of paravertebral shadow, and the limited involvement of the upper surface of the body of L4 are not consistent with tuberculous destruction. I would say that the appearances are consistent with a pyogenic infection secondary to lumbar puncture."



Radiograph showing antero-posterior view of lumbar spine.

The patient was put into a plaster jacket and discharged in good condition on March 1. When seen in May, 1948, she was in excellent health and had been comfortable and free from backache in her jacket. The operation wound had remained healed and there was no evidence of any recurrence of the abscess. Her E.S.R. at this time was 3 mm. per hour (Westergren). She was fitted with a lumbar support to be worn in the daytime only.

Discussion

The manner in which the infection in this case presented is interesting. No doubt intensive sulphonamide and penicillin therapy altered the course of the infection, but this cannot explain how an L3–L4 intervertebral abscess tracking laterally round the right side of the abdominal wall should present itself in the left mid-lateral line 5 cm. above the inguinal ligament. At first thought it is tempting to postulate that the pus followed the course of the anterior primary ramus of a lumbar nerve or of a lumbar branch of the abdominal aorta, but simple anatomical considerations show this to be unlikely.

In the majority of reported cases, as in this one, there was no history of sciatic or other root pain, or any related deep segmental pain, in spite of the obvious intervertebral joint disorder. A more detailed study of these patients may throw some added light on the mechanism of pain in intervertebral disk injuries.

The fact that the majority of reported cases have been in children could be accounted for because of the greater frequency of meningitis in children. It is, however, likely that, overall, at least as many lumbar punctures are performed on adults as on children, and the relative frequency of complications among children is therefore probably significant. The danger of intervertebral disk damage is clearly related to the fact that in children the depth of the disk from the skin is much less than in adults, which therefore allows for a smaller margin of error. The annulus fibrosus in young children is no more than 2–3 mm. in depth, and is considerably stretched and thinned in acute flexion of the spine, the standard position for lumbar puncture. Further, the nucleus pulposus is known to be under considerable tension, bulging backwards in acute flexion, and this makes for its easy escape along the needle puncture or its infection by the same means.

Consideration of all these factors might help to minimize the danger of intervertebral disk damage following lumbar puncture, particularly in children.

We are indebted to Mr. A. E. Porritt, under whose care this patient was admitted, for permission to publish this report, and to Mr. V. H. Ellis for helpful advice.

BIBLIOGRAPHY

Billington, R. W. (1924). *J. Amer. med. Ass.*, **83**, 683.
Epps, P. G. (1942). *Proc. R. Soc. Med.*, **35**, 220.
Everett, A. D. (1942). Ibid., **35**, 208.
Findlay, L., and Kemp, F. H. (1943). *Arch. Dis. Childh.*, **18**, 102.
Gellman, M. J. (1940). *J. Bone Jt. Surg.*, **22**, 980.
James, U. (1946). *Proc. R. Soc. Med*, **39**, 134.
Kendall, D. (1947). *Quart. J. Med.*, n.s. **16**, 157.
Levinson, A. (1929). *Cerebro-Spinal Fluid*. St. Louis.
Milward, F. J., and Grout, J. L. A. (1936). *Lancet*, **2**, 183.
Munro, D., and Harding, W. G. (1942). *J. Amer. med. Ass.*, **119**, 482.
Pease, C. N. (1935). *Amer. J. Dis. Child.*, **49**, 849.
Rangell, L., and Glassman, F. (1945). *J. nerv. ment. Dis.*, **102**, 8.
Sheldon, W. (1943). *Proc. R. Soc. Med.*, **36**, 379.
Stewart, V. A. F., and Owen, A. (1943). *Med. J. Aust.*, **2**. 295.
Stump, J. P., and Narins, S. A. (1943). *Nav. med. Bull., Wash.*, **41**, 400.

COUGH FRACTURE OF RIBS

BY

RAYMOND C. COHEN, M.D., D.P.H.

