# THE TREATMENT OF PERFORATED PEPTIC ULCER

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Perforation of a peptic ulcer is a common complication occurring in about 10% of all cases.[40] It threatens the life of the patient by producing first a chemical peritonitis, followed later by bacterial peritonitis, and early diagnosis and treatment are required if the patient is to survive.

In this paper I propose to review the literature on the subject, and to illustrate my remarks by referring to a series of 42 patients on whom I operated personally (Tables I and II).

Until recent years the treatment of perforated peptic ulcer consisted of simple closure of the perforation. However, with improved methods of fluid and electrolyte replacement, improvements in anaesthesia, and the introduction of the antibiotics, other forms of treatment have become increasingly popular.

At present there are 3 forms of treatment available: (1) conservative treatment, (2) simple closure of the perforation, and (3) radical surgery, including (a) immediate partial gastrectomy, and (b) immediate vagotomy combined with a gastric drainage operation.

Before discussing the various forms of treatment it is necessary to consider certain facts about perforated ulcers, since these have a bearing on prognosis and, therefore, on the choice of treatment.

## 1. The Chronicity of the Ulcer

It is important to distinguish between perforated acute and chronic ulcers, since there is a considerable difference in mortality and morbidity in the two conditions.[15]

They may be distinguished in two ways.

(a) *The history*. In acute ulcers there is generally no history of dyspepsia or only a very short one, whereas in chronic ulcers there is a history of chronic bouts of dyspepsia.

(b) *At operation*. In acute perforations the hole is small and punched out and the stomach and duodenal wall is mobile. In chronic ulcers the perforation is usually larger, and there is usually appreciable scarring and deformity of the adjacent stomach or duodenal wall. Thus, in some cases, despite a very short history of dyspepsia, it is obvious at laparotomy that the ulcer is a chronic one. This is illustrated by several cases in the present series. Case 14 gave no history of indigestion, but was found to have a chronic gastric ulcer at operation. Case 21 also had no indigestion, but operation showed a chronic duodenal ulcer, while case 36 gave a 6-weeks' history of indigestion and at operation a giant chronic gastric ulcer was found.

It has been shown that mortality occurs mainly in patients with chronic peptic ulcer. Thus Gilmour,[15] in a series of 119 cases treated by simple suture, and Taylor and Warren,[37] in a series of 47 cases treated conservatively, had no fatalities in patients with perforated acute ulcers, whereas in patients with chronic ulcers Gilmour[15] had a 15% mortality and Taylor and Warren[37] a 14% mortality. The reason for this is that in chronic ulcers factors such as chronic ill-health, electrolyte imbalance, and protein deficiency associated with pyloric stenosis, contribute to the fatal outcome.[33] In addition, it may be impossible to secure closure of the perforation owing to the rigidity of the affected area.[16]

In the present series there were 4 deaths, all of which occurred in patients with chronic ulcers.

## 2. The Situation of the Ulcer

Perforated gastric ulcers have a much worse prognosis than perforated duodenal ulcers.[3] Thus, in a series of 202 cases treated by simple closure, Desmond and Seargeant[12] found a 5.8% mortality in perforated duodenal ulcer, but a 21% mortality in perforated gastric ulcer. Gastric perforations are, on the whole,

