Discussion

To us the most interesting features of this case are the neurological findings and the effect of cortisone. The neurological findings noted at the first examination are well expressed by the term "mononeuritis multiplex," which was introduced by Lovshin and Kernohan (1949), who recorded such findings in eight cases. These manifestations, when present, are very suggestive of polyarteritis nodosa, particularly if there be pyrexia and signs suggesting dysfunction of other organs or systems. The findings at the second examination were those of an advanced polyneuritis, and indicate the necessity of considering polyarteritis nodosa in all cases of peripheral neuritis.

Histological examination of the necropsy material demonstrates the absence of an inflammatory infiltration around the areas of fibrinoid necrosis in the smaller arteries. When considered in relation to the intense perivascular inflammatory infiltration present in the biopsy specimen obtained 32 days before death it seems justifiable to regard the change as due to cortisone. This is in accordance with the findings of Shick, Baggenstoss, and Polley (1950), who treated three cases with cortisone. Two patients died in cardiac and renal failure in spite of initial improvement. Necropsy showed complete healing of all arterial lesions, but with the process of healing fibrous obliteration of the lumen of the vessels had occurred with widespread visceral infarction.

It is therefore evident that cortisone can be a two-edged weapon. If it eventually proves to be of value in the treatment of polyarteritis nodosa it will be of great importance to begin treatment at such an early stage that healing of affected vessels will not provoke serious visceral infarction. In consequence the early diagnosis of polyarteritis nodosa is desirable so that the effect of cortisone given at the onset of the disease can be investigated. As can be seen from the present and other recorded cases, this, in spite of a high index of suspicion, may be extremely difficult.

We wish to thank Professor Henry Moore for permission to publish this case.

REFERENCES

- Lovshin, L. L., and Kernohan, J. W. (1949). *Proc. Mayo Clin.*, **24**, 48.
Shick, R. M., Baggenstoss, A. H., and Polley, H. F. (1950). *Ibid.*, **25**, 135.

The U.S. Army medical service, in co-operation with the U.S. Department of Agriculture, has developed and is now using in Korea new insecticidal formulations capable of controlling Korean body lice which are resistant to D.D.T. These are preparations of lindane and pyrethrum louse powder which are highly effective against the Korean louse and have been tested and declared safe for human use by the Army Environmental Health Laboratory, Edgewood, Maryland. Army medical personnel will soon begin mass dusting of P.O.W.s with 100,000 lb. of lindane, which was shipped to Korea early this month. One million pounds of equally effective pyrethrum powder have been procured and will be put in use upon arrival in the Far East. Half of this amount will be distributed in 2-oz. individual cans to United Nations troops. Intensive dusting of the civilian population will start as soon as additional supplies of the powders are available. United Nations forces have been relatively untroubled by the stubborn Korean louse principally because of the accomplishments of preventive medicine companies, strict sanitary discipline in the field, and regular baths and change of clothes for combat troops. Routine immunization against epidemic typhus has furnished additional protection against this disease.

GASTRIC CARCINOMA AND ACUTE PERFORATION

BY

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Until recently acute perforation was regarded as a rare complication of carcinoma of the stomach. The prognosis, both immediate and remote, was generally regarded as very poor. Aird (1935) published eight cases from the Edinburgh Royal Infirmary and collected 71 cases from the literature. He found that about half the cases mimicked perforated peptic ulcer, and he stated that in nearly 50% metastases were present at operation.

Incidence

Doll (1950) has put the matter in its proper perspective. He found 17 cases of carcinoma in a consecutive series of 500 perforations, 11 occurring in 452 cases submitted to operation. Of 86 male cases with an operation diagnosis of perforated gastric ulcer, seven proved to be malignant.

