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## RESULTS OF PARTIAL GASTRECTOMY FOR PEPTIC ULCER

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An attempt is here made to assess the merits of four types of anastomosis used in partial gastrectomy. The operations were performed for chronic gastric and duodenal ulcer during the six years ending Dec. 31, 1946. We have excluded all cases of carcinoma, those cases of peptic ulcer in which a previous operation other than suture of a perforation had been performed, emergency gastrectomies for haemorrhage, and a few operations in which the pylorus was not removed but was excluded. The series consists of 248 patients, and in reviewing the results we have paid particular attention to (a) the immediate post-operative course, with special reference to complications due to the type of anastomosis, and (b) the functional results. These have been divided into good, fair, and poor. The result is good if the patient is satisfied with the operation and admits to no significant side-effects. It is fair if the patient is satisfied with the operation but is found to have modified his diet or eating habits to avoid unpleasant symptoms. It is classified as poor when the patient is dissatisfied with the operation or when we have considered the functional result to be unsatisfactory.

The length of time since the operation ranges from one to six years, the average period being thirty-seven months. Fifteen patients have not been traced. The last known residence of eleven of these has been visited, but they had left the district and all attempts at follow-up have failed. Visits were not paid to the residences of the other four, as two were known to have left the country and two lived a long distance away.

The following four types of anastomosis were used: Type I: An end-to-side anastomosis with an antecolic proximal loop attached to the greater curve (Fig. 1). Type II: An end-to-side anastomosis with a long antecolic proximal loop attached to the lesser curve with a valve and a small stoma (Fig. 2). Type III: An end-to-side anastomosis with a short post-colic proximal loop attached to the lesser curve with a small valve and a small

stoma (Fig. 3). Type IV: An end-to-end anastomosis of the Billroth I type, joining the duodenum to the greater curvature of the stomach (Fig. 4).

### Type I: Antecolic Anastomosis

Average period since operation	.. .. .	61 months
Number of operations	.. .. .	45
Operative mortality	.. .. .	1 (duodenal ulcer)

Cause of death: Bronchopneumonia.

Traced	.. .. .	41
Good	.. .. .	18 (8 duodenal, 10 gastric)
Fair	.. .. .	18 (4 " " 14 " " )
Poor	.. .. .	2 (1 " " 1 " " )
Since died	.. .. .	3 (1 " " 2 " " )
Causes of death: bomb injury (gastric), cardiac failure (duodenal), torsion of caecum (gastric).		
Untraced	.. .. .	3
(1 duodenal, 2 gastric)		

Male, duodenal ulcer. Very fit 4 months after operation. Changed address.

Male, gastric ulcer. Good 3 months after operation: changed address.

Female, gastric ulcer, changed address.

**Post-operative Period.**—The operation seemed to be safe and satisfactory. The only objection was that the stomach remnant was slow to begin emptying into the efferent loop. Accordingly a nasal suction tube was left *in situ* for several days until the stomach contents began to pass through into the efferent loop.

**Late Function.**—This operation is not really satisfactory. Many writers, including Ogilvie (1947), have pointed out that an anastomosis of this type leads to proximal-loop filling in many cases and consequent postcibal distress. Investigations show that proximal-loop reflux is present in most of the patients in this group. The barium meal can be seen to pass through the stomach remnant straight into the proximal loop; this contracts and gradually pumps its contents back through the stomach into the distal loop. In spite of the high incidence of proximal-loop reflux the results are quite good some years after operation. Most patients complain of side-effects for some months after the operation. Eighteen now claim to have a very good digestion. Eighteen are classed as fair: as a group these eighteen are very pleased with the operation and are living a reasonably normal life, but most of them like to rest for a period of half to one hour after their principal meal, and find that certain articles of diet, especially fats and fried food, should be taken with care. The results in the following two cases are poor:

**Case 1.**—A man, aged 35 at operation in 1942, had severe postcibal distress, including nausea and occasional vomits. In 1944 he was investigated at another hospital, and his troubles were attributed to proximal-loop reflux. Laparotomy showed no other abnormality, and an entero-enterostomy was performed. The patient says that he has had little relief from this operation.

**Case 2.**—A man, aged 44 at operation in 1943, has complained ever since of nausea and distension after meals. A barium meal shows considerable proximal-loop reflux but no other abnormality. He has worked continuously since operation and has maintained his weight, but the functional result is a poor one.