TABLE I. PERFORATED PEPTIC ULCER TREATED BY SIMPLE CLOSURE

| No. | Age | Sex | Previous history | Type of ulcer | Duration of perforation | Remarks |
|---|---|---|---|---|---|---|
| 1 | 73 | Male | ? | Giant Chronic G.U. | 6 hours | *Fatal haematemesis on 10th postoperative day. P.M.: Large benign G.U. |
| 2 | 48 | Male | ? | Acute D.U. | 3 hours | Uneventful recovery |
| 3 | 57 | Male | ? | Chronic D.U. | 5 hours | Had a previous perforation. Uneventful recovery |
| 4 | 72 | Female | ? | Chronic D.U. | 6 hours | Had haematemesis and melaena. 24 hours later had perforation. Uneventful recovery |
| 5 | 63 | Male | ? | Chronic D.U. | 4-6 hours | Uneventful recovery |
| 6 | 62 | Male | ? | Chronic D.U. | 4 hours | Uneventful recovery |
| 7 | 65 | Male | ? | Chronic D.U. | 8 hours | Uneventful recovery |
| 8 | 46 | Male | 2 weeks | Acute D.U. | 3 hours | Uneventful recovery |
| 9 | 45 | Male | 1 year | Chronic G.U. | 4 hours | Uneventful recovery |
| 10 | 27 | Male | Several days | Acute G.U. | ±6 hours | Uneventful recovery |
| 11 | 83 | Female | ? | Acute G.U. | 12 hours | Certified mental patient. Uneventful recovery |
| 12 | 42 | Male | 10 years | Chronic D.U. | 3-4 hours | Patient under treatment for active pulmonary tuberculosis. Therefore treated by simple closure |
| 13 | 10 | Male | Several weeks | Acute D.U. | 5 hours | Uneventful recovery. Still had indigestion one year later |
| 14 | 72 | Female | Nil | Chronic G.U. | 8 hours | *Admitted with melaena. 10 days later perforation occurred while in hospital. There was a ½-inch perforation in the pyloric region. Died 36 hours after operation |
| 15 | 18 | Female | 3 months | Acute D.U. | 4 hours | Uneventful recovery |
| 16 | 26 | Male | 6 years | Chronic D.U. | 3 hours | Chronic alcoholic. Uneventful recovery |
| 17 | 68 | Male | Nil | Acute D.U. | 18 hours | Uneventful recovery |
| 18 | 63 | Male | Nil | Acute G.U. | 6 hours | Uneventful recovery |
| 19 | 65 | Male | 3 months | Acute G.U. | 10 hours | Mental patient. Had a previous gastrostomy for oesophageal stricture. Ulcer about one inch away from site of gastrostomy. Uneventful recovery |
| 20 | 28 | Male | 9 months | Acute D.U. | 4 hours | Uneventful recovery |
| 21 | 56 | Male | Nil | Chronic D.U. | 5 days | *5 days abdominal pain, vomiting coffee grounds, melaena. Case of simultaneous bleed and perforation. Also chronic bronchitic. Gravely ill pre-operatively. Marked peritoneal soiling with a ½-inch perforation. Died 48 hours after operation |
| 22 | 27 | Male | 1 week | Acute D.U. | 4 hours | Uneventful recovery |
| 23 | 49 | Male | Nil | Acute D.U. | 4 hours | Previous history of bilateral Smithwick operation, nephrectomy, and coronary thrombosis. Uneventful recovery |
| 24 | 48 | Male | Nil | Acute D.U. | 8 hours | Also found to have a carcinoma of the rectum. Abdominoperineal resection 3 weeks later. Uneventful recovery |
| 25 | 47 | Male | 10 days | Acute D.U. | 5 hours | Uneventful recovery |
| 26 | 49 | Male | 6 days | Acute D.U. | 7 hours | Uneventful recovery |
| 27 | 23 | Female | 2 weeks | Acute D.U. | 3 hours | Uneventful recovery |
| 28 | 48 | Male | 3 months | Acute D.U. | 4 hours | Uneventful recovery |

D.U.=Duodenal ulcer.　　G.U.=Gastric ulcer.　　*=Death.　　P.M.=Postmortem examination.

TABLE II. PERFORATED PEPTIC ULCER TREATED BY IMMEDIATE GASTRECTOMY

| No. | Age | Sex | Previous history | Type of ulcer | Duration of perforation | Remarks |
|---|---|---|---|---|---|---|
| 29 | 51 | Male | 4 years | Chronic D.U. | 3 hours | Uneventful recovery |
| 30 | 57 | Male | 9 years | Chronic D.U. | 6 hours | Uneventful recovery |
| 31 | 65 | Male | 30 years | Chronic D.U. with stenosis | 1 hour | Uneventful recovery |
| 32 | 46 | Female | 10 years | Chronic D.U. | 10 hours | Uneventful recovery |
| 33 | 64 | Female | 6 years | Chronic D.U. | 8 hours | *Severe haematemesis and melaena 1 year previously. Operation advised but delayed in order that a radical mastectomy could be performed for carcinoma of the breast. Perforation treated by Moynihan antecolic partial gastrectomy. On 6th postoperative day developed severe abdominal pain. Laparotomy revealed strangulated loop of bowel behind anastomosis. Died 12 hours later |
| 34 | 39 | Male | 10 years | Chronic D.U. | 2 hours | Uneventful recovery |
| 35 | 63 | Male | 20 years | Chronic D.U. | 6 hours | Perforated anterior D.U., penetrating posterior D.U. and marked prestenotic diverticula. Small prepyloric ulcer and large hiatus hernia also present. Chronic bronchitic and alcoholic. Uneventful recovery |
| 36 | 45 | Female | 6 weeks | Chronic G.U. | 10 hours | Very pale. Pre-operative haemoglobin = 39%. Giant chronic G.U. with hour-glass deformity. Histology showed benign G.U. Uneventful recovery |
| 37 | 55 | Male | 4 years | Chronic D.U. | 6-7 hours | Uneventful recovery |
| 38 | 76 | Female | 6 months | 2 Chronic G.U.'s anterior and posterior | 24 hours | Little peritoneal contamination. Uneventful recovery |
| 39 | 79 | Male | 1 year | Chronic D.U. | 12 hours | Uneventful recovery |
| 40 | 79 | Female | 2 years | Chronic G.U. | 8 hours | Uneventful recovery |
| 41 | 39 | Male | 2 months | Chronic G.U. | 21 hours | Marked peritoneal contamination. Postoperatively left subphrenic abscess drained. Thereafter uneventful recovery |
| 42 | 44 | Male | 3 months | Perforated gastric carcinoma | 48 hours | Gross peritoneal contamination. Histology: anaplastic carcinoma of stomach. Uneventful recovery |

