BRITISH MEDICAL JOURNAL

LONDON SATURDAY FEBRUARY 14 1948

THE AFTERMATH OF GASTRECTOMY*

BY

NORMAN C. LAKE, M.D., M.S., D.Sc., F.R.C.S.

Senior Surgeon, Charing Cross Hospital

A survey of the treatment of peptic ulceration during the present century must of necessity recall those high points of enthusiasm associated with such methods as the old Lenhartz and Sippy diets with bismuth and mild alkalization, the reintroduction of intensive alkalization by MacLean, Aron's (1933) work and the resulting histidine treatment, the introduction of adsorptives (colloidal aluminium hydroxide, magnesium trisilicate, etc.), intra-gastric drips, intensive belladonna, and hyoscyamus; while on the surgical side there are gastro-enterostomy (with or without exclusion), pyloroplasties, gastric ligations (Somer-vell, 1942; Hey, 1947), vagal denervations, and the various types of gastrectomy. The increasing recognition of the importance of the psychological side of these cases must also be mentioned to complete the picture.

From my experience I do not think it can be regarded as too surgically biased a statement to say that of all these methods the only one which has steadily and consistently become more popular is gastrectomy. The ultimate method of treating peptic ulceration will almost certainly not be surgical, but at the present day gastrectomy gives better, and especially more permanent, results than most other methods, whether surgical or medical. Ogilvie (1947) has recently summed up the position by stating that "it runs the operation for haemorrhoids [which he regards as uniformly successful] a close second." For my part I should hope that it wins this race handsomely. If this be so, however, it becomes very important that the relatively small number of cases which have post-operative complications and complaints should be most carefully considered and investigated.

For a long time I have been interested in the outcome of these operations, and have followed some cases for over twenty years. The great movements of population during the war seriously upset this follow-up, but nevertheless I have records of several hundred cases of long duration. From the statistical point of view the total number could have been considerably increased if I had been willing to include cases of other operators, but such collected or group statistics are always equivocal and lacking in personal scrutiny, and so apt to be misleading. The smaller number of cases which are here analysed are all personal ones, and the surgical tragedies and complications which have occurred are due to my own bad surgery or to errors of judgment.

Consideration of 615 Personal Cases

The total number of such cases under review is 615, extending over a period of twenty-three years but not including any cases of less than one year's duration. The conditions for which operation was undertaken are shown

in Table I, and the type of operation performed is shown in Table II. It will be seen that the great majority of these cases were done by a modified Polya—i.e., end-to-side—method, which has been variously attributed to Finsterer, Hofmeister, myself, and others, although there

TABLE I.—Conditions for which Operation was Undertaken

Carcinoma	87
Sarcoma	3
Linitis plastica (non-malignant)	2
Jejunal (anastomotic) ulceration	35
Primary peptic (duodenal and gastric)	488

TABLE II.—Type of Operation Performed

Total gastrectomy	12
Bilroth I	4
Bilroth II	40
Polya (full aperture)	44
Polya (modified, restricted aperture)	502
Sleeve resection	11
Others	2

appears to be no doubt that that fine old surgeon Von Eiselsberg performed an end-to-side anastomosis with restricted orifice but without a valvular aperture (that is, of the Hofmeister type) as long ago as 1888; while in the previous year Krönlein, of Zurich, on the suggestion of Von Hacker performed the first end-to-side anastomosis of the so-called Polya type. However, as Ogilvie (1935, 1947) correctly emphasizes, it is the formation of a valvular opening which constitutes the most valuable and essential part of this technique. He also gives a very diverting summary of the position when he says: "If we must have names let credit be properly attributed and call the operation the high posterior Finsterer-Lake-Lahey modification of the Mikulicz-Krönlein-Hofmeister-Reichel-Polya improvement of the Bilroth II gastrectomy with a large valve and a small stoma."