Unfortunately, it is difficult to assess the risk of malignancy in perforated gastric ulcer. The exact anatomical site of the perforation is frequently uncertain, oedema at operation often masking the pylorus. Many perforations are therefore labelled by the surgeon "juxtapyloric." Many of these ulcers no doubt are duodenal, but some are in the prepyloric inch. Illingworth *et al.* (1944), Avery Jones *et al.* (1950), and others include these "juxtapyloric" ulcers in the duodenal ulcer group. By subtracting them from the gastric ulcers the apparent incidence of malignancy in gastric ulcers will be increased. Post-operative determination of the exact site of the ulcer may be equally difficult. The radiologist often finds it impossible to locate the pylorus because of distortion and irritability, and the ulcer may be beyond the range of the gastroscope. A further source of error is the possibility of carcinoma manifesting itself much later, to exclude which all perforated gastric ulcers would have to be followed up for at least five years.

In an attempt to assess the risk of malignancy in perforated gastric ulcer the records of all gastric and duodenal perforations admitted to the London Hospital between January 1, 1945, and December 31, 1949, have been studied. Table I shows the distribution of the 111

TABLE I.—Cases of Acute Perforation at the London Hospital, 1945-9. Site of Perforation

	Diagnosis at Operation	Final Diagnosis	Deaths
D.U.	57	74*	7
G.U.	12	12	3
Juxtapyloric	28	17	0
Gastrojejunal	1	1	0
Carcinoma	3	6	2
Not proved	—	1	1
Total	101	111	13

* Includes one patient with two perforations in the period.

cases admitted, and gives the diagnosis made at operation in 101 cases. The final diagnosis is that made when the patient was last seen at this hospital. There is a substantial increase in the number of duodenal ulcers in the final list, mainly at the expense of the juxtapyloric group. Table II shows the primary treatment adopted

and the mortality of each procedure. In the whole series there were six cases of carcinoma (5.4%), of which five presented as acute perforations; the sixth was clinically silent, the diagnosis being made only at necropsy.

TABLE II.—Primary Treatment

	Number	Deaths
Simple suture	96	5*
Suture and gastro-enterostomy	3	2
Partial gastrectomy	2	0
Drainage only	1	0
Conservative treatment	4	1
No treatment (moribund on admission or diagnosis made at necropsy)	5	5
Total ..	111	13

* Excluding one death due to intestinal obstruction four weeks after a subsequent gastrectomy.

The difficulty of determining the total number of gastric perforations has already been explained, but the maximum number must be 36 when all known duodenal and gastrojejunal cases are subtracted. One unproved case is included for completeness, a case in which there was no operation or necropsy but there were clinical grounds for the diagnosis of perforation. The minimum incidence of carcinoma in gastric perforations is therefore 6 in 36 (16.7%), but some may well have been actually duodenal ulcers, in which case the incidence would be even higher.

Five of the carcinomata occurred in the prepyloric inch, and so far as can be determined from the records the total number of prepyloric perforations was 25, an incidence of 20%.

From the practical point of view, as it affects the surgeon, of 43 gastric and "juxtapyloric" perforations encountered at operation five proved to be carcinomatous. Table III shows the age and sex distribution of the

TABLE III.—Age and Sex Distribution

Age	Males			Females		
	D.U.	G.U. and Juxtapyloric	Carcinoma	D.U.	G.U.	Carcinoma
10-19 ..	1	—	—	—	—	—
20-29 ..	7	6	—	—	—	—
30-39 ..	18	5	1	—	—	—
40-49 ..	18	5	1	—	1	(1)*
50-59 ..	18	8	3	—	—	—
60-69 ..	6	2	1	2	1	—
70-79 ..	4	1	0	—	—	—
Total ..	72	27	6	2	2	(1)

* Operation for perforation elsewhere (Case 6).

patients with ulcer and carcinoma. Most carcinomata, as of all perforations, occurred in males. The ages of the carcinoma patients range from 30 to 65, but five were between 48 and 57 years. The female case received treatment for her perforation elsewhere, being admitted here with pyloric stenosis.

