

is justifiable. A psychiatric opinion is often helpful, but it must be borne in mind that the lesion is never purely hysterical, though there may be a background or 'overlay' of neurosis.

If biliary regurgitation is the main complaint then reflux due to hiatus hernia or to obstruction of the stoma must be excluded. As indicated previously, the operation which the writer finds most satisfactory and which may even remove the troublesome idiosyncrasy to milk or eggs, is conversion from gastro-jejunal to a gastro-duodenal anastomosis (Fig. 6b). The writer has never found this impossible of performance, for the second and third parts of the duodenum can be extensively mobilized in order to anastomose the greater curve side of the stomach to the anterior surface of the second part of the duodenum. If the stomach is extensively adherent however, as, for example, after radical gastrectomy for cancer, then it may

be simpler to try a long anastomosis of the afferent and efferent loops, the so-called 'pantaloon operation' (Fig. 6d) which is moderately effective.

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## THE PATHOLOGY OF PEPTIC ULCERATION

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In this paper the remarks have been confined to the consideration of the pathology of chronic gastric and duodenal ulceration and the problem of ulcer-cancer. Whilst it is true that, at its conception, every chronic ulcer must have passed through the stage of erosion and acute ulceration, it seems unlikely that such lesions, when multiple and part of an acute erosive gastritis, commonly precede the development of one or more chronic ulcers.

The figures given in this paper are based on an analysis of 944 partial gastrectomy specimens removed for peptic ulceration. In comparing these figures with those of previous workers it must be remembered that gastric resection is now one of the commonest operations performed by the general surgeon, whilst at the time when most of the authoritative papers on this subject were written it was usually only undertaken as a last resort.

Of the 944 specimens examined, 523 were removed for duodenal ulceration and 421 for gastric ulceration. In eight of the specimens there was evidence of both duodenal and gastric ulceration. In three of these both the gastric and duodenal ulcers were active, in two the gastric ulcers

were active and the duodenal represented by puckered scars and in three the duodenal ulcers were active and the gastric represented by healed puckered scars. Thus 1.5 per cent. of chronic duodenal and 2.5 per cent. of chronic gastric ulcers were accompanied by evidence of chronic ulceration of the other organ. These figures are considerably lower than Stewart's (Hurst and Stewart, 1929), but his figures were based on an analysis of 4,000 autopsies and showed that 9 per cent. of chronic duodenal and 12 per cent. of chronic gastric ulcers were accompanied by chronic lesions of the other organ. These figures are much more likely to give a true figure of the frequency of association of lesions in the two organs. Whilst in surgical material some duodenum is frequently included, this is not always the case and some duodenal lesions are bound to be missed.

### Chronic Gastric Ulcer

#### *Sex Incidence and Age*

Of the 421 gastrectomy specimens showing chronic gastric ulcers, 322 were from males and 99 from females, giving a ratio of 3.2 : 1. This is a very different figure from that given by Hurst and

Stewart in 1929. They investigated the sex incidence of chronic peptic ulcer in 9,000 autopsies and their figures for the incidence of chronic gastric ulcer were 2.0 per cent. males and 2.6 per cent. females, giving a ratio of 0.8 : 1. Yet the writer's figures are almost identical with those given in a recent paper by Swynnerton and Tanner (1953), who report the results of a clinical investigation of 498 patients with chronic gastric ulcer. These authors give a sex incidence of 3.5 males to one female and state that the reason for the rise in the male figure is the great reduction in the incidence of gastric ulcer in young women.

The age at which patients with chronic gastric ulcer came to operation is shown in Table 1.

TABLE 1  
CHRONIC GASTRIC ULCERS : AGE AT WHICH PATIENTS  
CAME TO OPERATION

Age Group	Men		Women	
	No.	Per cent.	No.	Per cent.
20—	6	1.8	1	1.0
30—	28	8.7	6	6.0
40—	89	27.6	33	33.3
50—	124	38.5	23	23.3
60—	63	19.6	30	30.3
70—	10	3.2	6	6.0
80—	2	0.6	—	—
Total	322		99	

It will be seen that the peak period at which men come to operation is in the 50 to 60 age group, but that in women there are two peaks with almost identical figures, the first in the 40 to 50 age group and the second in the 60 to 70.

#### Number

Chronic gastric ulcers are almost always single. In the present series 28 specimens (6.6 per cent.) showed two or more active chronic ulcers, in one specimen there being as many as five and in two four chronic ulcers. In addition, six specimens (1.4 per cent.) showed an active chronic ulcer with the scar of a healed ulcer, and one specimen (0.2 per cent.) showed two scars of healed ulcers. In 8.2 per cent. of the specimens removed for gastric ulceration, therefore, there was evidence of two or more chronic ulcers either active or healed. Hurst and Stewart's figures for multiple chronic lesions in autopsy material are 12.6 per cent. and in partial gastrectomy specimens 6.6 per cent.