Although most patients are well satisfied, this anastomosis does not give first-class results. We suggest two reasons for this unexpected contentment with an operation which has given so high an incidence of proximal-loop reflux:

(1) All these patients were operated on at a time when only those with very large penetrating ulcers were recommended for surgery. The more severe the pre-operative symptoms the more tolerant is the patient of a moderate post-operative function. (2) All these operations were performed at least five years ago. The symptoms attributable to proximal-loop reflux become less severe with the passage of time.

We note that Watson (1947) has often used this anastomosis and has seldom detected proximal-loop reflux, but it

has been a common feature in our series, and, believing it to be responsible for postcibal distress, we abandoned the method some years ago.

### Type II: Antecolic Anastomosis

Period since operation (Average 37 months)	..	1 to 4 years
Number of operations	..	130
Operative mortality (duodenal ulcers)	..	3
Causes of death: Burst duodenal stump, twisted, proximal loop, pulmonary embolus.		
Traced	..	118
Good	..	88 (61 duodenal, 27 gastric)
Fair	..	19 (14 " 5 " )
Poor	..	6 (5 " 1 " )
Since died	..	5 (2 " 3 " )
Causes of death: Carcinoma of uterus (gastric), pulmonary tuberculosis (gastric), carcinoma of prostate (gastric), carcinoma of lung (duodenal), not known (duodenal).		
Untraced	..	9
(6 duodenal, 3 gastric)		

Male, gastric ulcer. Untraced since leaving hospital.  
 Male, duodenal ulcer. Very good 2 years later. Changed address.  
 Male, duodenal ulcer. Good at 6 months. Changed address.  
 Male, duodenal ulcer. Fair at 12 months. Changed address.  
 Male, gastric ulcer. Fair at 12 months. Left country.  
 Male, duodenal ulcer. Fit 2 months later. Changed address.  
 Male, gastric ulcer. Good at 3 months. Changed address.  
 Male, duodenal ulcer. Never reported. Changed address.  
 Male, duodenal ulcer. Good at 3 months. Changed address.

**Post-operative Period.**—We have experienced disturbing complications which appear to be due to the length of the proximal loop. One patient died on the fourteenth post-operative day, and necropsy revealed a proximal loop which

was obstructed at its junction with the lesser curve and which rotated behind the stomach.

Two other patients suffered this complication—one on the tenth and the other on the fourteenth post-operative day—but were rescued by operative correction of the fault. In these two patients the symptoms were the same: both suffered a severe attack of colicky pain in the left hypochondrium and both vomited gastric contents free from bile, suggesting obstruction of the proximal loop. In each case laparotomy revealed the grossly distended proximal loop

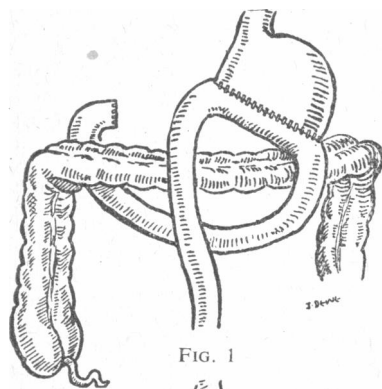


FIG. 1

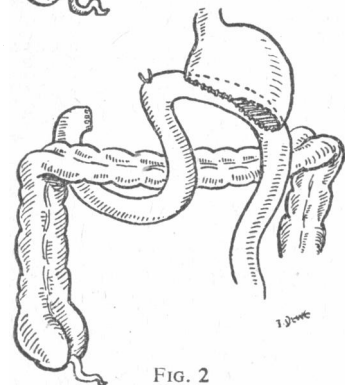


FIG. 2

rotated behind the gastric remnant. In one an entero-anastomosis was performed; in the other the loop was untwisted and a stitch inserted to fix the proximal loop to the right of the stomach remnant.

It is impossible to say whether the primary trouble was obstruction at the lesser curve, leading to dilatation and rotation of the loop, or rotation of the loop, leading to obstruction at the anastomosis. Nor is it possible to say whether in our one fatal case, in which the duodenal stump

leaked on the second post-operative day, the leakage was due to poor closure of the duodenal stump or to pressure in an obstructed afferent loop. We have never found this complication in a *ny* anastomosis where there was no long proximal loop, and we cannot help feeling that it may add some small risk in the post-operative period. It is fair to point out that at the time these troubles occurred we were not using the stitch advocated by Maingot (1948) to anchor the proximal loop towards the right of the stomach. If this operation is performed the possibility of a loop twist should be borne in mind in the event of an attack of abdominal pain associated with a bile-free vomit.

