Experience of this and other epidemics has shown the frequent association of heavy nasal carriers with outbreaks of streptococcal tonsillitis in residential schools. It is important that nasal as well as throat swabs should be obtained from all cases, however mild; heavy nasal carriers should be treated until their swabs are negative. This is especially necessary with the single case or in the early stages of an outbreak before widespread contamination of the environment and the build-up of a carrier rate has occurred. During the holidays every effort should be made to sterilize the noses of persistent carriers and to disinfect school premises.

Summary

The epidemiological and bacteriological findings in an outbreak of streptococcal tonsillitis in a residential school are described. The outbreak extended over two terms, and 57 out of 340 boys were attacked.

All the early cases were in the same house as the first case, a heavy nasal carrier. A nasal carrier was also associated with each of the three dormitories with the highest attack rates during the time fresh infections were occurring. In most cases, however, the dormitory did not appear to be of special importance in the spread of disease, and the significance of this is discussed.

The early detection and isolation of heavy nasal carriers before widespread dispersal of infection has occurred is emphasized.

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SPONTANEOUS PERFORATION OF THE OESOPHAGUS

SURGICAL REPAIR, WITH RECOVERY

BY

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This rare condition has been the subject of a number of papers, chiefly dealing with single case reports. It is probable that it is not so uncommon as is supposed. Thus Eliason and Welty (1946) were able to record three cases seen by the senior author in the space of twelve months. The mortality until recently has been 100%, but Barrett (1947) and Olsen and Clagett (1947) have recorded recoveries after immediate operative intervention and repair.

In view of these successes it seemed timely to review the condition once more and to put on record two further cases, the second of which represents the third recovery that can be found in the literature; for, as Eliason and Welty (1946) say, "with improved techniques in anaesthesia, freer use of blood and plasma and effective chemotherapeutic agents, the limiting factor in the treatment of this condition is that of diagnosis."

Case 1

A man aged 41 was admitted to the West Middlesex Hospital at 4.30 a.m. on Dec. 10, 1941, with a diagnosis of perforated gastric ulcer. He had always enjoyed good health, apart from occasional indigestion, till 8.30 p.m. the previous day, when after a bout of vomiting he was stricken with severe pain in the lower chest and lumbar regions. A large midday meal of sausage pie was the only explanation the patient could give for the initial vomiting. There was no history of alcoholism. The pain, which was intense, had become more widespread; it was especially felt in the scapular regions and was made worse on breathing. His only other complaints were severe dyspnoea and an inability to lie flat in bed. The temperature was 101.2° F. (38.4° C.), pulse 100, and respirations 64. The blood pressure was 130/100.

Examination on admission revealed a cyanosed, breathless man of rather stout build. His breathing was shallow and obviously painful. At this time no abnormal physical signs were found in the lungs or cardiovascular system. His tongue was moist. The abdomen was tense and rigid but not tender. Rectal examination was negative. The diagnosis was thought to rest between a coronary thrombosis, lobar pneumonia, diaphragmatic pleurisy, and a ruptured oesophagus.

Morphine, $\frac{1}{4}$ gr. (16 mg.), was given and the patient placed in an oxygen tent. A radiograph of the chest taken four hours later revealed a bilateral pleural effusion, but further detail was obscured by respiratory movement, the patient being unable to hold his breath. By this time, some twelve hours after the onset of the catastrophe, the effusions were quite obvious clinically, and well-marked surgical emphysema had begun to develop in both supraclavicular triangles and was extending on to the chest wall. A confident diagnosis of spontaneous rupture of the oesophagus was made. The patient's condition, however, rapidly deteriorated and he died at 6 p.m. on the day of admission—i.e., about 22 hours after the onset of his illness. Before death the surgical emphysema had involved the whole of the upper half of the body and had closed both eyes. It was noted at the time how little relief this patient obtained from repeated doses of morphine.

Necropsy revealed a linear rupture 1 in. (2.5 cm.) long on the anterior aspect of the oesophagus $3\frac{1}{2}$ in. (8.75 cm.) from the cardia. A large quantity of fluid was present in the posterior mediastinum, and 24 oz. (680 ml.) of blood-stained turbid fluid was found in the right pleural cavity and 18 oz. (510 ml.) in the left. No direct communication could be demonstrated between the mediastinum and pleural cavities. Apart from the tear the oesophagus had no disease of any kind, and the rest of the necropsy was essentially negative.