Deputy Medical Superintendent and Physician to Pulmonary Tuberculosis Unit, Black Notley Hospital; Tuberculosis Officer, N.E. Metropolitan Regional Hospital Board

The purpose of this paper is to call attention to an infrequent but possibly often unrecognized cause of pain in the chest of sudden onset and resembling dry pleurisy in its symptoms. I have observed a number of cases of "spontaneous" fracture of ribs occurring in tuberculous subjects, in some of which there was a clear history of pain following violent expiratory effort as in coughing or sneezing. These cases happen to have been discovered in women aged between 18 and 35, but other authors have recorded it occasionally also in men.

This condition, which I will describe as cough fracture of ribs, is not widely recognized, and the literature on the subject is scanty.

Halliwell (1929) reported fracture of the sixth, seventh, and eighth ribs after a bout of coughing in a doctor aged 40, of good physique and convalescent from pleurisy and "pseudo-asthma." About a month later, on getting out of a bus, he had another attack of coughing, and *x*-ray examination revealed a fracture of the ninth rib on the same side as before and in line with the other three. Recovery was uneventful. Howson (1934) was able to trace, in all, 58 reported cases, and added a further case of his own. This occurred in a woman of 26 with bilateral pulmonary tuberculosis who had had a thoracoplasty on the left side, and several months later was found to have a recent fracture of the ninth right rib, older fractures of the tenth and eleventh right ribs, and a fracture of the left tenth rib "with considerable callus formation." Sakka (1938) also described three cases of spontaneous rib fracture occurring in North African natives which he thought were due to tuberculous osteitis. The subjects were all men between 24 and 27, two of whom were suffering from pulmonary tuberculosis. Cramer (1943) described four cases —three in women aged 26, 65, and 72, and one in a man of 72. He thought the fractures were due to muscular action on areas of rarefaction in the ribs, and suggested that the upper five ribs are unlikely to fracture from cough because they are shorter and are supported posteriorly by the scapular musculature.

Case Reports

Case 1.—A woman aged 23 was admitted to Black Notley Hospital on April 8, 1937, for tuberculosis of the left lower lobe. *X*-ray examination on admission revealed, in addition to the tuberculous disease, a recent fracture of the seventh left rib about 1½ in. (3.75 cm.) from its junction with the costal

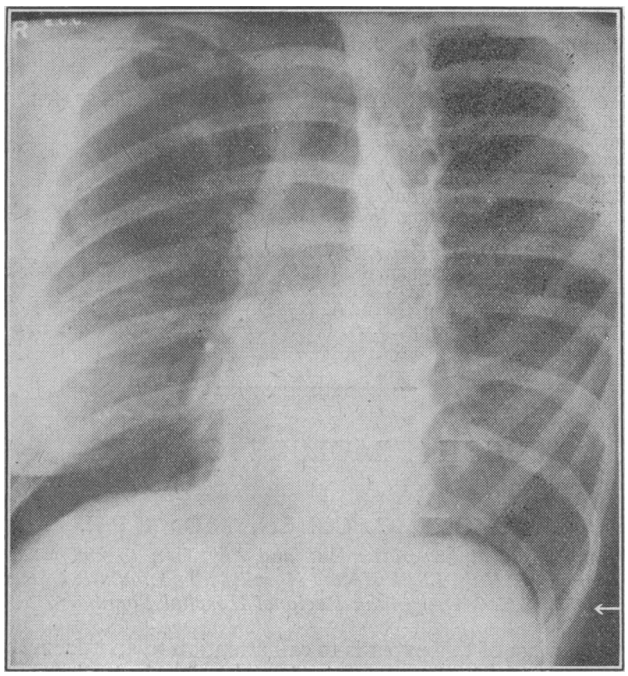


FIG. 1.—Case 2. Dec. 30, 1937. Oblique film. Fibrocaseous tuberculosis of right upper lobe; recent fracture tenth left rib.

cartilage. The patient gave no history of trauma or sudden pain, but confessed to having had some pain in that area shortly before admission. She had had cough and sputum for about three months.

Case 2.—A woman aged 28 was admitted on Oct. 14, 1937, for sluggishly active tuberculous disease of her right sub-apex with a small cavity. On Dec. 30 she complained of soreness in her left side, which she first felt during a bout of coughing. Physical examination revealed a small bump palpable on the angle of the tenth rib, and *x*-ray examination revealed a fractured rib in that position (Fig. 1). Subsequent films showed callus formation which had almost completely absorbed by June, 1938.

