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.

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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*

		No. of Cases	
Abnormalities noted on *x*-ray film indicating some other cause for the pain		42	
X-ray appearances normal:			
Clinical diagnosis	1. No cause found	24	50
	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.

Discussion

In many cases previously reported the patient felt a snap in the side during a vigorous bout of coughing followed by a severe pain. This suggested the diagnosis, which was easily confirmed by well-localized tenderness, crepitus, and often even palpable bone fragments. This sort of case is rare. In the present series all were surprised to learn that they had broken a rib; only one admitted feeling a snap. Comment cannot be made on local signs, because with one exception—a patient who had a loud pleural rub 48 hours after the onset of pain—the patients were seen too long after the pain began. Two practitioners heard pleural rubs; there were no other remarks about local signs in doctors' letters.

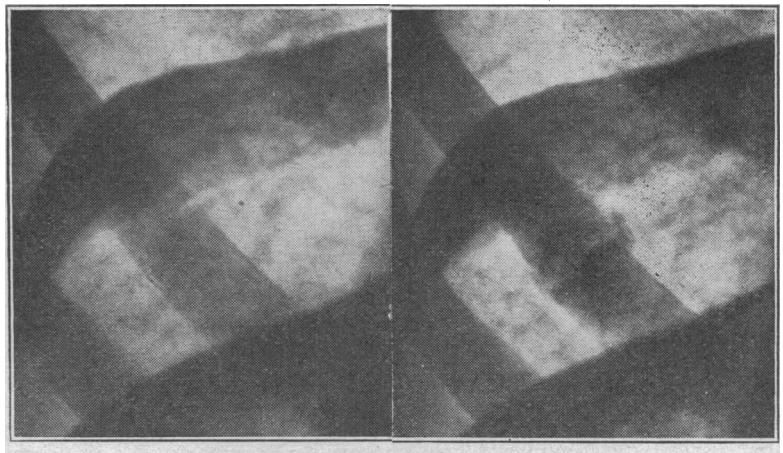

FIG. 1. FIG. 2.

FIGS. 1 AND 2.—Case 3. The fracture seen on Fig. 1 was much more obvious two months later, Fig. 2. (Oblique views.)

Swineford and McKinnon (1945) and Cohen (1949) said that the pain of cough fracture was indistinguishable from that of pleurisy. As long ago as 1852 John Hilton taught that a rib fractured by muscular violence might give rise to pleurisy. The presence of a pleural rub in three cases in this series supports this view. It is suggested that cough fracture has masqueraded as primary pleurisy, pleuropneumonia, and fibrositis.

The need for taking oblique views and repeat *x*-ray films after callus has formed has been stated before (Richardson, 1936; Cramer, 1943; Swineford and McKinnon, 1945; Bodenheimer, 1948; Douthwaite, 1949). Their usefulness is illustrated in Table II.

TABLE II.—*Analysis of X-ray Findings*

Case No.	Sex	Age	Rib Broken	Fracture Seen in Both Views	Seen in P.A. View Only	Seen in Oblique View Only	Repeat *X*-ray Needed for Confirmation
1	F	32	7th L.			+	
2	F	28	7th R.	+			
3	F	37	5th R.	+			
4	F	29	5th R.			+	+
5	F	30	7th R.			+	
6	F	21	6th L.			+	+
7	M	21	7th R.			+	+
•8	M	35	10th L.	+			
9	F	50	2nd L.		+		
10	F	27	9th L.		+		+
11	M	46	8th L.	+			
12	F	49	10th L.			+	
13	F	39	6th L.			+	
14	M	31	8th L.			+	

In no case was the fracture conspicuous; all would have been overlooked unless specially sought. Even so, standard views revealed only six cases, and in four of them the insufficient evidence needed confirmation by *x*-ray films later (see Figs. 1 and 2). In one case two oblique views were taken at slightly different angles to provide conclusive evidence. Oechsli (1936) observed that these fractures occurred just in front of the origin of the serratus anterior (upper eight or nine ribs) or just behind the origin of the obliquus externus abdominis (lower eight ribs). This provided a rational explanation for their situation. They are easily missed, because in standard *x*-ray views the lateral parts of the ribs are crowded and are apt to be obscured by scatter radiation, especially when, as is usual, "soft" films are taken which are designed to show lung lesions rather than bony defects.

Summary

Cough fractures were specially looked for during 1950 at the Cambridge Chest Clinic among patients with pleural pain in whom no other cause was apparent. An oblique *x*-ray view was taken in addition to the standard anterior view. The examination was repeated in doubtful cases after callus had had time to form. Out of 64 such patients 14 (21.9%) had fractured ribs.

John Hilton's teaching in 1852 that a fractured rib may readily be missed as a cause of pleurisy is reiterated.

I wish to thank Mr. W. R. LeFanu, Librarian, Royal College of Surgeons, for sending me a typescript of Graves's (1833) report; Dr. E. M. Cheffins for his co-operation; and Dr. W. Paton Philip, consultant chest physician, for permission to publish.

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A new hand-operated pump, about 4 in. in diameter (it is of circular shape) and ½ in. thick, has just been developed in New York to give rapid blood transfusions. The supply rate and pressure are controlled, and the pump is expected to be particularly useful in cases of extreme shock and massive bleeding where an intra-arterial delivery may be needed. It will supply a pint of blood in one and a half minutes, working at its top speed, without danger of air embolism. The mechanism is very simple, and consists essentially of a roller which milks the blood through a collapsible rubber tube (*New York Times*, Supplement, December 2).