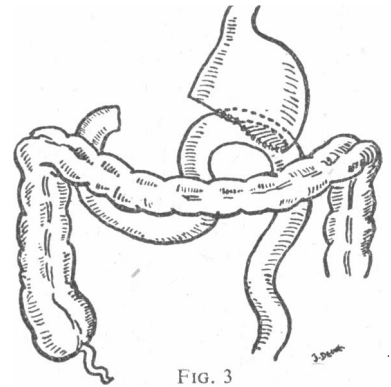


FIG. 3

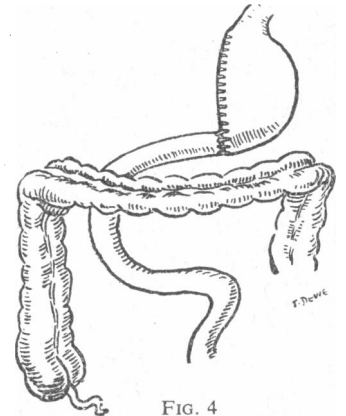


FIG. 4

**Late Results.**—On the whole this has proved a satisfactory operation. Results in 88 cases are classified as good and 19 as fair. We have had barium meal tests of all the patients who had fair results. Proximal-loop reflux did not occur, and we could detect no mechanical failure. Fats and fried food in excessive amounts are usually mentioned as apt to cause trouble. The results in the following six cases are definitely poor, and are worth closer review.

**Case 3.**—A man, aged 58 at operation in 1943, complained of pain in the chest and left hypochondrium after meals. Two years later his abdomen was explored. No ulcer or other abnormality was found. His troubles persist, but the pain is now chiefly in the back and he has some osteoarthritis of the spine. It is doubtful if his symptoms are digestive in origin, though there is no doubt that he is not a satisfied patient.

**Case 4.**—A man, aged 57 at operation in 1944, complained of severe postcibal distress, including nausea and vomiting. During a fortnight's stay in hospital recently he appeared to be having very little trouble with his digestion. Investigations with a barium meal, test meal, and glucose-tolerance test disclosed no obvious cause for his reported symptoms.

**Case 5.**—This patient, aged 20, had an antecolic gastrectomy with a rather long loop performed in 1943. The immediate result was satisfactory, but three months later he began to be increasingly troubled. Each meal, particularly a large one or one containing fats, caused lassitude, distension, and nausea, so that he had to lie down. These would pass off in an hour to an hour and a half, but occasionally he vomited fluid deeply stained with bile. Attacks of diarrhoea occurred. A barium meal emptied very rapidly indeed and caused some pooling in the small intestine. A test meal showed that there was no secretion of acid in the stomach. An indwelling Ryle's tube over twenty-four hours suggested that the meal left the stomach very rapidly, that the stomach then filled about half an hour later with a mixture of bile and pancreatic juices from the proximal loop, and that his nausea came at the time when his stomach filled with fluid. It was decided that a laparotomy was justifiable, since no simple remedies were of any avail and the patient was below weight and considerably disturbed by these symptoms even though he managed to do his work.

An unduly long and dilated proximal loop was found. The anastomosis was unpicked and remade with a very short proximal retrocolic loop with a small valve. This brought considerable improvement. It seems reasonable to suggest, therefore, that the long proximal loop emptied badly into the gastric remnant, possibly through slight rotation, and that food passed rapidly out of the remnant into the small intestine without a satisfactory mixture of bile and pancreatic juice.

*Case 6.*—A man, aged 34 at operation in 1945, now complains of postcibal distress. He looks well and has gained weight. Full investigation at hospital showed no apparent abnormality, and observation did not endorse his statement. He is in receipt of a pension for his gastric disorder, and has not attempted any work since the operation.

*Case 7.*—A woman, aged 42 at operation twenty months previously, made satisfactory progress at first but in the last few months has complained of pain and flatulence after meals. Investigation revealed no apparent gastric cause of postcibal distress, but showed the presence of gall-stones. Cholecystectomy has since been performed, with relief of her symptoms.