Case 2

A woman aged 63 was admitted to the West Middlesex Hospital on Dec. 1, 1947, with a diagnosis of ? perforated peptic ulcer. After a heavy meal of tinned meat, cheese, and milk at 8 p.m. the previous day she had vomited twice, and this was rapidly followed by agonizing pain starting in the region of the upper part of the sternum and rapidly spreading to the epigastrium. The pain, which was severe and constant, was made worse by breathing and movement. There was no history of previous indigestion or alcoholism.

Examination revealed a pale, dyspnoeic, rather stout woman in extreme shock. The temperature was 100.8° F. (38.2° C.), pulse rate 124, and respirations 32. The blood pressure was 85/60. The trachea was centrally placed; there were rales at the left base and dullness at the right base. Surgical emphysema was present over the upper sternum. The heart appeared normal. There was rigidity of the whole anterior abdominal wall, with pronounced tenderness in the epigastrium. Normal peristaltic sounds were audible and rectal examination was negative.

She was seen by Dr. J. A. Torrens, who suggested the diagnosis of ruptured oesophagus, and exploratory thoracotomy was advised in spite of the patient being in *extremis*.

It was decided to explore the right chest in view of the effusion on this side, and accordingly a large segment of the eighth right rib was resected and an excellent exposure obtained by means of rib-spreaders. At least 2 pints (1.14 litres) of

fluid resembling weak tea was evacuated from the right pleural cavity and a small rent in the mediastinal pleura demonstrated. This was widely opened and much blackish foreign material was removed from the posterior mediastinum. Fragments of food were identified, and one was impressed by the large quantity of undigested food present.

A small vertical linear tear 1 in. (2.5 cm.) in length was found on the right posterior wall just above the diaphragmatic orifice. This was rapidly closed with interrupted fine catgut sutures, and the posterior mediastinum and pleural cavity were cleansed so far as was possible. A soft corrugated rubber drain was inserted across the pleural cavity into the posterior mediastinum, and the chest wall was closed around this and a large tube to the pleural cavity. Penicillin, 500,000 units, was injected into the pleural cavity at the close of the operation and closed drainage instituted. Shock was treated by plasma, fluid requirements were met by intravenous glucose-saline, and infection was controlled by systemic penicillin and sulphamezathine. A radiograph two days later showed that the right lung had re-expanded, though there was now a little fluid in the left pleural cavity.

The mediastinal drain was removed and daily intrapleural injections of penicillin were continued. The intravenous drip was removed on the fourth day and a milk drip by means of a Ryle's tube substituted. At this time the left pleural cavity was aspirated and some 7 oz. (200 ml.) of straw-coloured fluid were obtained. The tube in the pleural cavity was shortened and finally removed on the twenty-first day after operation. The Ryle's tube was removed on the fourteenth day; but some leakage of milk occurred across the pleural cavity, so the tube was replaced. Two further trial removals were made, with further leakage, but eventually the Ryle's tube was discarded on Jan. 22, 1948, some eight weeks after operation. No further leakage occurred and normal diet was rapidly resumed. Excellent nutrition was maintained throughout by these means.

The patient was discharged on Feb. 18 with the wound almost healed, and when seen ten days later complete healing had taken place. Repeated chest films during the post-operative period had revealed a gradual return to normal, and a barium swallow on Feb. 26 showed an oesophagus of excellent calibre with slight dilatation of the lower end to the right, presumably due to adhesions. A letter from the patient at the end of June, 1948, told of perfect health and an ability to eat anything.

Incidence, Aetiology, and Clinical Course

Since the first classic case described by Boerhaave in 1724, Olsen and Clagett (1947) have been able to find some 60 cases in the world's literature. The majority of these were first diagnosed at necropsy, and only 14 were diagnosed before death. It should be made clear that these cases are those in which spontaneous perforation of a normal oesophagus has taken place, and that perforation of an oesophageal peptic ulcer or other disease process and rupture following instrumentation are excluded. The former inevitably fatal outcome allowed ample necropsy evidence that the oesophageal wall was indeed normal. There is no evidence to show that the muscle wall in these cases is exceptionally thin, and any congenital weakness can also be ruled out by the late onset of this catastrophe.

The presenting feature in almost all recorded cases is that of vomiting, and the sequence of events is probably as follows. The patient, after some dietetic indiscretion or a particularly heavy meal, begins to retch or vomit. There is a rapid rise in intragastric pressure, which is transmitted to the oesophagus. The sphincter at the cricoid level fails to relax and the oesophagus tears at its weakest point—that is, at the lower end of the oesophagus just above the diaphragm. Such tears have been produced experimentally and have also occurred in patients following crushing injuries to the abdomen, during convulsions, and after defaecation.