In my own technique the suturing for the anastomosis and the closure of the upper part of the stomach aperture is done at one and the same time with a continuous suture which also applies the proximal jejunum over the closed portion of the stomach, thus not only producing a valvular type of restricted aperture but providing an extra barrier against leakage. In a very few unusually high or difficult cases the stomach closure may have to be done as a separate procedure before the anastomosis is performed. The junction is retrocolic, the final result being seen in Fig. 1. Usually about two-thirds of the stomach is removed, but at times this may be increased to three-quarters or

FIG. 1.—End-to-side anastomosis with restricted valvular orifice. The anastomosis is retrocolic and about two-thirds of the stomach is usually removed. The broken line indicates the level of the transverse mesocolon.

but at times this may be increased to three-quarters or

* Summary of a lecture given at the British Postgraduate Medical School.

four-fifths. I first operated by this method in 1926, and, as the results were so satisfactory, increasingly year by year, until by 1930 all but the most exceptional cases were so dealt with. For the past seventeen years high spinal anaesthesia has been used for over 90% of the cases. Light "nupercaine" 1/1000, given by a method which I have described elsewhere (Lake, 1938), has proved very satisfactory. It is necessary to mention these details, since it appears not improbable that some of the conditions about to be described may bear a close relationship to the type of operation performed.

In considering the aftermath of this operation I shall in regard to most aspects limit the inquiry to cases of ulceration. It is also obvious that there are two types of sequel—the early, usually spoken of as complications of operation, and the late results. Here I am particularly concerned with the latter, but to enable us to assess the operation fully the early complications must in all fairness also be briefly mentioned.

Complications of Operation

Clearly, the most serious early sequel is death. The mortality of gastrectomy as given by different surgeons varies enormously, as great a difference as 0.8 to 25% being recorded, but all are agreed that the more extensive dissection and removal required in malignant cases and in anastomotic ulcers, with patients often in poor general condition, adds considerably to the risk. Over the whole period of twenty-three years my average mortality figures are disappointingly high. They are: carcinoma, 14%; anastomotic ulcers, 12%; duodenal and gastric ulcers, 5.7%. These figures include all deaths from all causes up to three months from the date of the operation. For the same period total gastrectomy gave a mortality of 41%. The difficulty in arriving at a fair assessment of the risk is that unless large numbers—i.e., several hundreds—of cases are included the figures are likely to be misleading, for it is common experience that a considerable sequence of successful operations is apt to be followed by a group of fatalities which would be missed in a small series. On the other hand, with improving techniques the risk is continuously getting smaller, but any large series of individual cases must of necessity include all those done in the earlier period of higher mortality. Bearing these points in mind, it is some mitigation to know that the recent mortality rate for 130 ulcer cases has been a little over 3%, whereas in the early days it was 9%. It is of some interest to inquire how the reduction has been brought about. It is certainly not due to any increased skill in technique or to a more discriminating choice of patients; indeed, the cases dealt with tend to become more rather than less severe. I attribute the improvement mainly to better preparation of the patient by blood transfusions, breathing exercises, and, for the last three years, the routine use of the sulphonamides as suggested by Tanner. Credit must be given also to biochemistry for its help in assessing the patient's various capacities. The most important factor has been the avoidance of lung complications, as is well seen in Table III. Whereas chest complications

to reopen cases when early signs of peritoneal irritation or of bleeding have occurred.

The immediate complications of the operation have often been dealt with, so I will do no more than list those I have encountered, with a few comments when indicated. These complications are: (1) operative shock; (2) leakage—duodenal stump or anastomosis; (3) bleeding—anastomosis or belly wall; (4) collapse of lung; (5) pulmonary embolism; (6) subphrenic abscess and empyema; (7) cardiovascular failure; (8) bursting of abdominal wound; (9) flare-up of tuberculosis and of thyrotoxicosis; (10) necrosis of omentum; (11) intussusception; (12) asthma (curare); (13) post-spinal complications, retention, headache, sixth-nerve palsy; (14) uraemia.

Before examining the items seriatim it should be recorded that gastrectomies have been performed with the object of increasing the patient's ability to take plenty of food in three cases of active tuberculosis of a non-pulmonary type, in five cases of fairly severe diabetes, in two cases of tabes dorsalis, and in one of disseminated sclerosis, all without any trouble. In six ulcer cases the spleen was removed at the same time; in two of these it was enlarged as a result of thrombosis of the splenic vein in the floor of a penetrating ulcer. In two of eight cases of gastro-colic fistulae a local resection of the colon was necessary. In three cases the transverse colon became retroperitoneal in the middle of its course and the anastomosis had to be antecolic. In nearly 20% of the total ulcer cases there had been a previous operation upon the stomach quite apart from those listed as jejunal or anastomotic ulcers. Unsuccessful gastro-enterostomies, local excision of ulcers, denervations, and of course perforations constitute the majority of these, but in two cases a higher resection was performed on previous gastrectomies where the first line of section had been too distal and further ulcers had formed proximal to the anastomosis.

In the whole series no death occurred within forty-eight hours of the operation, so that it would seem that shock is not severe—anyhow, when spinal anaesthesia is employed.

