

difference between the groups in the degree of streptomycin resistance shown by the bacilli.

It is concluded that 1 g. of streptomycin a day in a single injection, without intermission of treatment, is the most satisfactory way of giving the drug in pulmonary tuberculosis.

The relation of the emergence of streptomycin-resistant tubercle bacilli to the positivity of the sputum, and to various other factors, has been examined.

We are grateful to Dr. J. O. Irwin for assistance in the design of this trial; to Dr. L. G. Blair, who kindly made the radiographic assessments; and to the nursing staff of Brompton and Colindale Hospitals, who cheerfully undertook the added burden of work.

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## BORNHOLM DISEASE

BY

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Bornholm disease, "epidemic myalgia," or "epidemic pleurodynia," has been recognized as a commonly occurring disease in the Scandinavian countries for about the last twenty years. It probably occurs equally often in this country, but, apart from the pioneering work of Pickles (1933, 1939), has been curiously neglected, though at an earlier stage outbreaks of what was described as epidemic pleurisy were recorded as having attacked nurses and patients in two children's hospitals in London (Williamson, 1924; Lloyd, 1924). It is not included in the teaching of many hospital medical schools, and it figures briefly, if at all, in textbooks.

It is recognized when it occurs in epidemics, but the single sporadic case, and the first one or two in an epidemic, are usually not diagnosed. The milder cases are often referred to as fibrositis, strained muscle, indigestion, or pleurodynia; the severer ones as pleurisy, atypical pneumonia, coronary thrombosis, mesenteric adenitis, appendicitis, or poliomyelitis—according to the presenting symptoms and the predilection of the physician. The lack of familiarity with the disease is such that, as Hamburger and McNeil (1947) have suggested, it was still possible in 1944 for an epidemic to be reported as a "new syndrome."

Clinical descriptions of the disease show considerable variations between case and case, and also between epidemic and epidemic. If one sums up what is common to the various descriptions one gets the following picture. Bornholm disease is a benign illness occurring both in epidemics and sporadically. It is usually febrile, and is characterized by pain—usually of a muscular type (frequently described "as though a muscle were strained") and of very variable intensity—felt typically on deep respiration, coughing, laughing, or movement, somewhere around the thorax or abdomen. In children the pain is usually entirely abdominal. As a rule there is at least some abdominal tenderness, and this is particularly likely to be situated just below the costal margin and the xiphisternum. There are no true signs of affection of the viscera, though such may be simulated. A coarse pleural rub may occur. The disease shows extreme variability in severity and presentation, so that while a mild case may have only some

malaise and pain on deep respiration, others may present with a crippling pain of sudden onset; there may be a high fever, and possibly abdominal rigidity; rapid grunting respirations are described; headache may be prominent, and vomiting at the onset sometimes occurs.

The cause is almost certainly a virus infection. Observations which suggest that Bornholm disease may be related to infection with the Coxsackie group of viruses are described in the communication by Findlay and Howard in this issue of the *Journal*.

The morbid anatomy has not been finally elucidated. It was thought originally by Sylvest (1932, 1934) to be an inflammatory condition of the muscular system. However, Locke and Farnsworth (1936) point out that "a very important quality of the pain is its direct relationship to sneezing, coughing, laughing, deep breathing, and especially exercise—that is, anything that causes movement of the diaphragm." They go on to point out that the areas in which the muscular pains are felt are those in which Capps (1932) has shown that pain is felt when referred from the diaphragm; and they suggest that the inflammation is at least primarily in the diaphragm. Further observation is required concerning whether only the diaphragm is attacked (the other muscles suffering from reflex irritation and spasm) or whether the other muscles themselves are involved in the inflammatory process.

Scadding (1946), on the other hand, on the basis of one in three of his cases having had a pleural rub, regarded the lesion as primarily a pleurisy, suggesting that possibly his cases were of a disease differing from but related to Bornholm disease; he named it "acute benign dry pleurisy," thus returning to the nomenclature of Williamson (1924) and Lloyd (1924). There does not seem sufficient justification for this in view of the fact that pleurisy is known to occur as a complication of Bornholm disease, and that Locke and Farnsworth found a pleural rub in one in seven of their cases. (It does seem that in certain epidemics a pleural rub occurs more often than in others.)

The common occurrence of tenderness just below the costal margin and xiphisternum (where the diaphragm is partly inserted into the aponeurosis of the abdominal muscles) and of pain in the shoulder-tip suggests that Locke and Farnsworth's view is probably correct, and that pleurisy, when it occurs, is a complication, due to extension of the inflammatory process to the adjacent pleura.