D.U. = Duodenal ulcer.          G.U. = Gastric ulcer          * = Death.

larger than duodenal perforations,[1] and in duodenal ulcers there is a much greater tendency for the perforation to become either partially or completely sealed off by a neighbouring viscus or omentum.[33] Thus, peritoneal soiling is often minimal in amount in perforated duodenal ulcers. In addition, gastric ulcers occur in patients in the older age group and in whom mortality is higher.

### 3. The Question of Malignancy

Quite a high proportion of carcinomas of the stomach appear in the guise of simple gastric perforations.[30] Thus, Doll[13] found 17 patients with perforated carcinomas of the stomach at the Central Middlesex Hospital in the years 1938–1948. Kennedy[21] quotes a series of 111 cases of perforation from the London Hospital, which includes 7 cases of perforated gastric carcinoma. Louw[22] states that 12% of gastric perforations are malignant. Taylor[38], in a series of 256 cases of perforation, found that the incidence of cancer was 2·3% of all perforations and 21% of all the perforations occurring in the stomach.

In the present series of 42 cases, 1 of the perforations was malignant. Often the growth is small and well localized without evidence of glandular or hepatic involvement, and is liable to be mistaken for a benign gastric ulcer.

### TREATMENT

#### 1. Conservative Treatment[1]

##### Rationale

The rationale for this form of therapy is that at operation one often finds that the perforation has already been sealed off by an omental plug or by adherence to an adjacent viscus. The aim of treatment is to preserve this seal and thus prevent further contamination of the peritoneal cavity; any bacterial invasion that has already taken place will be adequately dealt with by the peritoneum.

##### Method

By far the most important factor in conservative treatment is effective and constant gastric suction. This removes swallowed air and most of the gastric secretions, and also reduces the amount of duodenal secretion by removing the stimulus of gastric contents entering the duodenum. The seal of the perforation is left undisturbed and is allowed to become firm. This most important aspect of treatment requires constant supervision by the surgeon and nursing staff responsible.

The rest of the treatment consists of fluid and electrolyte re-

placement, administration of antibiotics, and suitable sedation.

The amount of gas under the diaphragm, on a plain X-ray film of the abdomen, is noted, and another X-ray is taken 12 hours later. If the second picture reveals an increase in the amount of gas, operation is considered.

The above treatment is continued until the patient has a soft, flat abdomen, normal bowel sounds are audible, and the patient has passed flatus. Gastric suction and intravenous fluid therapy are then discontinued and oral feeding commenced.

Surgery is only necessary to deal with a residual abscess (usually subphrenic), should this occur.

*Advantages*

1. *Fewer complications.* Wound infections, disruptions, and incisional hernias are eliminated, as are anaesthetic complications. There is no risk of postoperative adhesions, and pulmonary complications are markedly decreased. Intraperitoneal abscesses are no more frequent than in surgically treated cases, except for subphrenic abscess, which may have a higher incidence.

2. *Less stress.* The patient is subjected to less stress than with operative treatment. The possibility of acute coronary occlusion, or a similar disaster, is diminished.

3. Should surgery become necessary at a later date because of recurrent ulcer symptoms, the operative area is surprisingly free from adhesions and distortion. This makes the definitive operation much easier and, therefore, much safer. In addition, the patient can be operated upon when he is in the optimum condition.

4. An occasional complication of simple closure of a perforation is pyloric obstruction. This complication is almost non-existent with conservative treatment.

*Disadvantages*

1. *Uncertainty or error in diagnosis.* Errors in diagnosis may have serious consequences. Perforation of another viscus may mimic perforated peptic ulcer clinically, and there are cases of appendicitis and intestinal strangulation which were treated conservatively in the belief that they were perforated peptic ulcers.