Leakage, when it occurs, is usually from the duodenal stump, and occasionally from the upper end of the anastomosis. Closure of the duodenum is probably the most important point in the technique of the operation. Nissen (1945) emphasized this and devoted the major portion of his book to details of methods advocated in difficult cases. I am not now dealing with operative details, but would mention that any obstruction to the drainage of duodenal contents across the anastomosis is as great a factor in causing leakage as any failure of proper closure of the duodenal stump.

Post-operative bleeding into the stomach is commonly insignificant; in more severe cases, as already mentioned, early reoperation is recommended. In two cases serious bleeding due to erosion of an epigastric vessel has occurred from the abdominal wall.

Collapse of the lung in some degree is common, but massive collapse is rare. We have investigated this complication, and the conclusions reached were published by Stringer (1947). Since the routine use of the sulphonamides the effects have been slight. Pulmonary embolism, as in all abdominal surgery, remains a bugbear. I know of no effective method of preventing it. The thrombosis usually arises in the abdominal wall or, as in two of these cases, from extension of thrombosis of haemorrhoids possibly produced by the administration of an enema pre-operatively.

Subphrenic abscess and empyema are probably usually due to slight leakages; they are not of necessity fatal if dealt with in their earliest stages, but it is not then easy to make a sufficiently accurate diagnosis. Bursting of the abdominal wound has occurred in five cases; this is nearly

TABLE III.—*Causes of Death after Gastrectomy*

Previous Figures (Lake, 1937) (320 cases)		Recent Figures (200 cases)	
Chest complications and		Chest complications and	
embolism	12	embolism	3
Leakage and peritonitis ..	6	Leakage from duodenal stump	
Haemorrhage	4	and anastomosis	4
Pulmonary tuberculosis ..	2	Uraemia	1
Uraemia	2		
Other causes	6		

were the chief cause of mortality in 1937 they now fall to second place. One further factor which has perhaps had some effect upon the mortality has been a greater readiness

always due to violent coughing or vomiting; the latter, however, is very uncommon after gastrectomy if spinal anaesthesia is employed. Four cases recovered after resuture, and one died from exacerbation of the lung complication.

I draw attention to necrosis of the omentum, which I have not previously found noted as a complication. I have had three cases proved by exploration and a further three in which the diagnosis was reasonably certain but not proved by operation. I believe that in smaller degree it occurs more often than we imagine, since the operation must at times interfere with the variable blood supply to the omentum and lead to considerable thrombosis therein, but I will not discuss the pathology here. All these cases recovered.

Intussusception of the upper part of the anastomosis into the lower part might sound almost impossible, but it was discovered post mortem in one case where I was at a loss to explain the patient's symptoms. It must be a very rare event. The post-spinal-anaesthetic sequelae have not been serious, but in two cases a sixth-nerve palsy was persistent; one of these was a case of tabes with ulcer, and the other cleared only after a period of six months.

The uraemic cases listed here were true kidney uraemias and not secondary to fluid depletion.

Late Results

We now pass to the main thesis—namely, the late sequelae or aftermath. These may be considered under the following headings: (1) Blood picture; (2) test meal; (3) barium meal; (4) weight; (5) appetite; (6) bowel action; (7) jejunal anastomotic ulceration; (8) distension of the afferent loop; (9) loss of energy, faintness and lassitude after food; (10) nausea in the early morning; (11) adhesions; (12) ventral hernia; (13) gall bladder symptoms; (14) colospasm.

Blood.—It was at one time confidently predicted (Hurst, 1928; Lake, 1928) that cases of extensive stomach resection would develop a macrocytic anaemia. We have had large numbers of blood examinations carried out up to ten years after the operation, but in no single instance has there been an anaemia of this type. The average of a large number of counts gave the following figures: red cells, 5,190,000; white cells, 9,390; haemoglobin, 95%; colour index, 0.88. A few cases revealed a definite microcytic anaemia with spoon nails which yielded to the usual treatment with iron.

Test Meal.—Post-gastrectomy test-meal curves are always open to criticism, since it is not easy to determine that the

tube end lies properly in the stomach. However, with special precautions a large series have been done (Figs. 2-7). With a complete Polya anastomosis there is practically always achlorhydria. With the restricted valvular orifice a small amount of free acid (10 to 20 degrees) is present in a few cases at one hour, but the general reduction is profound. Even the completely achlorhydric cases will respond to histamine stimulation, although this power is lost with the passage of time. Three of these cases still show considerable acid: they are obviously candidates for a possible anastomotic ulcer.