#### Position

Table 2 shows the distance between the lower edge of chronic gastric ulcers and the pylorus in the 421 specimens investigated.

TABLE 2  
DISTANCE BETWEEN LOWER EDGE OF CHRONIC GASTRIC  
ULCERS AND THE PYLORUS

Site	Men		Women	
	No.	Per cent.	No.	Per cent.
0—2.5 cms. . .	110	32.5	21	20.8
2.5—5.0 cms. . .	46	13.6	4	4.0
5.0—7.5 cms. . .	87	25.7	21	20.8
7.5—10.0 cms. . .	55	16.3	26	25.7
More than 10 cms. from pylorus . .	40	11.8	29	28.7
Total . . . . .	338		101	

NOTE.—Specimens showing multiple ulcers have been included in this table.

There is a striking difference between the two sexes. In women 54.4 per cent. of chronic ulcers occur over 7.5 cm. from the pylorus and 28.7 per cent. are over 10.0 cm. away. It will be noted, also, that 20.8 per cent. of chronic ulcers occur in the pyloric canal and antrum. In men there is a much more even distribution from the pylorus up the lesser curvature, but the most frequent site is the pyloric canal and antrum.

The extraordinary preponderance of chronic gastric ulcers high up on the lesser curvature in women is supported by clinical observation, the writer's figures being very similar to those of Swynnerton and Tanner (1953). The latter, however, found that chronic ulcers in the pyloric canal and antrum were very rare in women, their figure being 0.8 per cent. The figure of 32.6 per cent. for the frequency of chronic ulcers at the same site in men is also nearly three times as high as those given by Swynnerton and Tanner. A possible explanation for this discrepancy could be that duodenal ulcers very near the pylorus have been included in the present series as gastric ulcers, but a re-examination has shown that, in the majority of cases, there is clearly pyloric mucosa on either side of the ulcers, sections of which are always taken along the axis of the lesser curvature. It is no exaggeration to say that it is unknown for a duodenal ulcer to extend beyond the pylorus into the stomach and vice versa.

The topographical distribution of chronic gastric ulcers is seen in Table 3.

In both sexes the majority are found along the lesser curvature and are usually saddle-shaped, with part of the ulcer on the anterior wall and part on the posterior. Only those ulcers clearly entirely on the anterior or posterior wall have been so designated. In this respect it is nearly always impossible to define ulcers in the pyloric canal and antrum. In this series no chronic ulcers occurred at the cardia, in the fundus or on the greater

TABLE 3  
TOPOGRAPHICAL DISTRIBUTION OF CHRONIC GASTRIC ULCERS

Site	Men		Women	
	No.	Per cent.	No.	Per cent.
Pyloric Canal and Antrum ..	110	32.5	21	20.8
Lesser Curvature ..	176	52.1	66	65.3
Anterior Wall ..	7	2.1	4	4.0
Posterior Wall ..	45	13.3	10	9.9
Total .. ..	338		101	

curvature. It can be seen from Table 3 that in either sex it is rare for a chronic gastric ulcer to occur on the anterior wall away from the lesser curvature.

**Chronic Duodenal Ulcer**

*Sex Incidence and Age*

Of the 523 gastrectomy specimens removed for duodenal ulceration, 438 were from males and 85 from females, giving a ratio of 5.1 : 1. This figure is very similar to that given by various authorities in the past. Bockus (1946), in a review of 786 cases of duodenal ulcer, found an incidence of 636 males and 150 females, giving a ratio of 4.2 : 1.

The age at which patients with duodenal ulceration came to operation is shown in Table 4.

TABLE 4  
DUODENAL ULCERATION: AGE AT WHICH PATIENTS CAME TO OPERATION

Age Group	Men		Women	
	No.	Per cent.	No.	Per cent.
20— ..	24	5.5	—	—
30— ..	88	20.1	19	22.3
40— ..	149	34.1	26	30.6
50— ..	123	28.0	25	29.4
60— ..	45	10.3	13	15.3
70— ..	8	1.8	1	1.2
80— ..	1	0.2	1	1.2
Total ..	438		85	

From this it can be seen that the peak period for both sexes is the 40 to 50 age group.