2. There is the possibility of inadvertently inserting the nasogastric tube through the perforation, and thus keeping it open. However, if the gastric aspirations are carefully recorded, this complication would be suspected by the limited amount of fluid being withdrawn. (Usually 1-2 litres of fluid a day are aspirated under these conditions.) In addition, the patient's symptoms would persist and the amount of gas under the diaphragm would increase. This objection is, therefore, more theoretical than real.

3. The fact that with non-operative treatment the site of the perforation is unknown, is another important criticism. Perforated gastric ulcers carry a higher mortality than perforated duodenal ulcers when operative treatment is employed, and this is equally true with conservative treatment. Beattie,[2] in a series of 40 patients treated conservatively, had 1 death out of 32 patients with duodenal ulcer, and 5 deaths out of 8 patients with gastric ulcer, one of the gastric ulcers being a perforated carcinoma.

4. Another objection is that there is a possibility of a perforated gastric carcinoma being treated conservatively. As the site of the perforation is unknown it is possible that an early carcinoma of the stomach (for example, malignant change in one part of a benign gastric ulcer) will be missed. Thus the chance of cure by performing an early gastrectomy will be lost.

5. The treatment will not affect the natural history of peptic ulcer, and many patients will subsequently develop recurrent symptoms which will require surgery. Taylor[38] found that after non-surgical treatment of perforated acute ulcer there was hardly any recurrence of symptoms, but in chronic ulcers there is a recurrent ulcer rate of no less than 85%, a partial gastrectomy rate of 60%, and an ulcer mortality rate of 4%.

*Results*

Seeley and Campbell[32] treated 139 patients with a mortality rate of 5%. Heslop *et al.*[17] made a carefully controlled study comparing two series of cases, each consisting of 104 consecutive and unselected patients. The mortality rate in the operative group was 8·6% while in the non-operative group it was 7·7%.

The proponents of conservative treatment claim that this form of therapy has at least an equal mortality rate, a definitely lower incidence of complications, and a more rapid return to normal activity as compared with the patients treated by surgery. However,

examination of the results of other reported series does not confirm this favourable outlook.

I have already quoted Beattie's[2] series of 40 cases in which he had a mortality of 15%. Taylor[38] treated a series of 256 cases conservatively with 2·5% mortality in 79 patients with perforated acute ulcers, but with a 15% mortality in 177 patients with perforated chronic ulcers. A 4% mortality was added for subsequent deaths from recurrence, which made the ultimate mortality in patients with perforated chronic ulcers 19%. Taylor, therefore, reserves conservative treatment for perforated acute ulcers or for situations where operative treatment is impossible.

Höyer,[18] in a series of 97 cases, had a 50·5% mortality while Desmond and Seargeant,[12] in 12 unselected patients treated conservatively, had a 41% mortality.

The conservative treatment of perforated peptic ulcer has not received wide acceptance, partly because it has not lowered the mortality of this condition, and partly because of the great demands on the nursing and medical attendants for prolonged and anxious observation. It is unsuitable for routine usage.[36]

Conservative treatment is, however, useful in the following types of cases: (1) Where the patient refuses operative treatment, (2) where the patient is unfit for anaesthesia and laparotomy, and (3) where, for geographical reasons, surgery is not possible — for example, perforation occurring in an isolated country area or in a ship far out at sea.

In the present series no patients were treated conservatively.

## 2. Simple Closure[5]

*Rationale*

It is, firstly, a life-saving procedure and, secondly, will permit permanent ulcer control in many patients.

1. *Life-saving procedure.* It offers a safe and easy method of preventing further spillage of the gastric or duodenal contents into the peritoneal cavity. That it is a safe procedure is shown by the results of McCaughan and Bowers[26] who had a mortality of 1·5% in a series of 262 unselected cases.

Another advantage is that it can be more safely performed by the less experienced than can gastrectomy, and it can be performed in institutions with limited facilities.

2. *Permanent ulcer control.* After simple closure 35-40% of patients with perforated peptic ulcers will remain free of ulcer symptoms and will not require any further surgical treatment.