Case 3.—A woman aged 22 was admitted on Feb. 18, 1938, for fibrocaseous tuberculosis of her right upper lobe with cavitation. A radiograph on admission showed recent fractures of the anterior ends of her seventh and eighth left ribs, 1½ in. from the costo-chondral junctions. She had not complained of pain at that site, and there was no history of trauma.

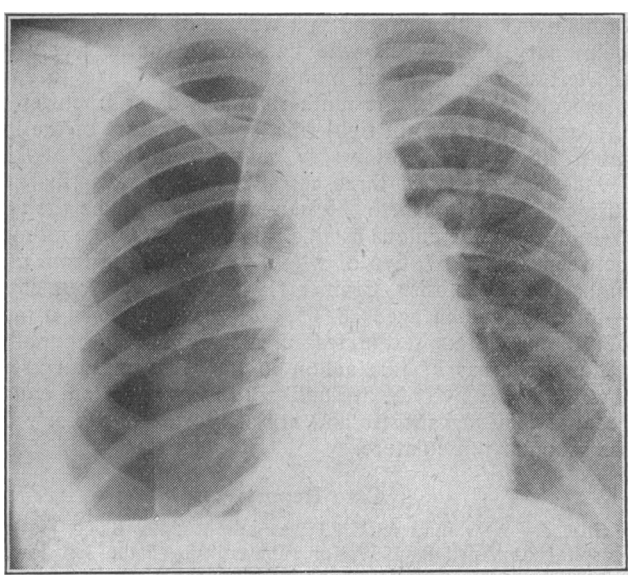


FIG. 2.—Case 4. Sept. 26, 1941. Right artificial pneumothorax, with small effusion; fracture with callus formation.

Case 4.—A woman aged 18 was admitted on April 26, 1938, with acute exudative tuberculosis of the right lung with cavitation. Right artificial pneumothorax was induced on May 2 and adhesions were cut on Nov. 9. She was discharged quiescent on May 7, 1939, and thence attended as an out-patient for refills. A routine *x*-ray examination on Sept. 26, 1941, showed a fracture of the seventh right rib about 2 in. (5 cm.) from the corresponding transverse process, with some callus formation (Fig. 2). The patient gave no history of pain or trauma.

Case 5.—This patient, aged 19, was admitted on Dec. 1, 1939, for exudative tuberculosis with cavitation of her right middle and lower lobes. A radiograph on Dec. 5 showed a fracture with early callus formation of the anterior end of her ninth right rib, about 1 in. (2.5 cm.) from the costo-chondral junction. There were no symptoms at the time of discovery, but on inquiry the patient recalled an acute pain which she had felt low down in her right chest, after a sneeze, a few days before admission.

Case 6.—A woman aged 33 was admitted on March 8, 1948, for fibrocaseous tuberculosis of the left lung with upper-lobe cavitation. A radiograph showed old nearly healed fractures of the fifth, sixth, and seventh ribs on the right side, about 4, 3½, and 3 in. (10, 8.75, and 7.5 cm.) respectively from the