*Number*

In contradistinction to the stomach it is common, in the duodenum, to find two chronic ulcers, one on the anterior wall, and the other on the posterior. In surgical material duodenal ulcers are frequently left behind, so that, in the present series, it is not possible to give any accurate figures. Stewart (Hurst and Stewart, 1929) gives a figure,

based on autopsy material, of 17.6 per cent. for the frequency with which double chronic ulcers are found.

*Position*

Duodenal ulcers are confined to the first part of the duodenum and almost invariably arise from the anterior or posterior wall or both. Occasionally a posterior wall ulcer will partially encircle the duodenum, thereby involving the lateral walls. Duodenal ulcers and scars are equally common on the anterior and posterior walls. In Stewart's (Hurst and Stewart, 1929) series nearly half the cases showed a lesion in both situations. In a series of 230 cases of duodenal ulcer, active or healed, 64 were anterior, 62 posterior and in 104 cases there was a double lesion. Duodenal ulcers may be situated very close to the pylorus, although most frequently they are 1 to 2 cm. away from it.

**Morbid Anatomy of Chronic Gastric and Duodenal Ulcers**

The size of the chronic gastric ulcers in the present series is shown in Table 5.

TABLE 5  
SIZE OF CHRONIC GASTRIC ULCERS IN 403 PARTIAL GASTRECTOMY SPECIMENS

Greatest Diameter	Chronic Gastric Ulcers
Under 1.0 cm. ..	145
1—2 cms. ..	141
2—3 cms. ..	67
3—4 cms. ..	24
4—5 cms. ..	11
5—6 cms. ..	6
6—7 cms. ..	3
7—8 cms. ..	3
Over 8 cms. ..	3

The largest number fall into the under 1 cm. group. As many chronic gastric ulcers are prepyloric and many are of this size, it must be very difficult to demonstrate their presence by radiology or gastroscopy. It is possible, therefore, that a considerable number of these cases are thought to have duodenal ulcers. This may be the explanation for the discrepancy in the figures for the frequency of prepyloric ulcers seen in surgically removed specimens and those diagnosed on radiology and gastroscopy alone.

In the duodenum chronic ulcers on the posterior wall tend to be considerably larger than those on the anterior wall. The explanation for this is that those on the anterior wall that reach any size are likely to perforate.

Most chronic peptic ulcers have a rounded or oval orifice to the ulcer crater, which, typically, is flask-shaped with overhanging margins, but there

is much variation. The size of the crater orifice may, therefore, be very misleading in relation to the size of the ulcer. In the stomach ulcers on the lesser curvature are usually elongated because they straddle the lesser curvature with their long axis at right angles to it.

Chronic peptic ulcers completely penetrate the muscle coat which is replaced by granulation tissue in which the amount of fibrosis depends on the age of the ulcer. The muscle coat ends in the outer wall, and, in well-established ulcers, the fibres splay out and sweep upwards to mingle with the muscularis mucosae in a very characteristic manner. The floor of an active peptic ulcer is covered by a thin slough which is usually firmly adherent. Chronic gastric ulcers on the posterior wall of the stomach frequently penetrate the underlying pancreas, which becomes part of the ulcer floor. Those on the anterior wall may become adherent to the left lobe of the liver, but this is not common. Chronic duodenal ulcers on the posterior wall nearly always involve the head of the pancreas.

The peritoneal surface of a chronic gastric ulcer shows thickening of the serosa, which is whitish in colour and opaque. Fibrous adhesions may be present to adjacent structures. Not infrequently, in association with a chronic gastric ulcer, the lymph nodes along the lesser and greater curvatures may be enlarged, firm and even whitish in colour from a marked degree of reactive hyperplasia. This appearance may mislead the surgeon into thinking that metastases are present and that he is dealing with a gastric carcinoma.

In the technique used in the investigation of the specimens in the series considered in this paper all ulcers, whatever their size, have been sectioned whole, the piece of tissue always being taken through the ulcer along the cardiac-pyloric axis. In the writer's experience chronic gastric ulcers never occur in body mucosa, no matter where they are situated. Sometimes, in high ulcers, body mucosa is present at the upper edge of the ulcer, but the mucosa at the lower edge is invariably pyloric in type. The distribution of the pyloric mucosa in the stomach is extremely variable and, on occasion, it may extend along the lesser curvature almost to the cardia. Chronic gastric ulcers which are found high up on the lesser curvature may arise at the junction of the pyloric with the body mucosa, although frequently sections will show them completely surrounded by pyloric mucosa.