*Method*

The perforation is closed by a series of sutures inserted in the long axis of the stomach or duodenum. Where the tissues are poor and closure difficult, the closure may be reinforced by bringing up omentum and tacking it down to the sutured area. If suture is impossible by virtue of the rigid unyielding margins of the perforation, it is simply plugged with omentum. However, this latter procedure, although perhaps immediately successful, is unsatisfactory since it leaves an area of defective duodenal wall. This, in the presence of hyperchlorhydria, will inevitably re-ulcerate and perhaps re-perforate.[30]

*Advantages of Simple Closure over Primary Resection*

1. *Psychological preparation of the patient.* In order that resection may get the best possible results, it is necessary to spend some time in preparing the patient psychologically for the operation and its after-effects. It is impossible to do this if the patient is virtually 'dragged off the street' for the resection. Simple closure delays the definitive procedure and permits the necessary psychological preparation if gastric resection is needed in the future.

2. *Joy of living with a normal stomach.* Simple closure also has the advantage that in many cases the patient may remain symptomfree for some years before gastrectomy becomes necessary. During this period the patient is able to enjoy all the benefits derived from having a normal stomach.

*Disadvantages of Simple Closure*

1. *Obstruction.* In duodenal ulcers simple closure is unwise where considerable cicatricial narrowing is present or in cases with large perforations, since it may produce complete stenosis occurring either immediately or at a later date. Pyloric obstruction occurred in 13% of 107 patients followed up by Scholnick and Hastings.[31]

Thus, if the patient's condition will permit, immediate resection is the preferable procedure in such cases.

2. *Haemorrhage.* It is claimed that this is uncommon in duodenal

ulcers, since most perforated ulcers occur anteriorly and laterally—areas which are not as vascular as the posterior duodenal region. However, it can occur in encircling duodenal ulcers or in patients in whom two ulcers co-exist — the anterior one perforating and the posterior one bleeding. Scholnick and Hastings,[31] in a series of 107 cases treated by simple closure, found that major haemorrhage occurred in 22% of patients while 2·3% of patients died of bleeding peptic ulcer.

The danger of haemorrhage is illustrated by case 1 of the present series. A male, aged 73 years, was admitted with a large perforated gastric ulcer, the perforation having been present for 6 hours. The perforation was too large to close with sutures and was, therefore, closed with an omental plug. Postoperative progress was satisfactory until the tenth postoperative day when he had a massive haematemesis and died. Necropsy examination confirmed the presence of a large benign gastric ulcer.

3. *Recurrent perforation.* Scholnick and Hastings,[31] in 107 patients treated by simple closure, found that 6% of patients had recurrent perforation, while Matheson,[25] in 115 patients, found that reperforation occurred in 11%. Case 3 in the present series was admitted with a reperforation of his ulcer, having had his first perforation treated by simple closure some time previously. I have also seen a patient admitted with a third perforation, the two previous perforations having been treated by simple closure.

4. *Delayed gastric resection is made slightly more difficult* than in the average patient with uncomplicated ulcer, by virtue of adhesions about the site of the perforation. However, this is not a great drawback.

5. In many instances *the lesion is juxta-pyloric*, and at the time of perforation it is difficult, if not impossible, to determine whether the lesion is pre- or post-pyloric. The possibility of carcinoma subsequently developing in patients with pre-pyloric perforations must not be overlooked.

6. *Later re-operation.* One of the most potent criticisms of simple closure is that many patients develop recurrence of their ulcer symptoms and in many a further operation is necessary. Turner[39] found that 85% of patients had a recurrence of symptoms after simple closure, while Henley[16] found that only 1 out of 5 patients remained symptom-free after simple closure. Re-operation, thus, cannot be avoided in a large percentage of cases, but it does have the advantage that it is performed when the patient is in a more favourable condition.

7. If a *perforated gastric carcinoma* is treated by simple closure, widespread peritoneal metastases are often found at the subsequent laparotomy, and even a palliative gastrectomy is then inadvisable.[12]

Reviewing the above criticisms one is led to the conclusion that simple closure is not satisfactory as a routine procedure.

*Indications for Simple Closure*

1. *Perforated acute ulcers.* As stated above, recurrence of symptoms is a complication mainly of perforated chronic ulcers and is uncommon after perforation of an acute ulcer. Thus simple closure is the operation of choice in treatment of perforated acute ulcers.

2. *Perforated chronic ulcers*, where the patient is unfit to undergo gastric resection.

3. *Perforated stomal ulcers.* In the majority of patients simple closure is the treatment of choice, since it gives satisfactory results and also because primary gastric resection in these patients may be fraught with difficulties. Desmond and Seargeant[12] had good results in 6 out of 7 patients with perforated gastrojejunal ulcers treated by simple closure.

However, primary gastrectomy may prove necessary where the stomal ulcer is very large, or where the perforation is difficult to repair without distortion of the anastomosis.