*Case 8.*—A man, aged 56 at operation three years ago, was fit for two years but then developed oedema and ascites, the cause of which was found to be cirrhosis of the liver.

Of the six patients in whom the results were classified as poor we can only be certain that two are suffering severe postcibal distress following their gastrectomy. This operation is still used, but is employed less than formerly. The loop is shorter and is stitched in position to the right of the gastric remnant to prevent the risk of rotation.

**Type III: Post-colic Anastomosis**

Average period since operation	.. .. .	29 months
Number of operations	.. .. .	26
Operative mortality	.. .. .	Nil
Traced	.. .. .	23
Good results	.. .. .	16 (14 duodenal, 2 gastric)
Fair	.. .. .	4 (3 " 1 " )
Poor	.. .. .	1 (gastric)
Since died	.. .. .	2 (duodenal)
Causes of death: Car accident, coronary thrombosis.		
Untraced	.. .. .	3 (duodenal)
Male. Good at 6 months. Changed address.		
Male. Left country after operation.		
Male. Fair at 3 months. Changed address.		

In this procedure the anastomosis lies below the mesocolon, the edges of the aperture in this structure being stitched to the stomach. To enable this to be done the jejunum is not carried up to the lesser curve, which necessitates the construction of a smaller valve than that in the antecolic anastomosis.

Suction from an indwelling Ryle's tube in the immediate post-operative period shows that the bile enters the stomach very rapidly. This suggested that it was the most suitable anastomosis to use if pressure in the duodenal stump was specially to be avoided.

During the period under review this anastomosis was employed in cases in which the antecolic anastomosis seemed to be inadvisable for the following reasons: (a) a very large transverse colon or mesocolon which, it was thought, might drag on the proximal loop; and (b) unsatisfactory closure of the duodenal stump due to extensive ulceration of the duodenum, which might lead to leakage if there was any pressure in the proximal loop.

*Post-operative Course.*—The immediate post-operative course has been very satisfactory. The short loop has given no trouble, and as the whole anastomosis is below the mesocolon there has been no herniation of small intestine. We have not yet seen trouble from fibrosis of the mesocolon and compression of the anastomosis, which is suggested by Ogilvie (1947) as a possible sequel of this type of operation.

*Functional Result.*—From the functional point of view the result seems satisfactory and the reduction in size of the valve does not appear to have had an adverse effect.

Sixteen are classified as good, four as fair functional results, and one (Case 9) as poor.

*Case 9.*—A man, aged 38 at operation three and a half years ago, has had considerable trouble from postcibal distress. This comes on immediately after a meal and consists of a feeling of distension and fatigue accompanied by sweating. It lasts about half an hour and then suddenly disappears, often accompanied by a loud gurgle. He can always produce these attacks by taking fat and fried food and by moving about immediately after a meal; he can avoid them if he does not eat fats and if he rests for half an hour at the end of a meal. Barium-meal examination shows rapid emptying of the stomach and some dilatation of the small intestine. The proximal loop here was made rather unnecessarily long, and it is probable that his trouble is due to delayed emptying of this loop.

**Type IV: Billroth I Anastomosis**

Average period since operation	.. .. .	23 months
Number of operations	.. .. .	47
Operative mortality	.. .. .	1 (gastric ulcer)
Cause of death: Pulmonary embolus.		
Traced	.. .. .	46
Good	.. .. .	36 (1 duodenal, 35 gastric)
Fair	.. .. .	7 (1 " 6 " )
Poor	.. .. .	1 (duodenal)
Since died	.. .. .	2 (gastric)
Causes of death: Jaundice 18 months later, aplastic anaemia.		
Untraced	.. .. .	Nil

*Post-operative Period.*—In the immediate post-operative period this procedure has been entirely satisfactory, except in Case 10 described below. It has the merit of dispensing with the proximal loop, the foramen in the transverse mesocolon, and the duodenal stump, and thus avoids all the possible complications these may cause. From the point of view of safety, therefore, this technique appears to have advantages over any other type of anastomosis.

*Functional Result.*—From the functional aspect we have found it as satisfactory as any other.

*Case 10.*—A woman, aged 46 at operation in 1945, suffered from duodenal ulcer. At the operation it was noticed that the duodenal lumen was small, consequently the anastomosis was a narrow one. An indwelling Ryle's tube suggested that the anastomosis did not become patent until the fifth day. She now complains of fullness during meals and has to take small ones. Barium-meal examination shows a remnant which retains a barium meal for two and a half hours and empties slowly via a stenosed anastomosis.