An incomplete follow-up of the gastric and "juxtapyloric" perforations has not revealed any further cases of carcinoma, though the time since perforation is in many cases still too short for carcinoma to be finally excluded.

In the same five-year period there were approximately 400 admissions for carcinoma of the stomach, the diagnosis being proved at necropsy in 88 cases. Search of these records revealed only one further case, the woman already mentioned, in which perforation had preceded admission to this hospital by a short interval. A summary of the history and treatment of the seven cases of carcinoma is given, Cases 2 and 5 being personal cases.

Case Reports

Case 1.—A bus driver aged 57 was admitted with acute perforation on February 15, 1946. *History:* One year—loss of weight; three weeks—vomiting (barium meal showed pyloric stenosis); three hours—acute perforation. *Operation:* Large pyloric tumour with a small perforation on the posterior surface of the lesser curve. Perforation closed with difficulty, using an omental graft. Anterior gastrojejunostomy performed. Died on fourth post-operative day. No post-mortem examination.

Case 2.—A painter aged 51 was admitted with acute perforation on January 10, 1948. *History:* Five years ago—suspected gastric ulcer; two months—recurrence of pain and vomiting; four hours—acute perforation. Examination showed typical perforation and severe bilateral basal bronchiectasis. *Operation* under local anaesthetic: large high lesser-curve perforation closed by suture. Indurated ulcer 5 cm. in diameter. Recovered satisfactorily, with diagnosis of simple ulcer. Follow-up barium meal February, 1949, showed hour-glass stomach but no active ulcer. Laparotomy was postponed because of his severe chest disease, but he was admitted to another hospital and died on June 21, 1949. Post-mortem examination showed a carcinomatous ulcer of the upper end of the lesser curve, the site of haemorrhage, and metastases in the liver, pleura, peritoneum, diaphragm, and pericardium.

Case 3.—A canteen assistant aged 30 was admitted with acute perforation on January 21, 1949. *History:* A few years' dyspepsia, with no definite relation to meals; five hours—acute perforation. *Operation:* Anterior prepyloric perforation sutured. There was some post-operative gastric retention, and at the convalescent home vomiting increased, with visible peristalsis. A barium meal on February 25 showed pyloric stenosis but no neoplasm. *Second operation* (March 2): A prepyloric neoplasm adherent to the pancreas was found and an exclusion operation performed. Biopsy of lymphatic nodes showed secondary carcinoma. Obstruction was relieved, but when last seen six months later the patient was moribund.

Case 4.—A miller aged 52 was admitted with acute perforation on February 11, 1949. *History:* Three months—abdominal pain and vomiting; four days before—barium meal showed antral filling defect; four hours—acute perforation. *Operation:* Anterior prepyloric perforation sutured. Biopsy of a hard mass in the gastroduodenal omentum showed carcinoma of stomach. *Second operation* (February 23): Transthoracic total gastrectomy. Large ulcerating carcinoma of lesser curve. Mucoïd carcinoma invading four of twelve glands examined. In September, 1951, he was well and working, with no evidence of recurrence.

Case 5.—A barman aged 49 was admitted with acute perforation on October 27, 1948. *History:* Two years—epigastric discomfort relieved by alkalis; 10 months—barium meal showed prepyloric lesser-curve ulcer. Treated in out-patient department with relief of symptoms and gain in weight of 7 lb. (3.2 kg.). Three months—recurrence of symptoms; barium meal showed persistence of ulcer. Six hours—acute perforation. Review of radiographs led to suspicion of carcinoma. *Operation:* Indurated mass encircling antrum with perforation on anterior surface. Perforation closed by suture. *Second operation* (November 12): Radical partial gastrectomy. Diffuse extensive carcinoma encircling antrum, with a peptic ulcer at its distal edge, which had perforated. Secondary carcinoma in six lymphatic nodes. In May, 1950, he was well and working, with no evidence of recurrence. He died at home on June 26, 1950.