Barrett (1946), in a most comprehensive survey of the whole subject, has stressed the high percentage of alcoholics among these patients, and it is thought that, though alcohol

may have a deleterious effect on the oesophagus, it is the vomiting and retching it produces which is the important factor. However, as he points out, this condition is unfortunately not confined to gluttons and alcoholics.

The pathological findings are remarkably constant. A linear longitudinal tear 1–8 cm. in length, usually on the left posterior wall, is most often present, and this involves the lower end of the oesophagus just above the diaphragmatic opening. The right posterior wall, as in Case 2 above, may be affected, and occasionally two tears have been present. It will be noted that the tear was on the anterior wall in Case 1. The posterior mediastinum becomes filled with food and regurgitated gastric contents, and the pleural cavities may be secondarily involved.

Males are predominantly affected, and Ridgway and Duncan (1937) were able to find only five females in the 35 cases recorded at that time. The middle-aged are most often affected, and my second case is the oldest of those recently reported.

As noted above, vomiting and retching usually initiate the process. This is rapidly followed by pain, variously located in the upper abdomen, the lower part of the sternum, or posteriorly on the left at the level of the lower thoracic or upper lumbar vertebrae. The pain is severe and agonizing, and has sometimes been described as tearing in character. A feature noted by several authors is the lack of relief obtained from morphine. The patient shows the usual features of shock, the pulse being rapid and the temperature subnormal, though the latter may be raised. Dyspnoea, pain on breathing, and cyanosis are commonly present, and the respiratory rate is increased. The patient is unable to lie down, some relief being obtained by sitting up in bed.

In the very early stages there may be tenderness and guarding, amounting to board-like rigidity in the epigastrium, and many of these cases have come to laparotomy on the erroneous diagnosis of a perforated peptic ulcer. Very shortly two phenomena develop which give the surest clues to the diagnosis. First, unilateral or bilateral pleural effusion appears. Initially this is probably reactionary to the highly irritating gastric contents in the posterior mediastinum, but soon gastric juice itself appears in the pleural cavity, either because the tear involves the pleura or because it bursts through the pleura, and may readily be recognized on aspiration and analysis. Secondly, in many cases surgical emphysema has developed; this begins over the upper part of the sternum and then spreads to the neck and face.

Should all the classical features be present, diagnosis should not be difficult provided the condition be known to the clinician.

The chief conditions for which spontaneous perforation of the oesophagus has in the past been confused are perforated peptic ulcer, dissecting aneurysm of the aorta, coronary disease, acute pancreatitis, acute cholecystitis, and spontaneous pneumothorax. A brief consideration of the main symptoms and physical signs should lead to a correct diagnosis in the typical case.

In untreated cases death rapidly occurs, the majority dying within 48 hours. In a few cases the process has been much slower, and at least three such cases have ultimately survived. The mortality in the past for the acute cases which form the vast proportion has been 100%. However, Graham (1944) and Frink (1947) have reported cases of late drainage in patients who appear to have localized the spreading infection, with ultimate cure.

Barrett (1947) and Olsen and Clagett (1947) have reported successful repair in the early stages, and Case 2 above is a further instance. In all three cases direct approach to

the lower oesophagus through a long thoracotomy wound, with primary repair of the tear and adequate drainage followed by intensive chemotherapy and the use of antibiotics, has resulted in a successful issue. Eliason and Welty (1946) suggested posterior mediastinotomy as a possible approach, but the majority would, I think, favour the transpleural operation.

In my opinion feeding difficulties in the post-operative period can be better overcome by a nasal indwelling tube than by further adding to the patient's discomfort by the performance of a gastrostomy or jejunostomy. It is well, however, as Frink (1947) suggests, to check the position of the tube, as this has been known to pass through the rent into the mediastinum.

It seems to me that if a correct and early diagnosis is made and is followed by urgent operation and energetic after-treatment many of these cases can be saved.

Summary

Two further cases of spontaneous rupture of the oesophagus are recorded, with recovery after operation in one.

The main pathological and clinical features are reviewed and a plea for earlier diagnosis and surgical treatment is made.

I wish to thank Dr. J. A. Torrens for his assistance with the management of the second case, and Dr. Patricia Chippindale, my house-surgeon, for her painstaking care and enthusiasm in the after-treatment of this same patient.