It should be noted that abdominal tenderness may occur in one of two distinct areas: (1) just below the costal margin, due to tenderness of the underlying diaphragmatic insertion; and (2) as referred pain, anywhere in the area supplied by the roots of D6–D12.

The epidemiology is somewhat similar to poliomyelitis, with maximum incidence in the late summer and autumn.

#### Illustrative Cases

The first seven cases described below occurred in one house consisting of two flats, every one of the occupants contracting the illness. They illustrate the diversity of presentation of illness, the children in general complaining of abdominal pain, the adults of pain on breathing. The dates of occurrence suggest an incubation period of not more than from four to eight days in these cases. Thus the first patient became ill on October 12, 1949, and the next two on October 16. Two further cases occurred on October 22, another on the 23rd, and the last on October 24. The interval between the first infection and the next two cases was therefore not more than four days. The next interval was six days. This is shorter than is usually reported.

*Case 1.*—M. H., who presumably introduced the infection, was a schoolboy, aged 8, who on October 12, 1949, said it hurt when he breathed. He was sent to school. Next day he had a temperature of 99.8° F. (37.7° C.); the pain was localized to the right abdomen and was still more painful on respiration. He did not appear ill. His appetite and bowel action were normal. There was tenderness in the right inguinal fossa, and the diagnosis was thought to be either retrocaecal appendicitis or mesenteric adenitis, the latter being more likely because of a palpable mesenteric gland. On the third day the abdominal symptoms had disappeared, but now he had headache, vomiting, and slight meningism. He then developed a mild lymphocytic meningitis, which subsided within a week, leaving no sequelae. (Lymphocytic meningitis has been described as an occasional complication of Bornholm disease. Lindberg, 1936; Gsell, 1949; Howard *et al.*, 1943.)

*Case 2.*—On October 16 B. H., aged 6, brother of M. H., felt unwell in the morning, was found to have a temperature of 100.6° F. (38.1° C.), and was put to bed. In the afternoon he began to complain of pain in the left upper quadrant of the abdomen, the pain being worse on breathing. Examination revealed nothing abnormal in the lungs. The abdomen generally was slightly tender and hyperaesthetic, especially in the left upper quadrant. The abdominal reflexes were diminished on the left. By the evening he was flushed and irritable, and looked toxic; the conjunctivae were congested. On the second day he woke up free from pain, much improved, and with a temperature of 99° F. (37.2° C.). There was nothing abnormal on examination. Next day he was apparently well, with a normal temperature. On the fourth and fifth days he had a symptomless temperature of 99° F., and on the sixth day was well.

*Case 3.*—On October 16, the same day as Case 2 became ill, N. S., aged 4, his playmate, woke up at 4 a.m. complaining of left upper abdominal pain. When I saw him later in the day the pain had gone and there was no abdominal tenderness, but his temperature was 101° F. (38.3° C.). As he was at that time convalescent from an attack of bronchitis and asthma, and as there were one or two rhonchi in his chest, I thought this was a recurrence of the bronchitis, and started him on a course of sulphamerazine. On the second day there was no cough, nor any symptoms or abnormal signs except a temperature of 99° F. (37.2° C.). Next day his temperature was normal, and the sulphamerazine was stopped. On the fourth day his temperature was 100° F. (37.8° C.), but he was still symptomless. On the next two days his temperature was 99°, and on the seventh day he was well.

*Case 4.*—On October 22 the father of M. H. and B. H. complained of vague aching subcostal pain, mainly on deep breathing and laughing; it was felt also in the left shoulder-tip. There was slight malaise and normal temperature. The only abnormal sign was tenderness in the epigastrium, mainly below the xiphisternum. Next day there was no pain, but his temperature was 99.2° F. (37.3° C.) in the evening. On the third day his temperature was normal, but he had slight malaise, which remained for a day or two.

*Case 5.*—On October 22 the mother of N. S. developed almost the same symptoms as those of Case 4—that is, a subcostal ache, felt also in the left shoulder-tip and aggravated by deep breathing. Her temperature was normal. There was tenderness in the epigastrium. Next day she had a symptomless temperature of 99° F. By the third day the original pain had disappeared, but there was an increase in malaise, with severe muscular pains across the back in the scapular regions, though no local tenderness could be elicited. The temperature was normal. During the following two days the back pains gradually became less, and on the sixth day she was well.

*Case 6.*—On October 23 the wife of Case 4 developed a very similar condition to her husband's, lasting for three days, and with a maximum temperature of 99.3° F. (37.35° C.).