Case 6.—A single woman aged 48 was admitted with pyloric stenosis on October 16, 1946. *History:* Three years—weight loss; nine months—abdominal pain and vomiting; four months—operation elsewhere—suture of acute perforation of prepyloric ulcer. Since then there has been

increasing pyloric stenosis. Barium meal did not demonstrate the cause. *Operation* (October 18): Large prepyloric carcinoma found. Multiple peritoneal nodules—assumed to be seedling metastases. Biopsy of peritoneal nodule—no carcinoma. On January 24, 1947, gastroscopy showed large ulcerating carcinoma of antrum. *Operation* (February 1): In view of the negative biopsy re-explored, but metastases now found in liver, abdominal wall, and ovaries.

Case 7.—A man aged 67 was admitted on April 11, 1946, with a diagnosis of carcinoma of stomach. *History*: Six months—weight loss, 1½ st. (9.5 kg.); six weeks—pain and vomiting. Examination showed a thin wasted man with a palpable pyloric tumour. Deteriorated, and died 18 days later without any symptoms or signs of acute perforation. *Necropsy*: Carcinomatous ulcer encircling pylorus. Anterior perforation with pus, fibrin, and intestinal contents in general peritoneal cavity.

Discussion

It is remarkable that the frequent association of carcinoma with perforated gastric ulcer had escaped general recognition until the publication of Doll's paper. Routine follow-up of perforated gastric ulcers is exceptional, and it seems possible that in this way many latent cases have in the past been overlooked, as might well have happened in Case 2 of this series. It was this case, in fact, which first drew our attention to the problem. In the literature there are many reports of isolated cases of perforated carcinoma, but most of these describe cases in which the diagnosis of carcinoma was at once obvious, the cases mimicking simple ulcer receiving far less attention. Failure in diagnosis is the probable reason why the high incidence of malignancy has hitherto been unrecognized.

Diagnosis

A correct pre-operative diagnosis is unusual, the history and physical signs being ordinarily those of a perforated simple ulcer. Only when examination before perforation has revealed a lump, or a barium meal has shown a carcinoma, is the malignant nature of the perforation suspected. Rarely, distant metastases may be present, as in one patient seen in this hospital who refused admission and died in his own home. Provided that all perforated ulcers are treated by immediate operation no harm is done by failing to diagnose carcinoma before operation.

The disturbing fact is the frequency with which carcinoma is overlooked at the emergency operation. This occurred in three of these cases, in eight of Doll's cases, in one of Susman's (1939) three cases, and in the cases of Aird (1935), Reid (1948), and others. These cases are probably fairly early ones and offer the best prospects of cure by radical resection.

It is astonishing that this error is so often made. The most likely explanation is that the possibility of malignancy is not even considered by the surgeon. The key to the diagnosis is awareness of the high incidence of carcinoma. Inflammatory exudate and oedema may mask the true nature of the lesion, and the surgeon may be reluctant to do more than close the perforation. Correct diagnosis will depend upon a careful examination of the stomach, particularly by palpation, at the time of the emergency operation. Case 5 illustrates this point. At operation there was no outward sign of carcinoma, but re-examination of the pre-operative radiographs led to a suspicion of carcinoma, which was confirmed only by careful palpation of the whole pyloric antrum. The ulcer itself resembled in every way a simple peptic ulcer.

The gastrectomy specimen showed that it was a peptic ulcer arising in the edge of an area of carcinomatous infiltration.

Biopsy of the edge of the ulcer may be of value in doubtful cases, though it was used only once in this series. It is, however, not entirely reliable, as the piece taken for section may come from the edge of a peptic ulcer, not from the associated carcinoma.

When great care is exercised, particularly in dealing with "juxtapyloric" perforations in middle-aged men, the proportion of correct diagnoses should be increased, but a few cases may still be overlooked. Post-operative follow-up of all cases is essential to detect these missed cases, but radiology is handicapped by the distortion inevitable immediately after perforation, and gastroscopy is not always reliable in detecting carcinoma in the prepyloric inch.