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RUPTURE OF INTESTINE DUE TO NON-PENETRATING INJURY

UNUSUAL ACCIDENTS FROM A MECHANICAL SAW

BY

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While most surgeons are familiar with injuries of the fixed portions of the bowel due to severe crushing of the abdomen, it is less common to encounter isolated rupture of the mobile loops following on what at first appears to be a relatively slight injury.

Case 1

On June 21, 1948, a woodworker aged 59 was sawing lengths from a beam 4 in. (10 cm.) square by means of a circular saw. At about 3 p.m. one of these sections was caught by the revolving blade of the saw and flung over the guard, striking him in the left lower quadrant of the abdomen and throwing him backwards for a distance of about 4 ft. (1.2 metres).

He was doubled up with intense pain at the time and was taken to hospital—where he was catheterized, clear urine being obtained—and kept under observation for two hours. No abnormality was detected in the abdomen. At the end of this time his pain had almost gone, his pulse rate was 80, and he was allowed to leave. He walked back to his works (about 500 yards—457 metres) and wished to resume work, but was sent home, walking a further 200 yards (182 metres). He experienced little pain at the time; there was slight nausea, but no vomiting throughout. He went to bed without having his evening meal.

About 9 p.m. (six hours after injury) abdominal pain returned, mainly in the left iliac fossa, and became steadily worse. Just after midnight he was admitted to Bethnal Green Hospital. Though in considerable distress from abdominal pain, he was not shocked. Blood pressure was 160/110, temperature 98° F. (36.7° C.), pulse 110. The tongue was dry and furred; the abdomen was immobile, the knees were drawn up, and rigidity was board-like. Tenderness was maximal over the left iliac fossa. No trace of bruising or abrasion could be seen. Bowel sounds were absent; the abdomen was resonant, with some alteration of percussion note in the left iliac fossa. Per rectum there was some resistance and definite tenderness in the recto-vesical pouch.

Laparotomy under general anaesthesia 11½ hours after injury revealed about a litre of free seropurulent fluid in the peritoneal cavity and some fibrinous exudate in the left iliac fossa. There was hardly any bruising of bowel or mesentery, but an isolated rupture of the jejunum was found about 9 ft. (2.75 metres) from its upper end, situated on the anterior surface ¼ in. (1.9 cm.) from the mesenteric border and about the diameter of a lead pencil. From this opening gas, fluid, and a piece of lettuce were escaping. Bacteriological examination of the peritoneal fluid subsequently proved sterile on culture. Apart from two patches of fibrinous exudation presumably due to irritation by the intestinal contents, the jejunum, ileum, sigmoid, and transverse colon showed no abnormality. The opening in the jejunum was closed by two layers of Lembert sutures in the transverse axis of the bowel and the peritoneal cavity was drained through the left iliac fossa.

Post-operatively the patient was treated by gastric suction and intravenous fluids with systemic penicillin for five days. Bowel sounds returned in thirty-six hours. Convalescence was uneventful; the patient got up on the tenth post-operative day and was discharged on the eighteenth day.

Case 2

A woodworker aged 42 was working with a mechanical saw on Sept. 10, 1948, when a piece of timber flew up, hit him in the abdomen, and knocked him down several feet away. He was doubled up at first, but after about forty-five minutes was able to walk into the casualty department of a hospital. Examination revealed no obvious abnormality, and he was advised to go home and rest.

During the night severe abdominal pain developed and he was admitted to Hackney Hospital twenty hours after injury. At that time there was no shock and the pain had passed off, but there was evidence of peritonitis. Although he was thought to have a rupture of the small gut, intervention was considered unjustifiable in view of the interval since the injury, and he was treated with chemotherapy. Although his condition improved for a few days it then deteriorated, and he died seventeen days later.

At necropsy he was found to have general peritonitis resulting from a complete rupture of the transverse colon and a longitudinal tear into the duodenum.

Discussion

Bodenheimer (1945) has also described the case of another woodworker who was struck while using a mechanical saw. Here again the abdomen showed no marks, bruises, or abrasions, but the diagnosis was confirmed by the presence of air seen under the diaphragm on x-ray examination. An isolated rupture was found in the lower ileum and was successfully sutured.

Rupture of a hollow viscus is the result of a sharply localized blow upon a distended loop of bowel which is unable to slip out of the way, owing either to its peritoneal relations or to pathological fixation by adhesions or hernia. The abdominal musculature may be off guard as the result of alcoholic intoxication or the unexpectedness of the sudden blow.

At first the rupture may be very slight, even incomplete, and temporary inhibition of peristalsis may allow plugging of the leak with fibrin (Zachary Cope). Resumption of