In the ulcer floor of a typical active chronic peptic ulcer a section shows clearly the four distinct zones originally described by Askanazy (1920-24). First, there is a layer of purulent or fibrino-purulent exudate which is easily detached from

the underlying necrotic zone. The latter is narrow but well defined and usually intensely acidophilic. It is a zone of fibroid necrosis and is usually structureless. The granulation tissue zone comes next. It is of variable width and passes imperceptibly into the fourth or fibrous zone. It is infiltrated by a varying number of chronic inflammatory cells. The fibrous zone is composed of dense fibrous tissue and fills the gap formed by the penetration of the muscle coat. It contains vessels, nerves and frequently foci of lymphoid tissue. The smaller arteries show a varying degree of obliterative endarteritis and some of the veins may be thrombosed.

At the edges of a chronic ulcer the mucosa may terminate abruptly or overhang. The muscularis mucosae is usually thickened and extends right up to the wall of the crater. The submucosa is thickened and fibrotic. The muscle coat ends abruptly in the walls of the ulcer and, in ulcers of some chronicity, the muscle fibres are splayed out and sweep upwards to merge with the muscularis mucosae.

The early signs of healing of a chronic peptic ulcer are the slow disappearance of the acute inflammatory reaction in the tissues surrounding it with progressive reduction in tissue oedema. At the same time the ulcer floor starts to be cleaned up with a separation of slough and fibrino-purulent exudate. The collagen fibres in the fibrous zone of the ulcer floor contract more and more, thereby greatly reducing the size of the ulcer and the area to be re-epithelialized. New formed epithelium commences to grow inwards from the ulcer margins over the healthy granulation tissue now lying in the ulcer floor and the whole area eventually becomes epithelialized. At first the covering epithelium is thin and pinkish in colour, but it soon increases in thickness by the formation of simple tubular glands. Even after the ulcer floor is completely covered with epithelium contraction of the fibrous tissue in the floor continues, ending in the formation of a puckered scar which may be a mere fraction of the size of the original ulcer. The breach in the muscle coat is never restored by muscle, but is filled by dense fibrous tissue, remaining as a permanent scar in the stomach wall.

### The Pathology of Ulcer-Cancer

For the last hundred years the pendulum has swung one way and then the other with regard to the frequency with which a chronic gastric ulcer undergoes malignant change. The peak of the swing towards a high frequency of ulcer-cancer was reached in 1910, when Wilson and McCarthy published a paper claiming that 71 per cent. of 153 cases of gastric cancer showed histological evidence that the cancer had arisen in a pre-existing gastric

ulcer. These findings were not confirmed by subsequent investigators, who showed that epithelial hyperplasia at the edges of chronic gastric ulcers and its distortion by fibrosis could easily be mistaken for evidence of early malignant change. Between 1925 and 1935 the problem was most carefully investigated by Stewart (Hurst and Stewart, 1929), Dible (1925) and Newcomb (1932-33). These three workers all applied the same strict histological criteria to the diagnosis of ulcer-cancer and their figures were very different from those of Wilson and McCarthy. Stewart found cancer in the margins of 11 out of 180 chronic ulcers investigated, an incidence of 6.1 per cent. Dible investigated 33 cases of gastric cancer and found that in two cases, i.e. 6 per cent., the cancer had arisen in a gastric ulcer. Newcomb found that 3.75 per cent. of the chronic gastric ulcers he investigated showed evidence of cancer in their margins.

The present position in this country would seem to be that, whilst most pathologists believe that about 5 per cent. of chronic gastric ulcers undergo malignant change, many clinicians have swung to the opposite extreme and doubt if a chronic gastric ulcer ever becomes malignant. In America, however, most clinicians believe that at least 10 per cent. of chronic gastric ulcers eventually become malignant. To the writer it seems rather like burying one's head in the sand to state that a chronic gastric ulcer never becomes malignant and that all such lesions can be explained on the basis of an excavating primary carcinoma. Chronic indolent ulcers in other parts of the body occasionally become malignant and there is no reason why this should not happen in the stomach.

The histological criteria to be strictly applied before the diagnosis of ulcer-cancer can be established are twofold. Firstly, there must be definite

evidence of a pre-existing chronic gastric ulcer and, secondly, there must be irrefutable evidence that malignant change has occurred at the edges of the ulcer. In the present series of cases the four histological criteria laid down by Newcomb (1932-33) as being necessary for the diagnosis of a pre-existing chronic gastric ulcer have been followed. These criteria are:

1. Complete destruction of an area of muscle corresponding in size roughly to the floor of the ulcer.
2. The presence of a large area of dense fibrosis and granulation tissue in the floor of the lesion.
3. The presence of endarteritis obliterans and thrombophlebitis in the vessels around.
4. Fusion or close approximation of the muscularis mucosae and muscularis at the margin of the ulcer.