*Case 7.*—On October 24 the husband of Case 5 developed the illness, the course resembling that of his wife—first with subcostal pain and tenderness on breathing, and on the second and third days with myalgic pains in the back. The maximum temperature was 99.4° F. (37.4° C.).

With Case 7 everybody in the two flats had had the illness. It was only half-way through the outbreak that I realized what the diagnosis was. On making inquiries at the school attended by M. H. I found that two boys were absent about the same time as he was—one with "atypical pneumonia," the other with "glandular fever." Through the kindness of their doctors I obtained the following histories.

*Case 8.*—On October 7 P. B., aged 9, developed a pyrexial illness with pain on breathing and upper abdominal tenderness. His father, who was a doctor, called in a consultant, who, on minimal signs (diminished breath sounds at one base), diagnosed atypical pneumonia. A radiograph was negative. Recovery occurred in a few days with sulphonamides and penicillin.

*Case 9.*—On October 17 C. R., aged 9, developed pain on breathing in the lower part of his chest, at first on the left and later on the right, with rapid respiration. His doctor "thought he had a pleural rub." A chest radiograph was negative. He later developed pain across the shoulders and eventually a generalized glandular enlargement, upon which a consultant was called in; he diagnosed glandular fever. A blood count on October 25 showed 9.5% monocytes, a Paul-Bunnell test being negative. The condition subsided in 14 days, the pyrexial condition lasting for about 10. It seems probable that this was a further case of Bornholm disease, complicated by lymph-node enlargement of uncertain aetiology.

### Subsequent Cases

Since the above cases, in one month I have come across the following cases in my practice.

*Case 10.*—A housewife from another part of London had awakened at 3 a.m. one day with "indigestion." The next morning she could hardly walk; she said it felt as though she had strained a muscle in her epigastrium, which was tender. On October 26, three days later, when I saw her, she felt pain "all over the back" on moving and breathing. Her temperature and pulse were normal, and there was no pleural rub. On the 27th she felt pain across the front of her chest, in her breasts, and across her back: "every breath hurt." There were still no abnormal physical signs. Next day she was well.

*Case 11.*—On October 27 a boy aged 10, in the same neighbourhood as the other cases, said that 36 hours previously he had begun to feel a pain, worse on breathing, along the right costal margin and in the R.I.F. He had felt ill at the onset, but had continued to attend school. When I saw him he had almost recovered and had no abnormal signs.

*Case 12.*—A barman, working in London, on November 14 complained of malaise, feverishness, headache, backache, and stiffness in his legs. He was seen on the 15th, when he had pain on both sides of his thorax, aggravated by deep breathing. His temperature was 98° F. (36.7° C.). There was no pleural rub; slight tenderness was present below both costal margins, and especially the xiphisternum. On the third day his temperature was normal and the pain less. He was well on the fifth day.

*Case 13.*—A boy aged 14 complained on November 25 of pain in his left lower thorax, worse on running and deep breathing. Next day the pain was worse, he felt ill, and was off his food. There was no change on the third day. When I first saw him, on November 28, the pain was less, his temperature was 96° F. (35.6° C.), and he had no pleural rub; there was vague tenderness about the eleventh rib posteriorly, and in the left hypochondrium. He was well on November 30.

### Previous Cases

Since becoming familiar with the syndrome I have looked back over the last two years, and, from memory and notes, now realize that I have seen, but missed, many cases of Bornholm disease. The following representative cases show the confusion that may occur if the disease is not kept in mind.

**Case 14.**—About two years ago I myself developed pain on respiration and movement somewhere in the mid-trunk, which I felt to be diaphragmatic, because it was clearly referred to the shoulder-tip. I felt ill, and thought it was pleurisy, probably tuberculous; I intended to see somebody about it, but in two days it was gone, and I had forgotten about it until the second attack.

**Case 15.**—In September, 1949, a girl of 5 was brought to see me, complaining of right-sided abdominal pain. The pain was worse on breathing; her temperature was 99.6° F. (37.55° C.), and there was an area of tenderness to the right of the umbilicus. I sent her into hospital for observation, and she was discharged a few days later, diagnosed by a process of exclusion, rather than by any positive evidence, as “? mesenteric adenitis.”

