plained of pain in the back of the neck as well as subcostal pain. Movement of the trunk and walking increased the pain in several cases. The pain was accompanied by sickness and vomiting in only two cases, and only one complained of constipation. Four patients had sore throat and nine had headache. All but three had a rise in temperature, the range being from 99 to 102° F. (37.2 to 38.9° C.).

Upper abdominal tenderness was present in nine, being in the right subcostal region in five. One patient had pain at the right shoulder-tip on deep palpation in the right hypochondrium. Tenderness over the lower thorax was noted in one case. Apart from these signs no other abnormality was noted on abdominal examination.

Examination of the chest at the onset of the illness revealed no definite abnormality except restricted breathing and occasionally inverse breathing. In five cases pleural friction was noted four to ten days after the onset (Table II). One patient

TABLE II.—Cases with Pleural Friction

Age in Years	Sex	Situation	Time from Onset of Symptoms	Duration
16	M	Left base anteriorly	8 days	Less than 7 days
26	F	Right " "	9 "	10 days
34	M	" " "	9 "	3-6 "
35	F	{ Left " "	4 "	" "
		{ Right base posteriorly	7 "	14 "
35	M	{ Left base anteriorly	" "	" "
		{ " " posteriorly	10 "	21 "

was entirely free from symptoms before the development of the pleural rub; another stated that she felt the rub. The symptoms usually subsided in a few days, most patients being fairly well within a week. Some took up to two weeks, and a few who developed pleural friction took longer.

Typical Cases

A girl aged 10 was brought to the surgery on the evening of June 21. She had complained of abdominal pain when home for lunch. After returning to school the pain got worse and she had to be sent home. Her main complaint was of severe pain across the upper abdomen, worse in the right costal region. The pain was excruciating whenever she took a deep breath. She also had a headache. Her temperature was 101° F. (38.3° C.) and there was marked tenderness in the right hypochondrium. She had no sickness or vomiting. There were no definite abnormal clinical signs in her chest. We thought she was in for pneumonia and sent her home to bed. Next day her temperature was normal; she was breathing quite freely and had no pain. The tenderness in the right hypochondrium had gone. A day later she was feeling so well that she was allowed up and in two days she was allowed out.

On June 22, when visiting this girl, we were asked to see her younger brother, aged 8. He complained of pain in the lower left chest anteriorly which was catching his breath. There was a slight rise of temperature to 99° F. (37.2° C.). No abnormal clinical signs could be detected in his chest. Next day he was feeling quite well again. The pain had gone and he was allowed up.

These two cases were direct contacts of two others which occurred in the same block of houses and probably of another one.

Observations on the Outbreak

Differential Diagnosis.—Pneumonia was excluded by the absence of abnormal clinical signs in the chest, and by the subsequent course of the illness. Pleurisy (tuberculous): all cases with pleural friction were x-rayed and declared negative. Abdominal conditions were ruled out by the absence of typical signs and symptoms, and by the fact that the pain in most cases was related to breathing.

When first seen more than half the cases were given "sulphatriad" until the possibility of pneumonia was ruled

out. On the non-appearance of definite signs the drug was usually discontinued after a very short course. Otherwise treatment was symptomatic. No complications were noted.

There were five families in which two members were affected. Contact could also be traced between another pair and probably between two others. No definite conclusions could be reached on the incubation period, but it was possibly between four and six days. When reviewed in October, five of the patients stated that pain lasting one day recurred two weeks after their first attack.

Pleural Friction.—The onset of pleural friction rub four to ten days after the onset of symptoms is noteworthy, as also is the age group—16-35 years. The incidence of pleural rub was almost one in five. Scadding (1946) reported cases which he called "acute benign dry pleurisy." Eleven out of his 20 cases had pleural friction. Finn, Weller, and Morgan (1949) reported 28 cases with pleural friction in their series of 114 cases.

Summary

The main features of an outbreak of 24 cases of Bornholm disease are described.

Observations are made on certain of the features, especially the occurrence of pleural friction rub.