The final criterion of malignant change is the occurrence of metastases which were present in the majority of the cases to be considered. When a gastric ulcer becomes malignant the process commences in the margin of the ulcer and spreads slowly round the ulcer, the cancer cells also infiltrating the muscle lying in the ulcer wall. The infiltration does not extend into the ulcer floor until a very late stage and it was not present in any of the cases to be described. It is difficult to think of a primary ulcerating carcinoma in which not a single cancer cell remains in the whole ulcer floor.

Applying the above criteria to the present series, eight cases were found to be ulcer-cancers, an incidence of 1.9 per cent. It must be remembered that we are only dealing with partial gastrectomy specimens, so that the figure for the incidence of ulcer-cancer could be expected to be considerably lower for chronic gastric ulcers as a whole.

The salient features of the eight cases of ulcer-cancer are summarized in Table 6.

TABLE 6  
EIGHT CASES OF ULCER-CANCER

Age	Sex	Length of History	Site	Size of Ulcer	Fate
43	F	3 years	Prepyloric	4.0 cms.	Died from metastases 1 year after operation
52	M	4 years	10 cms. from pylorus on lesser curvature	1.5 cms.	Died from metastases 3½ years after operation
35	F	1 year	Prepyloric	2.0 cms.	Metastases in lymph nodes. 1 year after operation alive and well
38	M	7 years	Prepyloric	3.0 cms.	Died from metastases 2½ years after operation
38	M	5 years	2 cms. from pylorus	2.0 cms.	No metastases in regional lymph nodes. Died 2 years after operation from cerebral haemorrhage. No post mortem
46	M	20 years	3 cms. from pylorus	3.0 cms.	Metastases in lymph nodes. Last seen 5 years after operation—lost much weight, believed to have metastases
64	M	4 years	Prepyloric	3.0 cms.	Died from metastases 1 year after operation
40	M	2 years	Prepyloric	1.0 cm.	No metastases in lymph nodes. Alive and well 8 months after operation

It will be seen that three of the cases were under forty and two under forty-five. Except for one case, the length of history was measured in years. Seven of the eight ulcer-cancers occurred in the pyloric antrum, thus confirming that it is the chronic ulcer in this situation which is particularly liable to undergo malignant change. Five of the patients are dead, one was dying when last seen and two are still alive and well, but these were operated on within the last 18 months.

From the present series, therefore, it may be concluded that it is rare for a chronic gastric ulcer to undergo malignant change, but that it does

occur there can be no doubt. The prognosis is extremely bad.

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## THE ACUTE COMPLICATIONS OF PEPTIC ULCER AND THEIR SURGICAL TREATMENT

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Perforation and haemorrhage, the acute complications of peptic ulcer, are of importance mainly because they may be the cause of death in a disease which otherwise does not usually threaten the life of the patient; these complications are also of special interest at the present time because the views of physicians and surgeons about their treatment have recently changed and are, indeed, still undetermined.

### Perforation

The term 'perforation' is used to describe the free perforation of a peptic ulcer into the peritoneal cavity in distinction to the 'penetration' which occurs when an ulcer invades a neighbouring organ such as the pancreas.

Perforation occurs most commonly in ulcers on the anterior surfaces of duodenum or stomach, but occasionally a posterior ulcer perforates freely into the lesser sac. Perforation may also occur in a gastrojejunal ulcer or in an ulcer related to Meckel's diverticulum, and an oesophageal peptic ulcer may perforate into the pleural cavity. The simultaneous perforation of two ulcers has been reported.

Most perforated ulcers are of a chronic type, but the complication may occur in relatively acute ulcers which have been present for at most one or two weeks (Fig. 1).

### Incidence

Because perforation of a peptic ulcer almost invariably leads to admission to hospital and to accurate diagnosis, studies of the frequency of the complication are comparatively reliable. In the 19th century perforation was an uncommon event and the majority of cases occurred in young women (Brinton, 1857), but a remarkable change of the incidence has occurred since the first decade of this century (Stewart and Winsor, 1942; Tidy, 1945). Perforation is now relatively common and occurs much more frequently in men—about 15 men to one woman. It may occur at any age, but is rare before adolescence; it is most frequent between 30 and 45 years, but it is now not uncommon in the aged. The perforation of an ulcer does not appear to be related in time to the eating of food or to physical exertion. There is more danger of the complication when the patient is physically or mentally tired; the incidence of perforation rises in the winter months, at the end of the working week and at the end of the working day (Illingworth *et al.*, 1944; Jamieson, 1947).

### The Clinical Features of Perforation

The typical clinical picture of an acute perforation in a patient who gives a history of peptic ulcer symptoms is easily recognized from the