3. Radical Surgery: Primary Gastrectomy[35]

*Rationale*

Not only does this deal with the perforation, but it also removes the ulcer, thereby sparing the patient the inconvenience caused by recurrence of his symptoms, and avoiding a subsequent operation in a large proportion of cases.

*Simple Closure Compared with Primary Gastrectomy*

In assessing the value of any surgical procedure the two most important factors for consideration are the late results and operative mortality.

1. *Late results.* The major objection to simple closure is that it does not alter the natural history of the disease, irrespective of the view, that was prevalent at one time, that once an ulcer perforates the healing process has been initiated. Statistics show a high incidence of recurrence of symptoms.

Illingworth *et al.*,[19] found that remission of ulcer symptoms after perforation was seldom of long duration. Within 5 years 70% relapsed and 50% developed severe symptoms. The prognosis was found to be worse in patients with a long antecedent history, while the incidence of major complications, particularly reperforation and haematemesis, was 20% within 5 years of perforation.

Stabins,[36] in 167 cases, had a 65·1% recurrence of symptoms and 36·5% of his patients required further surgery later.

Emmett and Owen[14] found that in 70-85% of their patients in whom simple closure was done, recurrence of symptoms occurred, and about 40% required further surgical treatment for the relief of their persistent symptoms.

Höyer[18] in 430 patients, had a 72% recurrence of symptoms and 44% had a partial gastrectomy later.

Turner[39] found that 85·3% of patients treated by simple closure developed recurrence of symptoms. He stressed the dangers of reperforation and massive haemorrhage that exist in the immediate postoperative period, and advised gastric resection in the immediate postoperative period in those patients in whom primary gastric resection is contraindicated.

Tanner[36] found that, in a late follow-up of the patients with ulcer perforation treated by simple closure, one quarter of the patients with acute ulcer perforations had severe relapses of symptoms, and three quarters remained well, but of 65 patients with chronic ulcer perforations all had relapsed, two thirds requiring further operative treatment.

Thus, one is led to the conclusion that, with the exception of perforated acute ulcers, the late results of simple closure are far from satisfactory.

On the other hand, the late results of immediate gastric resection are very satisfactory and are probably no different from those following elective gastric resections.

Thus De Bakey[11] found, in a 1-5 year follow up of 74 patients treated by immediate gastrectomy, that the results were good or excellent in 89%, while Martinis, Olson and Harkins[24] found that 83% of their patients treated by primary or early elective gastric resection were completely asymptomatic on follow-up. Reports from other institutions similarly indicate a high percentage of good long-term results.

2. *Operative mortality.* Critics of primary resection argue that the procedure is too formidable for an acutely ill patient. They feel that the first duty of the surgeon is to save life and that control of the ulcer is a secondary consideration. They feel that there is no reason why a surgeon should attempt to perform a more difficult and more hazardous operation when a simpler safer closure procedure will keep the patient alive for a resection at a more propitious time.

Critics of resection argue that the mortality following simple closure is significantly less than that following resection. However, a review of the literature does not substantiate this contention.

Henley[16] treated 22 patients with perforated peptic ulcer by resection, with 2 deaths. In the same period 36 patients were treated by simple closure, also with 2 deaths.

Brachman, Cooley and De Bakey[6] treated 44 cases by resection with a 2·3% mortality. Noordijk[27] compared two series, the patients being of the same age group and having the same interval between perforation and operation. In 1,269 patients simple closure was carried out and in 777 gastrectomy. He found that the mortality rate was not significantly different in the two groups.

In the present series of 42 cases, 28 were treated by simple closure with a 10·7% mortality, while 14 were treated by primary gastrectomy with a 7·1% mortality.

De Bakey,[10] in his last 100 patients treated by primary gastric resection, had a mortality of 1%.

Nuboer,[28] in 131 patients with primary resection, had a mortality of 3·8%. It might be argued that it is impossible to compare the mortality rates of simple closure with resection, because simple closure is a routine procedure, whereas in resection a certain amount of selection of cases takes place. On the other hand, these mortality figures do not include the additional deaths that occur in patients who have had a simple suture of the perforation and either die later of further complications, such as reperforation or haematemesis, or who die later after being subjected to gastric resection for recurrence of their symptoms.

On the whole, increasing experience in many clinics has demonstrated that primary gastric resection may be applied with equal, if not with less, risk than the procedure of simple closure.

As regards the argument that emergency resection for perforation is more difficult and hazardous than elective resection, this, also, is not true. As Lowdon[23] pointed out, the anterior duodenal perforation is usually not associated with the technical difficulties so common with posterior and penetrating ulcers.