We are grateful to Drs. P. Aitken and J. Rubin, radiologists at Dunfermline and West Fife Hospital, for their x-ray reports.

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Medical Memorandum

Pneumatic Rupture of the Colon

As pneumatic rupture of the colon has rarely been reported in British medical literature the case here described is of interest.

CASE REPORT

A lad aged 16½, employed as an apprentice fitter at an engineering works, was admitted to hospital on October 20, 1949. He complained of difficulty in breathing and of abdominal pain. His story was that while at work, about an hour before admission, two of his workmates had placed the nozzle of a compressed-air pipe between his legs and turned on the air. He said that he had felt suddenly blown up and had found that he could breathe only with difficulty. He had some pain in the lower abdomen but had not vomited.

Examination showed a pale, shocked boy. His lips were cyanosed and he was extremely dyspnoeic, with marked movement of his alae nasi. The respirations were shallow and grunting in type. The abdomen was very distended and tympanitic, with tenderness on deep pressure and absence of peristaltic sounds. An interesting feature of the abdomen was a curious reddish-blue mottling on the abdominal wall, particularly in the flanks. The blood pressure was 150/72. There was no evidence of any surgical emphysema. On rectal examination nothing abnormal was felt, but withdrawal of the finger was followed by a profuse discharge of blood-stained faecal-smelling fluid. A diagnosis of pneumatic rupture of the colon was made. A Ryle's tube was passed and the patient was prepared for operation.

Under general anaesthesia, the abdomen was opened through a left paramedian incision. This was easily done,

as the tissues were so stretched and attenuated that they fell apart as each layer was incised. A small opening was made in the peritoneum, air whistled out, the abdomen collapsed like a pricked balloon, and his breathing improved considerably. Examination of the peritoneal cavity showed no free fluid and no gross faecal contamination. The upper end of the pelvic colon had ruptured, and in the hole was a plug of solid faeces. The pelvic mesocolon and retro-peritoneal tissues were much infiltrated with blood and there was a little blood in the pelvis. Closer examination of the pelvic colon and rectum showed tears in the serous and muscular coats on the antimesenteric border of the bowel. They started at the peritoneal reflection from the upper part of the rectum, where they were small, and increased in size as the bowel was traced proximally until the point of rupture was reached. Thereafter the bowel was normal. The affected area of bowel was quite viable, and active pulsation was seen in the vessels throughout the operation.

The hole in the pelvic colon was closed in two layers with No. 60 thread and the tears in the serous and muscular coats were sutured. As the damage to the pelvic colon and upper third of rectum was so extensive a transverse colostomy was performed and opened at the end of the operation. The abdomen was closed round a sump drain inserted into the pelvis.

His post-operative condition was fair, with a blood pressure of 100/70. He was transfused with 1 pint (570 ml.) of blood, and a Wangenstein continuous-suction apparatus was attached to the sump drain. A course of 250,000 units of crystalline penicillin twice daily was started. Next day his general condition was much improved. The abdomen was soft in all areas and not distended. Two ounces (57 ml.) of blood-stained fluid had been drawn from the sump drain and 5 oz. had been aspirated from the Ryle's tube. Thereafter he continued to make steady progress. The sump drain was removed on the second day and the Ryle's tube on the fourth. On November 12 the transverse colostomy was closed, and five days later his bowels were open in the normal way. He was discharged from hospital on November 23.

He was readmitted on January 2, 1950, to ascertain if any alteration in the colon could be found on x-ray examination. A barium enema showed that the barium flowed to the caecum and through into the terminal ileum. The whole colon showed some loss of tone in that it dilated during filling and was only partly evacuated afterwards. His general condition was good and he had no bowel symptoms.

COMMENT

The first case of pneumatic rupture of the colon, reported by Stone (1904), is the only case recorded in the British medical literature; thereafter all the reported cases occurred in America or on the Continent.

The condition is not common despite the prevalent use of compressed air in modern industry. When it does occur it presents a familiar history and a classical picture.