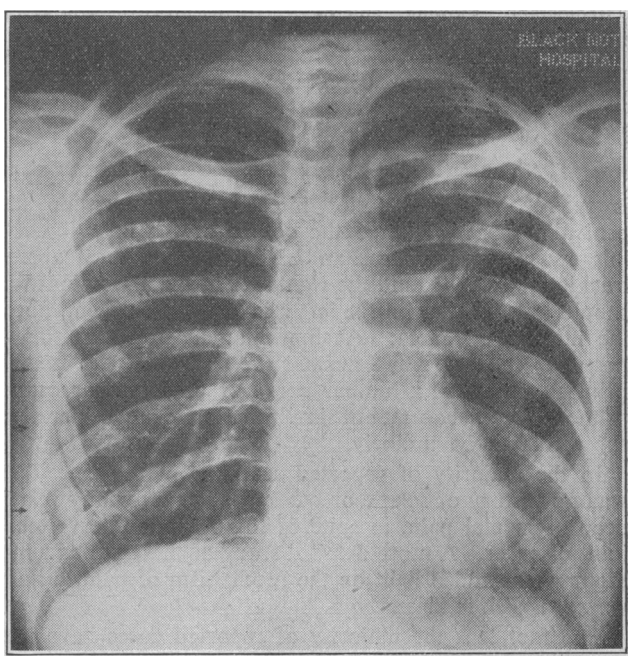


FIG. 3.—Case 6. April 6, 1948. Bilateral tuberculosis of acute exudative type, with cavitation left apex and right sub-apex; fractures with callus formation of fifth, sixth, and seventh right ribs.

costo-chondral junction, so that the fractures appeared vertically above each other (Fig. 3). In November, 1947, she had felt a sudden pain in the right side of her chest, much worse on coughing and catching her breath. She found relief by pressing her hand to her side. The pain lasted about two weeks, gradually diminishing.

Case 7.—A woman aged 35 was transferred to Black Notley Hospital from another sanatorium on March 31, 1948, for fibrotic tuberculosis of her left lung. A radiograph on April 2 showed a fracture of the anterior end of her sixth left rib, 1 in. from the costo-chondral junction. Reference to her previous radiographs showed that the fracture first appeared on an *x*-ray film dated Feb. 13, 1948—it was not seen on the preceding film of Dec. 3, 1947. About Dec. 20 she had felt a sudden pain in the lower part of her left chest which "caught her breath" and was diagnosed as pleurisy. Her chest was strapped for seven days and the pain eased off after a day or two. There was no history of trauma, and she did not think the pain followed coughing, but could not remember for certain.

Discussion

These cases, together with those already reported by other writers, show clearly that it is possible for ribs to fracture as a result of otherwise normal respiratory exercise. The occurrence must be a rare one, but is likely to be observed occasionally by those who see a sufficient number of chest radiographs, and it probably occurs more often than might be supposed. Cases are easily missed if chest radiographs are not carefully examined and the condition borne in mind.

The mechanism of such fractures is difficult to determine. Primary tuberculous osteitis of ribs is generally believed to be so uncommon that it is unlikely to be the basic cause. There was no evidence of it in my own cases, though it is conceivable that areas of bone rarefaction may occur in a rib adjacent to a cold abscess arising from a caseous tuberculous gland; and, so far as I have been able to ascertain, most reported cases, excluding those due to gross localized changes such as secondary malignant deposits or osteitis fibrosa, have occurred in tuberculous subjects, but the condition is not confined to them. Cough fractures of ribs have also been known to occur in elderly subjects, probably associated with increased fragility of bones associated with advancing age, and it would not be surprising if it occurred also, for example, in cases of rheumatoid arthritis, in which rarefaction of bones is sometimes found.

The apparently high incidence in tuberculous subjects suggests a possible constitutional effect on bone structure, but it must also be remembered that such subjects are repeatedly having their chests *x*-rayed and the lesion is therefore more likely to be discovered.

I have been unable to find any evidence to suggest that the ribs of a tuberculous patient are particularly liable to decalcification, except in so far that prolonged bed-rest may lead to some degree of this from diminished use. Certainly the blood calcium level remains remarkably constant in tuberculous subjects. Healing of the fractures has followed normally, and there does not appear to be any delay in callus formation and eventual union.

The most reasonable explanation of these fractures seems to be the violent and abnormal action, probably associated with asymmetrical posture producing uneven action on the ribs, occurring during the violent expiratory effort of a cough or sneeze. Diminished use of the thoracic musculature that occurs in a patient confined to bed for long periods may also lead to a mild degree of decalcification and be a contributory factor.

REFERENCES

Cramer, A. (1943). *Rev. méd. Suisse rom.*, **63**, 333.
Halliwell, B. T. (1929). *British Medical Journal*, **2**, 1056.
Howson, C. R. (1934). *Amer. Rev. Tuberc.*, **30**, 566.
Sakka, A. (1938). *Rev. Tuberc.*, **4**, 949.