3. *Another objection to resection is that gastrectomy is unnecessary in many cases.* It has been shown that some 30% of patients are symptom-free after simple closure and most of these belong to the group of perforated acute ulcers, in whom a good result can be expected in the majority of cases. If the policy were adopted of performing a primary gastrectomy in all cases, it would involve an unnecessary mutilation in this 30%. Obviously, therefore, cases must be selected. In patients with chronic ulcers the majority will require further surgery after simple closure and there is, therefore, a very good case for performing primary gastrectomy in these patients, and simple closure in patients with perforated acute ulcers.

*Factors Influencing the Choice of Patients for Primary Gastrectomy*

Before undertaking emergency gastrectomy certain factors have to be considered.

1. *The surgeon.* It is essential that the surgeon has adequate experience of performing gastrectomy and is working in an institution with adequate facilities for good operative and postoperative care of the patient. If emergency gastrectomy is undertaken by inadequately trained surgeons in ill-equipped institutions the mortality figures would rise to prohibitive levels and would bring the operation into disrepute.

2. *Age.* Mortality increases with age. Desmond and Seargeant[12] found no mortality under the age of 40 years, while above this age the mortality of perforation steadily rose to 80% in patients over 80 years of age. Berne and Mikkelsen[3] found that the mortality of perforation was 4% for patients under 50 years of age and about 16% for patients over 60 years. As a general rule, in the elderly the smallest possible operation, namely, simple closure, should be performed. However, age, *by itself*, need not be a determining factor. Other factors besides age have to be taken into account and each case has to be treated on its own merits. Thus, in the present series, 3 patients were aged 76, 79 and 79 years, but since all were in good general condition, primary gastrectomy was performed and all made a good recovery.

3. *Duration of perforation.* The ideal time to perform resection is within the first 12 hours, since it has been shown that the mortality increases considerably with perforations of longer duration. As a general rule, we are reluctant to perform gastrectomy in cases where the perforation has been present for more than 12 hours. However, duration need not, *in itself*, be a determining factor. It often happens, especially in duodenal perforations, that partial or complete sealing off of the area by a neighbouring viscus has occurred. In these cases peritoneal contamination is often surprisingly small, even 12 hours after perforation, and what infection is present can be controlled by antibiotics and by fluid and electrolyte replacement. Thus de Bakey[9] found that 75% of gastrectomies were performed in the first 12 hours after perforation and 10% as late as 24 hours after perforation.

As a general rule, a gross degree of peritoneal soiling is a contraindication to resection, but this need not always be a deterrent. For example, Tanner[36] reported successful cases of primary resections in late perforations with frank pus in the peritoneal cavity. Rowlands and King[30] had a similar experience in 2 patients.

In case 41 in this series the patient had a perforated chronic gastric ulcer for 21 hours with gross peritoneal soiling and frank pus. A primary resection was performed. Postoperatively a left subphrenic abscess required drainage, otherwise recovery was uneventful.

In case 42 in this series the patient had a perforated gastric carcinoma of 48 hours' duration. There was a considerable amount of frank pus in the peritoneal cavity. Primary resection was followed by an uneventful convalescence apart from mild wound sepsis.

4. *The size of the ulcer* plays no part in the final decision unless it is an acute ulcer, in which case simple closure is all that is necessary. The great majority of perforated duodenal ulcers are situated on the free border of the duodenum and constitute no unusual technical difficulty. It is usually easy to free the duodenum, pylorus, and stomach from the inflamed and oedematous surrounding tissues. Closure of the duodenal stump in perforated duodenal ulcers is usually easy, though it is necessary in most cases to perform an open division and closure of the duodenum, since the oedema of its walls and the size of the perforation prevent the application of a clamp either across the ulcer or distal to it. Emmett and Owen[14] confirm that the technical difficulties of gastrectomy performed as an emergency for perforation are no greater than that performed as an elective procedure. A similar view is expressed by Louw.[22]

It is important to stress these points since the idea seems to be current that immediate gastrectomy in these cases is a hazardous procedure with a stormy postoperative course to be expected.

*Selection of Cases for Gastrectomy*

In *selecting cases for gastrectomy* the criteria of Desmond and Seargeant[12] are useful. Gastrectomy is carried out in the following cases:

1. *Perforated chronic gastric ulcer.* (Because of the high mortality of simple closure and because of the 12% risk of the ulcer being malignant.)