**Case 16.**—In June, 1949, I was asked by another practitioner to see an adult whose history was that two days previously he had awakened with epigastric discomfort. He thought “he had strained a muscle.” He later played nine holes of golf and then gave up because of the pain and retired to bed. The pain was worse on stooping, belching, and deep breathing. He had been pyrexial for two days when I saw him. His temperature was then 99° F. (37.2° C.). There were no abnormal physical signs in his chest, but there was a typical area of tenderness just below the xiphisternum. We sent him to hospital, where his case was diagnosed as “? strained muscle, ? upper respiratory infection,” though there was no cough. However, a radiograph showed an area of decreased translucency at the right base consistent with either consolidation or collapse, and he was discharged three days later with a diagnosis of lobar pneumonia. A repeat radiograph a week or two later showed a clear lung field.

While Case 16 might, on the x-ray findings, be regarded as a virus pneumonia, the onset and symptoms are typical of Bornholm disease, as is also the epigastric tenderness: these, coupled with the absence of any cough, suggest that this was probably a case of Bornholm disease with lobar collapse (a complication which has been described).

**Case 17.**—In May, 1949, a man sent for me in the middle of the night, complaining of severe right-sided abdominal pain, worse on deep breathing and laughing, which had begun two days previously. I could detect nothing abnormal on examination, and endeavoured to reassure him. The pain persisted during the day, and I called in a consultant. The temperature was normal, there was no tenderness in the R.I.F., but it was thought he was slightly tender per rectum. He was sent to hospital as a possible case of acute appendicitis; laparotomy, however, revealed a normal appendix and no cause for his pain. He made an uneventful recovery.

**Case 18.**—In July, 1948, I saw a youth with pyrexia and pain and tenderness in his left loin and subcostal region. It was worse on respiration. There were no abnormal signs in his chest, and the urine was normal. One wondered at first whether it might be a case of perinephric abscess, but he was never seriously ill and made a quick recovery. He later saw a consultant, who on the history diagnosed pleurisy, and he was obliged to lead a restricted life for some months, on the basis of some x-ray changes in the lung fields.

**Case 19.**—In August, 1948, a man complained of severe pain in the lower chest. He said that every time he took a deep breath it tightened up round him like a belt. There were no abnormal signs in the chest. He was pyrexial for about a week, and was sent to hospital, whence he was discharged two weeks later with the bizarre diagnosis of “prolapse of a thoracic intervertebral disk.”

### Comment

These cases are described to illustrate the extent of the variability of the disease. Mostly they are relatively mild cases, in contrast to the severer type of case usually described in the literature, where one meets with such phrases as “an anxious expression and stiff abdomen” (Ord, 1948) or “a violent pain arising suddenly in the lower thorax” (*Lancet*, 1946). The importance of the

disease lies not so much in itself as in its potential mimicry, to those unfamiliar with it, of other severer illnesses. Case 17 was subjected to laparotomy, Case 18 to prolonged observation as a suspected case of tuberculosis, and Case 8 was subjected unnecessarily to sulphonamides and penicillin. Similar mistakes of diagnosis abound in the literature. The differential diagnosis is not so difficult as has been suggested. It is only necessary that the disease be borne in mind. Those cases which present with right-sided abdominal pain, and which are often confused with appendicitis, differ from it in that (1) they do not have the typical onset of appendicitis, and (2) patients are nearly always quite definite that the pain is worse on deep breathing, whereas in appendicitis this does not occur until the development of peritonitis. Similarly, in mesenteric adenitis the pain is not worse on breathing.

The diagnosis from pleurisy originating in the lung can be made on the more pronounced general myalgia and abdominal tenderness, and on the curious lack of association between the severity of the pain and the loudness of the pleural rub. Other cases with a muscular type of pain may suggest the pre-paralytic stage of poliomyelitis. In these it may be possible to form an opinion only from the typical distribution of the pain and the course of the illness.

The commonness or otherwise of the disease in this country is difficult to assess. Several epidemics have been described. The disease was comparatively unknown in Denmark until Sylvest began to publish his observations, as a result of which it became notifiable and was found to be occurring at the rate of several thousand cases a year. In view of the number of cases seen here in one practice in two years it seems not unlikely that there is a similar incidence in this country.

### Summary

Several cases of Bornholm disease are described. It is suggested that the disease occurs commonly in this country, but is often unrecognized.

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Under the 1950 Lord Memorial Essay Competition, founded in memory of the late Dr. J. R. Lord, the National Association for Mental Health offers certificated mental nurses a prize of £5 and a medal for the best essay on “What Satisfaction would Mental Nurses Gain from Exercising to the Full their Personal Talents and Professional Skills?” The closing date is August 31, and particulars may be obtained from the association at Maurice Craig House, 39, Queen Anne Street, London, W.1.