The Mental Survey Committee of the Scottish Council for Research in Education has recently completed an investigation into the intelligence of Scottish children. The results were briefly described in *The Times* of Nov. 17, 1948, by Professor Godfrey Thomson, the chairman of the committee. The full results are to be published in a series of volumes, the first of which will appear in the spring. The main task of the investigators was to repeat a group intelligence test given in 1932 to 87,498 Scottish children whose eleventh birthday fell in that year. The same test was given to 70,805 children whose eleventh birthday fell in 1947, but on this occasion much additional sociological information was collected about each child. The possible score was 76 points, and in 1947 the mean score, 36.7, was higher than the mean score, 34.5, in 1932. The boys went up 1.3 and the girls no less than 3.2 points. At least as a first deduction this appears to show that no decline in intelligence is going on, but Professor Thomson thinks the rise may be due to the fact that children are now much more familiar with intelligence tests. The now common observation that intelligent children are more frequently found in small families than in large ones is confirmed. The average score obtained by the only children, 7,824 out of 70,805, was 42 points, and children of families of two averaged nearly as much. But for families of four the average score was 35.3 and for those of eight 28.8.

COUGH FRACTURE IN LATE PREGNANCY

BY

J. W. PAULLEY, M.D., M.R.C.P.
First Assistant, Professorial Medical Unit, Middlesex Hospital

D. H. LEES, F.R.C.S.Ed., M.R.C.O.G.
Lately Chief Assistant, Department of Obstetrics and Gynaecology, Central Middlesex Hospital

AND

A. C. PEARSON, M.B., B.S.
Obstetric and Gynaecological Registrar, Middlesex Hospital

Rib fractures due to cough alone, or with an added factor of shearing stress from simultaneous action of other muscles, have been recognized for many years (Gurlt, 1862; Tunis, 1890; Hawley, 1890; Skyrme, 1890; Bähr, 1894). In addition, sneezing, choking, vomiting, and straining at stool are recorded as causes among other varieties of expiratory effort. Numerous forms of exertion, such as a handspring or mounting a restive horse (Hilton, 1852; Seilin, 1917), have also been blamed, although here again associated grunting expiration through partly closed cords may have been responsible.

In recent years the number of cough fractures reported from sanatoria has tended to overshadow the non-tuberculous cases, which may be more numerous but have less chance of being diagnosed. Oechsli in 1936 found 77 cases of cough fracture in the literature to that time. He indicated that when a routine search was made in chest films the incidence of the condition was high. In his series of approximately 3,000 admissions to Olive View Sanatorium 22 cases with cough fracture were found. At the same time Richardson (1936) at Ray Brook Sanatorium reported 20 cases out of 1,903 tuberculous admissions. Osteoporosis in the late stage of phthisis has often been suspected as predisposing to cough fracture, but evidence that it is the chief cause is as yet unconvincing.

Tunis (1890), analysing 40 such stress injuries from muscular action, noted that more than 25% occurred in patients in whom bone fragility could be excluded as a factor, and Seilin (1917) supported this view. Reports since published do not suggest a different conclusion.

Kleiner (1924), quoting Tunis and bringing the literature up to date, found that of 57 cases (which included 14 by muscular action other than coughing) 28 were left-sided, 17 were right-sided, and the side was unrecorded in the remaining 12. There were more fractures of lower ribs than upper, the site of fracture on 19 occasions being the upper seven ribs and on 36 occasions the eighth, ninth, tenth, and eleventh ribs. (The apparent discrepancy is due to more than one rib being involved in some instances.) Kleiner's analysis was made before the papers on the large series of tuberculous cases had been published. In seven of eight patients with fracture of the eleventh rib reported by Tunis and Seilin this was the only rib affected. Multiple fractures appear to be more frequent when the higher ribs are involved.

The older writers (Tunis, 1890; Bähr, 1894) suggest that the preponderance of left-sided damage pointed to a cushioning action of the liver on the right side. Oechsli found no left-sided prevalence and was therefore sceptical of this theory, but the majority of his fractures were mid-thoracic and above liver level. Richardson in a similar series of tuberculous patients noted that the sixth and seventh ribs in the mid-axilla were the commonest sites.

In the literature there are six reports of this accident in pregnancy. Only one occurred during labour, and that in