Treatment

There are two major alternatives—immediate gastrectomy or simple suture followed by early secondary gastrectomy. The only valid reason for immediate gastrectomy is difficulty in closing the perforation. This was certainly present in Case 1 of this series, who might have survived if immediate resection had been performed. The protagonists of immediate gastrectomy assert that there is always difficulty in suturing malignant perforations; but this is not so, at least in those cases simulating peptic ulcer. So far as cure is concerned there is no advantage in immediate gastrectomy. The chief disadvantage of immediate gastrectomy is that a major operation is performed, perhaps by an inexperienced surgeon, on an ill patient without preparation—all factors tending to increase the mortality.

The policy recommended is simple suture with confirmation of the diagnosis by palpation and perhaps biopsy at the emergency operation, followed by a radical gastrectomy two to three weeks later. The patient, after blood transfusion if required, is much better equipped to withstand such a planned secondary operation. In the two cases in which this was done no special difficulties were encountered.

What policy is to be adopted towards the "juxtapyloric" and gastric perforations in which the operation diagnosis does not suggest malignancy? Doll tentatively suggests immediate gastrectomy in men over 30 with perforated gastric ulcers, but such a policy would undoubtedly lead to a number of unnecessary resections. It is suggested that all perforated gastric and "juxtapyloric" ulcers should be carefully followed up, and that, unless they can be definitely proved to be benign by radiology and gastroscopy, they should be treated by early gastrectomy. In the group of ulcers in the prepyloric inch exclusion of malignancy is so difficult and the incidence of carcinoma so high (20%) that early gastrectomy is indicated in every patient over 40 years and should be seriously considered even in younger patients.

Prognosis

Traditionally the immediate prognosis is poor because of difficulty in closing the perforation, and the remote prognosis hopeless because of widespread peritoneal dissemination resulting from the perforation. The cases here reported support neither of these beliefs. There is no reason why simple suture should carry a mortality much higher than that in cases of simple ulcer. These cases are often relatively early and without metastases, so there is no reason to suppose that the ultimate

prognosis is any worse than that of non-perforating carcinomas. Neither of the two cases resected showed ascites or other evidence of widespread peritoneal metastases. One died after 20 months, but the other is alive and well with no evidence of recurrence 31 months after total gastrectomy.

Summary

Of a total of 111 acute perforations in five years, 6 proved to be carcinomatous. The incidence of carcinoma in perforated gastric ulcer was at least 16.7%, and may have been even higher. The reasons why it is impossible to assess this risk exactly are discussed.

Seven cases of carcinoma associated with perforation are reported, in three of which the diagnosis was missed at operation. The reasons why carcinoma is frequently overlooked are discussed. The surgeon should consider the possibility of malignancy in every perforated ulcer.

Simple suture of the ulcer, followed by gastrectomy after an interval of two to three weeks, is recommended. Immediate gastrectomy is indicated only exceptionally.

The incidence of carcinoma in prepyloric perforations is so high (20%) that secondary gastrectomy is advised in all these patients over 40 years.

The immediate prognosis is little worse than that of perforated simple ulcer, and there is no reason to regard the ultimate prognosis as hopeless.

I wish to thank those members of the surgical staff of the London Hospital under whose care these cases were treated for permission to use their records. My thanks are also due to Mr. Alan Perry, Dr. Denys Jennings, and Mr. J. E. Richardson for their help and criticism in the preparation of this paper.

REFERENCES

- Aird, I. (1935). *Brit. J. Surg.*, **22**, 545.
 Doll, R. (1950). *British Medical Journal*, **1**, 215.
 Illingworth, C. F. W., Scott, L. D. W., and Jamieson, R. A. (1944). *Ibid.*, **2**, 617.
 Jones, F. A., Parsons, P. J., and White, B. (1950). *Ibid.*, **1**, 211.
 Reid, D. R. K. (1948). *N.Z. med. J.*, **47**, 259.
 Susman, M. P. (1939). *Med. J. Aust.*, **1**, 456.