This technique was used on two other patients suffering from duodenal ulcer, and one of them also shows a stomach which empties slowly, though it did not cause symptoms. There has been no sign of stenosis at the anastomosis in the gastric ulcer cases.

We are satisfied that as a treatment for gastric ulcer this anastomosis is sound, but the increased difficulty of mobilizing an ulcerated duodenum and the risk of late stenosis render it an unsuitable method for the patient with a duodenal ulcer.

**The Follow-up**

Consideration of the cases whose results are listed as fair or poor leads to three conclusions: (1) That pain of the ulcer type is most unusual, and in the patients we have followed we have been unable to prove the presence of an anastomotic ulcer. (2) That the departure from a normal digestion is due to the incidence of what is described as "side-effects" or postcibal distress. The symptoms of which the patients complain are nausea and, less often, vomiting, a feeling of distension, lassitude, sweating, and attacks of diarrhoea, and these come on at varying periods during or after a meal. (3) That fats and fried food are the articles of diet most likely to cause trouble.

**Side-effects**

*Incidence and Severity.*—If we consider that all patients in whom the results are classified as fair are suffering from

mild side-effects then the incidence is 47 (22%) out of 216 followed up. But in these patients the side-effects either are occasional or are preventable by eating only small or moderate meals. These restrictions do not interfere unreasonably with the life and habits of a normal person. From the ten patients whose results are classified as poor we can exclude two (Cases 7 and 8) whose trouble is due in one instance to gall-stones and in the other to cirrhosis of the liver. This leaves us with eight (3.6%) patients in whom side-effects due to the operation appear to be a serious problem.

**Causation and Treatment.**—Various causes have been suggested in the literature, and we have examined our eight cases with these in mind. They have been investigated with barium meal, an indwelling Ryle's tube for twelve hours with a normal diet, blood counts, and sugar-tolerance curves. Three causes seem to us to fit certain of our patients and, moreover, to be due to the type of anastomosis used. They are proximal-loop filling, slow emptying of the stomach remnant, and delayed emptying of the proximal loop.

**Proximal-loop Filling.**—Cases 1 and 2 come into this category. These patients may show one or more of the following symptoms, coming on shortly after a meal: distension, lassitude, nausea, vomiting, sweating, and a feeling of "bile" rising in the back of the throat. Post-operative barium-meal examination shows the meal entering a dilated proximal loop and gradually passing back through the stomach into the distal loop. They therefore empty slowly into the jejunum, and the meal should have ample time to mix with the bile. It is noteworthy that diarrhoea does not seem to be associated with this group. Proximal-loop filling has occurred only with anastomosis of the afferent loop to the greater curve, a method which should not be used. In our patients who show proximal-loop filling the symptoms are partly relieved by resting for half an hour after a meal and by avoiding excess fats and fried food.

**Slow Emptying of Stomach Remnant.**—One patient (Case 10) who had had a Billroth I gastrectomy for duodenal ulcer comes into this category. The chief symptom is fullness coming on during a meal; this prevents further eating and takes some time to pass off. In this particular case a barium meal showed retention of the meal in the stomach remnant up to two and a half hours. The meal given was the usual fluid one, and it is to be expected that any solid food would take even longer to leave the stomach. The cause of this delayed emptying is stenosis of the anastomosis in a Billroth I operation performed for a duodenal ulcer. This complication can be prevented in duodenal ulcer cases by performing an end-to-side anastomosis.

**Delayed Emptying of Proximal Loop.**—This complication is mentioned by Lake (1948) as a possible cause of postcibal distress. If there is any obstruction to the outlet of the proximal loop the bile and pancreatic juice secreted during a meal will accumulate there, and emptying of the loop across the anastomosis will be delayed. On the one hand distension of the proximal loop may be produced, causing symptoms similar to proximal-loop reflux. On the other hand the food may proceed on down the jejunum unmixed with bile and pancreatic juice, causing a tendency to fatty diarrhoea. The symptoms are therefore very similar to those of proximal-loop reflux with the addition of diarrhoea. Fatty diarrhoea does not seem to be a complication of proximal-loop reflux where the meal is well mixed with bile and pancreatic juices and empties slowly into the jejunum. In the obstructed-proximal-loop syndrome the meal may empty rapidly down the jejunum, although the bile and pancreatic juices are detained at the upper end of the intestinal tract. Two patients (Cases 5 and 9) fit into this category.