Radiographs.—The radiographic results of the different types of gastrectomy were studied by Shanks (1934). Of my cases he says: "This modification, judging by the radiographic appearance, controls the efflux of the gastric contents better than any other of the Polya type. In addition to preventing 'dumping' into the jejunum, it renders reflux into the afferent loop very improbable. . . . The gastric stump fills reasonably well in the erect position, and the stoma is clearly seen at the lower pole. The right border of the stump is formed by the remaining portion of the lesser curve and the sutured end of the stump above the stoma. This largely loses its initial angularity and becomes more or less straightened out."

Weight.—The general tendency is to gain weight, especially when as a result of dyspepsia the patient is much under weight before operation. Not all of the cases gain, however: as is well recognized, many hypersthenic duodenal cases are quite well covered despite the ulcer.

Appetite.—There seems to be little qualitative change in the appetite; the patient's likes and dislikes are unaffected. Quantitatively there is usually an improvement in the gastric cases, with small change in duodenal ulcers, when the appetite is often good before operation.

Bowel Action.—It might be expected that with more rapid emptying of the stomach there would be increased activity of the colon, but experience shows that if anything there is some tendency to constipation. In some cases this is due to colospasm, which we shall consider later.

Jejunal Ulceration.—In this series there have been six cases in which anastomotic ulceration was suspected. In four of these it was proved by exploration (in one by perforation); in the other two the symptoms are mild but the suspicion remains. As is well known, it is difficult to get reliable radiological confirmation in post-gastrectomy cases. The incidence does not seem to exceed 1%.

Distension of the Afferent Loop.—i.e., the duodenum—is a possible cause of symptoms, and occurs when there is some obstruction to the free passage of duodenal contents across the anastomosis, or when the stomach efflux is

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 2.—Test meal after gastro-enterostomy for duodenal ulcer. Figs. 4 and 5.—Test meals before and after vagotomy. This operation was done 15 years ago, therefore division of nerves was subdiaphragmatic. Higher division, whether performed by transthoracic or transdiaphragmatic approach, gives somewhat better results. Figs. 6 and 7.—Test meals before and after the so-called "physiological gastrectomy"—that is, ligation of vessels and nerves. It will be noted that gastrectomy produces much more profound changes in acid secretion than the other procedures.

directed into the afferent loop by a badly designed anastomosis or obstruction of the efferent loop. It has proved to be very rare in cases done by the method here described: only two definite cases—i.e., radiologically proved—have been met with. As has already been remarked, overdistension of this loop is one of the most potent factors leading to leakage from the duodenal stump in the early stages.

The "Dumping" Syndrome.—The loss of energy and feeling of faintness and lassitude after heavy meals has interested me for many years, and despite the article by Gilbert and Dunlop (1947) I feel that the complete understanding of it remains a problem. They report that no fewer than 17 of 45 gastrectomies had evidence of this syndrome and suggest that rapid emptying of the stomach is the primary cause; this produces a transitory rise in the blood sugar, followed by a rapid fall to very low levels due to excessive insulin production. The lassitude is thus due to a hypoglycaemia and is a concomitant of the so-called dumping stomach. It is, however, of some importance to note that they record it as occurring after both the ordinary Polya and the restricted stoma operations. My own series shows a much lower incidence of this syndrome—only twenty cases, and some of these quite mild in degree. In searching for the cause I have considered four possibilities.

1. Dumping of the stomach contents into the jejunum with reflex effects, via the splanchnic innervation, from overdistension.—This has not seemed likely, since the condition is painless, and, furthermore, there is no radiographic support, as Shanks's studies show, in the case of the operation here described.

2. Hypoglycaemia.—The blood-sugar curves which I have had done in these cases have not given powerful support to this idea; but since the publication of the article by Gilbert and Dunlop I recognize that this may have been due, as they suggest, to the fact that the samples were not taken often enough. In some cases the administration of sugar has seemed to give some relief, and I am therefore inclined to think that this may be the explanation. It is surprising, however, that these observers failed to detect any difference in the results of the full Polya and the restricted stoma operations, for this would certainly be expected.

3. Vagal stimulation.—There can be no doubt that many vagal fibres are included in the ligature of the vessels of the lesser curve and must be involved in the scar. They may therefore be stimulated by the pull on the lesser curve when the stomach is loaded. I have unsuccessfully looked for post-prandial changes in the blood pressure and have failed to find other supporting evidence.