COUGH FRACTURE

BY

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My interest in cough fracture was stimulated by the following case.

A woman aged 32 complained on December 6, 1949, of a vigorous dry cough, of feeling feverish, and of pain around the seventh left intercostal space overlying the anterior axillary line. The pain was worse on coughing and on deep breathing. Three days later her temperature was 102° F. (38.9° C.); her doctor heard a pleural rub, and gave sulphathiazole. Next morning her temperature was normal, and remained so. Her chest was x-rayed six weeks later. The standard postero-anterior view looked normal, but the left anterior oblique view showed a recent fracture of the seventh left rib. It appeared that a simple cause of pleurisy had been overlooked and would never have been found had not an oblique x-ray view of the chest been studied.

Since Graves (1833) described a case of cough fracture more than 130 have been reported. Malgaigne (1859), Gurlt (1862), Bähr (1894), Tunis (1890a, 1890b), and Seilin (1917) have collected cases and reviewed the subject. Pospischill (1921) reported 14 cases occurring in children with whooping-cough. Richardson (1936)

found 30 cases among tuberculous subjects. Oechsli (1936) reported a further 12 cases and Cohen (1949) seven cases. Paulley *et al.* (1949) reported four cases occurring in pregnant women. Until recently cough fractures were regarded as rare accidents. With one exception (Palfrey, 1924) there has been no published account of their common occurrence in otherwise healthy subjects. Webb and Gilbert (1923) and Richardson (1936) said that the fractured rib might easily be missed. Webb and Gilbert (1923), Howson (1934), Swineford and McKinnon (1945), and Douthwaite (1949) have suggested that these fractures occur far more often than is generally supposed. In order to test this, x-ray films in the anterior oblique as well as in the standard position were taken in all patients referred for unilateral chest pain that was worse on coughing and on deep breathing (pleural pain), in the absence of another cause. In cases of doubtful fracture the examination was repeated about two months later to see if callus had formed.

The Present Series

Out of 720 new adult non-tuberculous patients referred by general practitioners on account of chest symptoms (over a period of a year), 106 (14.7%) had pleural pain. These are analysed in Table I.

TABLE I.—Incidence of Cough Fracture as a Cause of Pleural Pain

Abnormalities noted on x-ray film indicating some other cause for the pain	No. of Cases
X-ray appearances normal:	42
Clinical diagnosis	50
1. No cause found	24
2. Dry pleurisy or resolved pleuropneumonia	19
3. Muscle strain	5
4. Direct trauma to chest wall	2
Cough fractures	14

In all cases of cough fracture coughing occurred before the onset of pain. Coughing was vigorous in all cases except one in which the patient tried hard to suppress it. Five had a dry and nine a productive cough when the pain came on. In only five was the onset of pain sudden; three others had an ache in the side which suddenly changed to a stabbing pain after several days; in the remaining six the onset was gradual. Eleven said that the pain was severe, the severe pain lasting from 48 hours to 14 days (one said that it remained, on coughing, severe for three months); three denied that the pain was ever severe. One patient said she was free from pain after a month, but the average duration of pain was three months. In one patient pain was still present after six months.

In 12 patients pain was referred to an area surrounding the anterior axillary line and the segment corresponding to the fractured rib or the rib below. In one patient the fifth right rib was fractured just in front of the mid-axillary line and pain was referred to the seventh and eighth spaces in the scapular line; in another a fractured second left rib gave rise to pain along the vertebral border of the left scapula (pressing on the rib or working the serratus anterior reproduced the pain). Coughing and deep breathing made the pain worse in all cases; in seven moving the trunk and in three contracting the serratus anterior made it worse. Holding the side, lying on the unaffected side, avoiding any sort of movement, and, in one case, lying with the painful place pressed against a hard pillow were mentioned as giving relief. The patients were all well-nourished healthy-looking subjects.