In Case 5 the evidence is: (a) Investigation shows that the proximal loop empties its contents into the stomach some time after the meal has passed through. (b) The patient obtains relief by vomiting a mixture of bile and pancreatic juice containing no food about one hour after the meal. (c) At operation the proximal loop was found to be dilated, and

remaking the anastomosis has given considerable relief of his postcibal distress.

In Case 9 there is some clinical evidence that the distress is due to obstruction of a proximal loop. The patient notes that his distress is largely obviated if he lies on the left side, and also that when he is experiencing the distress relief occurs suddenly and is accompanied by a loud gurgle in the upper abdomen.

Both these patients find fat and fried food very 'troublesome' and should they eat much of this type of food they are liable to attacks of fatty diarrhoea. The trouble here is presumably either making too long a proximal loop or making one which at its junction with the stomach is slightly rotated or in some other way obstructed. If the symptoms are severe enough, remaking of the anastomosis seems justifiable.

It is more difficult to ascertain the cause of the other cases of postcibal distress. Adlersberg and Hammerschlag (1947) divided their cases of this syndrome into early and late postprandial types, and this is a convenient arrangement. The early cases showing distress and coming on within an hour of taking a meal were considered to be typical of the so-called "dumping" stomach, whereas the late cases, coming on one to three hours after a meal, were thought to be due to hypoglycaemia. We have classified the remaining "poor" cases on these lines.

### The "Dumping" Stomach

This syndrome was described by Hertz (1913) as occurring after gastro-enterostomy. The term "dumping" stomach appears to have been first used by Mix in 1922, again in relation to gastro-enterostomy. In this paper the term is used to cover any cases of early postprandial distress for which no other explanation is available. Ingelfinger (1944) has reviewed the symptoms and possible causes of this syndrome. The symptoms include sweating, nausea, palpitations, and a feeling of weakness coming on towards the end of or just after a meal and lasting up to an hour. The cause of this is not clear: many suggestions as well as the original one of a rapidly emptying stomach have been made. It is difficult to believe that rapid emptying by itself is the cause of the trouble, because so many patients with no symptoms show extremely rapid emptying of a barium meal.

Glaessner (1940) considered that the symptoms might be due to hyperglycaemia, and Zollinger and Hoerr (1947) thought that rapid absorption of sugar was the cause. Custer *et al.* (1946) blamed the sudden mechanical distension of the jejunum due to rapid emptying of the stomach.

This syndrome in a mild degree is seen in some of our cases which are listed as "fair" functional results. It has been observed after a Billroth I anastomosis, and H. Daintree Johnson (1948—personal communication) has reported similar symptoms following simple vagotomy without gastro-enterostomy. It is therefore not necessarily due to the stomach emptying straight into the jejunum when an end-to-side anastomosis is made. We agree with the usual view that this anastomosis is less likely to be followed by dumping symptoms if it has a small stoma and an adequate valve.

We have placed two of our "poor" cases (Nos. 4 and 6) in this ill-defined category.

### Hypoglycaemia

Barnes (1947) described several cases in which hypoglycaemia appeared to be the cause of postcibal distress. The symptoms begin one hour or more after a meal and the patient experiences weakness, giddiness, and nausea: sweating and pallor may be noted.

After careful investigation none of our poor results can be attributed to hypoglycaemia. Questioning has revealed

that a few times in the year two patients listed under "fair" results have had attacks that are suggestive of hypoglycaemia, and their glucose-tolerance curves, though not conclusive, lend support to this belief. Apart from this there is nothing to suggest that hypoglycaemia is either a frequent or a troublesome factor in producing postcibal distress, and we find nothing to support Gilbert and Dunlop's (1947) view that it is the essential cause of that distress.

In this series the symptoms usually begin during or shortly after a meal, at a time when the blood-sugar curve is high. In addition the symptoms are exacerbated, not alleviated, by taking meals with a high fat content.

### Neurosis

We have been loath to attribute post-gastrectomy symptoms to neurosis, though there is some evidence of this in Cases 4 and 6. While under observation in the ward they did not complain of postcibal distress, nor did they show the objective phenomena, such as sweating, which are associated with this condition. They probably have occasional symptoms. These two patients come under the ill-defined heading of the "dumping" stomach, but both are in receipt of a pension on account of their gastric disability, which may well be a factor in their symptomatology.