Investigation at engineering works revealed that, while managers and supervisors were familiar with the possibility of such an injury occurring in those working with or near compressed air, no one was found who had seen a case. Inquiries at the City of Manchester Coroner's Court showed that no deaths from such a cause had been reported in the past 14 years. There had, however, been one death from rupture of the oesophagus following a blast of compressed air in the face.

The history invariably indicates that the injury is the result of a prank, and in scarcely any case has maliciousness been admitted. Hays (1926) states that the injury has never been self-inflicted. The prank consists in applying the nozzle of a compressed-air pipe to the area of the patient's buttocks. The important point is that the nozzle does not need to touch the skin or even to touch the clothes. In the present case this aspect of the history is well illustrated, because the boy was leaning over a balcony watching

his colleagues at work beneath him. A younger apprentice, standing behind him, held the end of a compressed-air pipe about 18 in. (46 cm.) from the patient's clothes, while another turned on the air. The pressure of the air in this case was about 140 lb. per sq. in. (9.8 kg. per cm.²). After his admission to hospital it was found that his trousers and dungarees were quite intact and showed no evidence of having been damaged by the passage of compressed air.

The first reaction of the patient was that he had been blown up and then that he had difficulty in breathing. Abdominal pains were not a marked feature at this stage, and this, too, is characteristic of early cases.

Andrews's (1911) explanation of what occurs is probably correct. He postulated that air at 50 to 125 lb. per sq. in. (3.5 to 8.8 kg. per cm.²) forms a column which acts like a solid body, forcing open the anal sphincter. In addition the anatomical configuration of the perineum is such as to facilitate the concentration of air pressure at the anal orifice. Once the air has entered the bowel it produces tears in the muscular and serous coats and then perforation of the entire wall. He has shown that, under experimental conditions, the normal intestine will be ruptured by a pressure of 7 to 12½ lb. per sq. in. (0.49 to 0.88 kg. per cm.²). Brown and Dwinelle (1942) reviewed 32 cases with 37 perforations. They found that perforation occurred most commonly at the recto-sigmoid angle and less often at some other flexure of the colon. Of their 32 cases, 29 had single perforations, two each had three perforations of the sigmoid colon, and one case had two perforations. Block and Weissman (1926) state that the anal canal and rectum escape injury because of their outside support.

The case here described illustrates these observations admirably. The tears in the serous and muscular coats increased in size as the bowel was traced proximally. This appeared to indicate that the effect of the air pressure increased until it ruptured the bowel and then spent its force on distending the peritoneal cavity.

Hays (1926), reporting one case, thought that the striking feature was the great amount of free air in the peritoneal cavity. He, too, found tearing of the serous and muscular coats in addition to perforation of the colon.

The diagnosis should be made if a history of working with compressed air is given. The tense, distended, tympanitic abdomen, the respiratory distress, and the absence of inflammatory signs together make a characteristic picture which is diagnostic of the condition. In doubtful cases, Brown and Dwinelle (1942) recommend x-ray examination of the abdomen in the erect position, to demonstrate air between the liver and the diaphragm.

The prognosis is generally considered to be grave. Block and Weissman (1926), reporting one case and reviewing 26 others, found a 70.3% mortality. In 12 of these cases which were not operated on, the mortality was 75%. The mortality of cases operated on was 47%. This was, however, before the advent of penicillin and the sulphonamides.

Treatment consists in immediate laparotomy with repair of the bowel. If the damage to the bowel is severe or the blood supply is doubtful, a transverse colostomy should be done. Drainage of the pelvis is advisable if there has been gross faecal contamination or if operation is not carried out within a few hours of injury.

I am indebted to the late Mr. P. G. McEvedy, under whose care this case was admitted, and to Mr. G. O. Jelly for their advice and criticism in the preparation of this report.

J. C. COMLINE, M.B., Ch.B., F.R.C.S.Ed.,
Lately Senior Surgical Registrar, Ancoats Hospital, Manchester.

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