4. Neurosis.—This is always a possibility after an extensive abdominal operation, but, in my inexpert opinion, it is not a likely explanation of the phenomenon.

Morning Nausea.—Another interesting syndrome, unassociated with the last, is a sensation of nausea the first thing on awaking in the morning. It nearly always disappears quickly when the patient assumes the upright attitude or with the first mouthful of food or drink. I have also noted that it is inclined to occur in those who sleep on the left side and may be relieved if they sleep on the right. I believe it is due to bile entering the stomach through the comparatively large orifice, devoid of sphincteric control, at night, which it does more easily with the patient on his left side and recumbent. The upright posture or the taking of a little food or drink empties the bile out of the stomach and so the nausea immediately disappears. Luckily it can be added that both the dumping and morning nausea syndromes tend to improve with the passage of time.

Adhesions have been thought to be responsible for post-operative symptoms in a fractional percentage of cases,

and in these there had been one or more previous operations for perforation.

Ventral hernia has necessitated further operation in two cases; four other bulges are adequately controlled by a light belt.

Gall-stones.—Subsequent operations for gall-stones have been undertaken in four cases—a very much smaller percentage than was found by Majoor and Suren (1947), who reported six cases after 174 gastrectomies, apparently especially after the Billroth II operation. They suggest a post-operative aetiological relationship; but I am not impressed, since in my own series the figure is very small and points to a chance association. I have on several occasions removed a pathological gall-bladder, with or without stones, at the time of the resection, and of course it often happens that an ulcer is adherent to the gall-bladder, sometimes densely to the point of perforation.

Colospasm.—It is perhaps not surprising that in ulcer cases, when the patient is often of the sthenic vagotonic type, there should frequently be noted some degree of colospasm and its associated diverticulosis. Nearly half of the gastrectomy patients who return complaining of abdominal symptoms have been shown to be cases of colospasm, and, as I have previously mentioned, this is probably the cause of the constipation which may follow the operation. It should therefore always be borne in mind when investigating an apparently unsuccessful gastrectomy.

Summary

Gastrectomy is probably the most permanently satisfactory method of dealing with chronic peptic ulceration at the present day.

A type of end-to-side anastomosis with a restricted and valvular orifice has been found to give good results in the vast majority of cases.

The risk of the operation is being steadily reduced, chiefly as a result of greater pre- and post-operative care.

Sulphonamides, used as a routine, have proved valuable in the prevention of infective lung complications.

The early and late sequelae of over 600 cases are analysed.

Omental necrosis and early morning nausea are noted as after-results not previously described.

The incidence of anastomotic ulceration after this operation appears to be a little under 1%.

The syndrome of post-operative hypoglycaemia associated with a "dumping" stomach is discussed.

REFERENCES

- Aron, E. (1933). *Recherches sur L'Ulcère expérimental et sur le Rôle des Acides aminés dans son Evolution*. Editions Universitaires de Strasbourg.
- Gilbert, J. A. L., and Dunlop, D. M. (1947). *British Medical Journal*, 2, 330.
- Hey, Wilson H. (1947). *Ibid.*, 2, 395.
- Hurst, A. F. (1928). *Lancet*, 2, 477.
- Lake, N. C. (1928). *Ibid.*, 2, 268.
- (1937). *British Medical Journal*, 2, 49.
- (1938). *Lancet*, 2, 241.
- Majoor, C. L. H., and Suren, J. J. (1947). *British Medical Journal*, 2, 8.
- Nissen, R. (1945). *Duodenal and Jejunal Peptic Ulcer*. Heinemann, London.
- Ogilvie, Sir Heneage (1935). *British Medical Journal*, 1, 457.
- (1947). *Lancet*, 2, 377.
- Shanks, S. C. (1934). *British Medical Journal*, 2, 1032.
- Somervell, T. H. (1942). *Brit. J. Surg.*, 30, 113.
- Stringer, P. (1947). *Lancet*, 1, 289.

The *British Orthoptic Journal*, which is published under the auspices of the British Orthoptic Society, has now opened its pages to contributions from overseas. In its issue No. 4, 1947, Dr. Walter B. Lancaster, of Boston, Massachusetts, explains "What is Orthoptics?" and Miss Diana Mann, of Melbourne, Australia, contributes a paper entitled "The Role of Orthoptics," which was read before the Australian Ophthalmological Society in 1946. Another new departure is the publication of case notes of special interest.