There is one other patient (Case 3) whose chief post-operative symptom is backache. Neither his symptoms nor investigations suggest that his alimentary tract is the cause of the trouble.

### Conclusions

The review of this series has brought out the following points:

That the operation of partial gastrectomy for simple ulcer carries a reasonably low mortality. In this series it was 2%.

That in the main the patients who have had a partial gastrectomy for ulcer are satisfied. 73% are symptom-free and 22% have slight symptoms which are not severe enough to make them dissatisfied.

Approximately 5% either have a poor functional result or are dissatisfied. Investigation of this group is worth while: in some cases faults due to the technique of the operation are disclosed and can be remedied. Intercurrent disease may be the cause in other cases.

That the more troublesome and chronic the original ulcer the more tolerant is the patient of minor functional disturbances in his post-gastrectomy result.

With the exception of anastomosis of the afferent loop to the greater curve, which leads to a high incidence of proximal-loop filling, there is nothing to choose between the functional results of the other three anastomoses employed.

The long proximal loop needed in the antecolic operation is more likely to lead to complications than the short loop used in the retrocolic operation. The Billroth I anastomosis is probably the safest of all, as it has no afferent loop. Owing to the risk of stenosis this is not a suitable anastomosis after gastrectomy for duodenal ulcer.

That in this series there is no evidence to support the view that gastrectomy for duodenal ulcer gives worse results than for gastric ulcer. 80% of operations for duodenal ulcer were classified as good, as opposed to 58% for gastric ulcer. In both types of ulcer the incidence of poor results was 5%.

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## THE STREPTOMYCIN-SULPHADIAZINE TREATMENT OF UNDULANT FEVER

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The results of chemotherapy in undulant fever have hitherto been disappointing. *Brucella abortus* is sensitive to sulphonamides, but a full course of treatment with these drugs, though often of temporary benefit, does not usually eradicate the infection: possibly sulphadiazine together with blood transfusions, as recently advocated by Holmes and Hughes (1948), may give better results. Penicillin is useless owing to the insensitivity of the organism. On the other hand, *Br. abortus* is sensitive to streptomycin, its growth being inhibited by from 0.5 to 3.75  $\mu$ g. per ml. (Report, 1946), a finding well within limits compatible with successful treatment.

Such *in vitro* findings accurately reflect the therapeutic capacity of penicillin, but in connexion with streptomycin they are sometimes misleading, and the two principal diseases which have not responded to streptomycin treatment in accordance with expectation on these grounds are typhoid fever and undulant fever. Earlier reports from the U.S.A. (Reimann *et al.*, 1945; Report, 1946; Nichols and Herrell, 1946), all based on the treatment of a substantial number of patients, usually with full doses given for what should be an adequate period, are unanimous in their disappointment with the results. Some patients have not appeared to respond in any way, fever continuing and blood culture remaining positive even during the course; others have improved temporarily, but few have apparently been cured.

When two chemotherapeutic agents of partial efficacy are available it is likely that they will have an additive if not a synergic effect when administered together. Hence it was clearly indicated that a trial should be made of the combined effect of streptomycin and sulphadiazine. Eisele and McCullough (1947) claim to have reported the first case so treated: it is very fully described, and the result seems highly significant. The patient was severely ill and his blood culture was regularly positive during earlier courses of treatment, which included periods during which streptomycin and sulphadiazine were administered separately. Only when the two drugs were given together, at the rate of 6 and 12 g. respectively per day for ten days, was there a response. This was complete, the temperature reaching normal levels at the end of this short course and remaining there: no relapse occurred during the ensuing 17 months. Six cases were treated by Pulaski and Ampacher (1947), who recommend that 0.5 g. of streptomycin and 6 g. of sulphadiazine should be given four-hourly for fourteen days. In one patient the treatment was a complete failure; it is mentioned that *Brucella* could not be cultivated from the blood, and the evidence on which the diagnosis was based is not given. In the other five patients, four of whom had positive blood cultures, treatment was successful: evidently the six cases described by Pulaski and Seeley (1948) are the same, and in this further paper it is recorded that two patients had recurrences after six and twelve weeks respectively. It is to be noted that the dose of sulphadiazine advocated by these authors is only half that used by Eisele and McCullough.