2. *Perforated gastric carcinoma.* It is usually assumed that when a gastric carcinoma perforates, it liberates viable neoplastic cells into the peritoneal cavity, which then form widespread peritoneal implants. However, Doll[13] has shown that this does not necessarily always occur, and this point is given further emphasis by Emmett and Owen's[14] patient with perforated gastric carcinoma who remained well for 6 years after primary resection.

3. *Perforated chronic duodenal ulcer* (for the reasons already given). There are several subgroups under this heading:

(*a*) In patients over 40 years of age with a history of dyspepsia of 6 months or more.

(*b*) In patients under the age of 40 years with a history of dyspepsia of at least 12 months.

(*c*) In patients with perforated duodenal ulcer with a short history, when the ulcer at operation is obviously a chronic one.

4. *Perforation combined with haemorrhage.* This double complication is said to occur in between 1-13% of patients.[34] The combination is very dangerous, the co-existence of haemorrhage increasing the mortality.[20] This combination was present in cases 4, 14, and 21 of the present series. All were treated by simple closure, 2 patients (cases 14 and 21) died.

## 4. Radical Surgery: Vagotomy and Gastric Drainage.

*Rationale*

Vagotomy plus a gastric drainage operation has become increasingly popular in the definitive treatment of chronic duodenal ulcer. Davies[5] has reported favourable results while Burge[7] considers it the operation of choice in the treatment of chronic duodenal ulcer. In recent years vagotomy has been introduced in the treatment of perforated duodenal ulcers. Not only does this form of therapy deal with the perforation, but it also provides a permanent cure of the ulcer.

The operation may take one of two forms.

(*a*) At operation the perforation is carefully inspected and, if the duodenum appears suitable for pyloroplasty, a Heineke—Mikulicz pyloroplasty followed by subdiaphragmatic vagotomy is performed.[29]

(*b*) Alternatively, the perforation is treated by simple closure. Then immediate subdiaphragmatic vagotomy and a gastroenterostomy is performed.[7]

*Advantages*

1. It saves the patient a subsequent operation for the control of recurrent ulcer symptoms and it provides permanent control of the ulcer in the vast majority of cases.

2. It is an operation of considerably less magnitude than partial gastrectomy.

3. The stomach is not removed and postoperatively the patient's nutrition is better than in patients who have had a gastrectomy.

*Disadvantages*

1. In performing vagotomy the posterior mediastinum is opened, and infected material from the peritoneal cavity may be introduced into this space giving rise to mediastinitis.

2. Where pyloroplasty is performed to provide gastric drainage, it is possible that leakage may occur owing to the duodenal wall being fibrosed and rigid due to the presence of a chronic duodenal ulcer.

3. The incidence of recurrent ulceration is higher than that following partial gastrectomy.[8]

## Results

Pierandozzi, Hinshaw and Rogers[29] treated 36 patients with an average age of 38 years and an average duration of perforation of 9 hours. There were no deaths and no evidence of postoperative duodenal leaks or fistulae. There were no symptoms or signs of mediastinitis, while a residual abscess developed in 1 patient. The procedure was not used in patients over 55 years of age, in late perforations, if there was excessive peritoneal spill, in patients who remained in shock, or in those with severe systemic diseases or alcoholism.

Vagotomy and gastric drainage was not used in treating any cases in the present series.

As yet no one has had sufficient experience with vagotomy and a gastric drainage operation in the treatment of perforated chronic duodenal ulcers to make any dogmatic statements, but further experience may show that it is a very satisfactory method of treating such cases.

## SUMMARY

1. The mortality of perforated peptic ulcer occurs mainly in chronic ulcers.

2. Perforated gastric ulcers have a higher mortality than perforated duodenal ulcers.

3. Some 12% of perforated gastric ulcers are malignant.

4. Conservative treatment is indicated where: (a) the patient refuses surgery, (b) surgery is impossible for geographical reasons, and (c) the patient is unfit for surgery.

5. Simple closure is indicated in: (a) perforated acute ulcers, (b) perforated chronic ulcers where the patient is unfit for gastrectomy, and (c) most perforated stomal ulcers.

6. Immediate gastrectomy is indicated in: (a) perforated chronic gastric ulcer, (b) perforated gastric carcinoma, (c) perforated chronic duodenal ulcer, and (d) where bleeding is present in association with perforation.

7. The place of vagotomy and a gastric drainage operation in the treatment of perforated duodenal ulcer has not, as yet, been settled.

8. A personal series of 42 cases is presented. Of these patients, 28 were treated by simple closure with a 10·7% mortality and 14 by immediate gastrectomy with a 7·1% mortality.

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