MODIFIED RADICAL GASTRECTOMY FOR CANCER OF THE STOMACH

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Until a better method of therapy becomes available, surgery is still the best treatment we can offer for carcinoma of the stomach. While the results with this treatment may not be a source of pride to surgeons, there is a certain proportion of cases in whom 5-year cures are obtainable.

In an effort to improve the number of cures, wider and wider methods of excision have been advocated until, within the last few years, total gastrectomy as a routine operation has been advocated and practised by some schools. The usual surgical operation for carcinoma of any viscus is planned with the developmental anatomy of the organ in mind. In cancer of the stomach, however, the embryological point of view is not usually considered. Anatomically the stomach appears to be suspended by the lesser and greater omenta and extra efforts are usually directed towards removing as much of these structures as possible under the impression that within them run the major lymphatic channels from the stomach. A consideration of the embryology will show that this is probably incorrect.

The immediate effect of total gastrectomy has been to increase the operative mortality significantly, whereas a significant rise in the number of eventual cures has not been produced (Marshall and Uram, 1954). In addition, it left the patients in an a-gastric state and many required a considerable time to adjust themselves to their new status.

Analysis of survival times of patients who have recovered after partial gastrectomy for carcinoma shows that the average duration of life after operation was about 20 months (McNeer *et al*, 1951). It seems unreasonable to spend too many of these hard-won months in adjustment. After a partial gastrectomy, independent of the size of the gastric pouch, the patient settles down very quickly and is able to return to normal work in about 6 weeks. He puts on weight and improves generally, and this is maintained until a few weeks before death. Death is usually painless and is due to liver secondaries and hepatic failure with or without ascites.

In addition, leaving a small gastric remnant avoids a thoraco-abdominal operation—a considerable strain on a debilitated patient and a fertile source of early post-operative deaths—and permits a safe and solid anastomosis.

It was shown by McNeer *et al.* that about 60% of

recurrences occur at the transected part of the gastro-intestinal tract. One cannot doubt that a proportion of these cases might have been saved by wider local resection. If this wider resection were uniformly employed in carcinoma-gastrectomy a marked improvement in the results could be anticipated.

With these aims in view, an operation is here described which takes into account the development of the stomach and allows a total gastrectomy or an oesophago-gastrectomy to be performed if this is thought necessary. It utilizes the abdominal approach, which is modified by removal of the xiphoid process, and it is designed to take most of the gastric bed away in continuity with the stomach and its draining glands.

DISCUSSION

The development of the foregut differs from that of the hind-gut and the mid-gut in that it possesses a ventral as well as a dorsal mesentery (Figs. 1 and 2). In the dorsal mesogastrium the spleen appears, and divides it into 2 portions which become the gastro-splenic and the

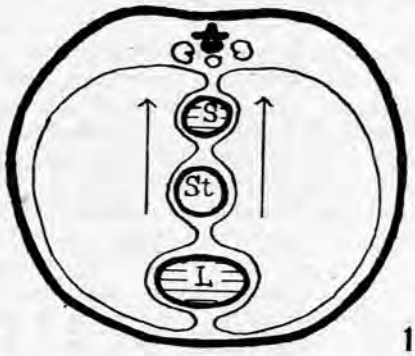

Fig. 1. Transverse section of embryo to show (diagramatically) an early stage in the development of the foregut. Arrows indicate direction of lymphatic flow.
S=spleen, St=stomach, L=liver.

lieno-renal ligaments respectively. The greater omentum develops from the dorsal mesentery and the greater curvature of the stomach constitutes this organ's primitive dorsal border. At the caudal end of the foregut the two buds of the pancreas appear. The blood supply of this organ arises partly from the superior mesenteric artery and this indicates that it originates near the midgut. The upper border of this organ can thus, for practical purposes be considered to be the caudal end of the wedge-shaped dorsal mesogastrium; the septum transversum, later the diaphragm, is of course, its cranial limit.

All the blood supply of the gut reaches it through its dorsal mesentery and the lymphatic drainage follows the blood supply. It can be justifiably presumed that the main lymphatic drainage from the stomach must pass along the dorsal mesogastrium. This structure is the anlage of the lieno-renal ligament, the spleen, the gastro-splenic ligament, the posterior wall of the lesser sac, the upper peritoneal surface of most of the transverse mesocolon, and the greater omentum. An operation which leaves behind any substantial portion of the dorsal

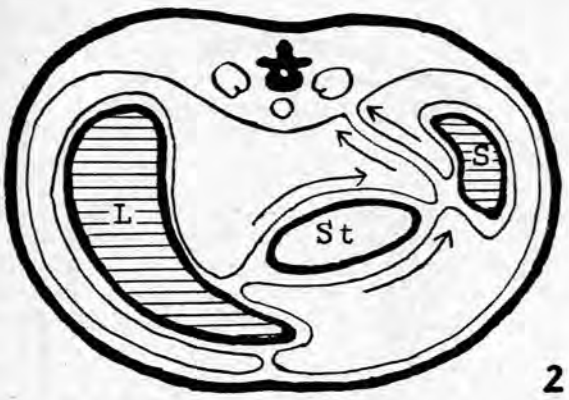

Fig. 2. Transverse section of embryo to show a later stage in the development of the foregut (diagramatic). Arrows indicate direction of lymphatic flow.

mesogastrium, cannot be considered to be radical surgery for carcinoma of the stomach.

In neoplasms of the small or large bowel, removal of a suitable and extensive wedge of mesentery, with its vascular and lymphatic drainage, is a *sine qua non* of adequate carcinoma surgery. It is only when the primitive rotation of the stomach has been corrected that one is able to assess the position and to realize the inadequate nature of our usual type of operation (Figs. 3, 4, 5 and 6). When this is done it also becomes clear that the distance between the surgically inviolable aortic glands and the body of the stomach is usually little more than one inch. Carcinoma spreading by direct extension has only this short distance to traverse for the case to become hopeless from the point of view of radical cure.

It is therefore not surprising that the incidence of cure in gastric carcinoma remains disappointingly low, since not only does the operation usually performed remove only a minor portion of the dorsal mesentery of the stomach but there is, in addition, the anatomical handicap of the very short distance between a primary and its irremovable glands.

It is generally accepted that retaining a small fringe of stomach at the cardiac end will permit an easier anastomosis through an entirely abdominal approach. Convalescence is almost indistinguishable in its smoothness from that following ulcer-gastrectomy. Since many gastric neoplasms permit of such a resection, the operation suggested here is applicable to a great number of cases. Where the growth has extended towards the cardia to such an extent as to prevent the retention of a fringe of gastric mucosa, the oesophagus can be mobilized, and an oesophago-jejunal anastomosis is done with a total gastrectomy. Only in those few cases where the neoplasm originates in the lower oesophagus, or at the oesophago-gastric junction itself, may the thoraco-abdominal approach be necessary.

Although leaving a gastric fringe violates the principle of removing the diseased organ completely, the gain in the reduced immediate mortality and the rapid convalescence outweigh the probable increased chances of a recurrence. In short, it is proposed to exchange the immediate better results of a slightly less radical opera-

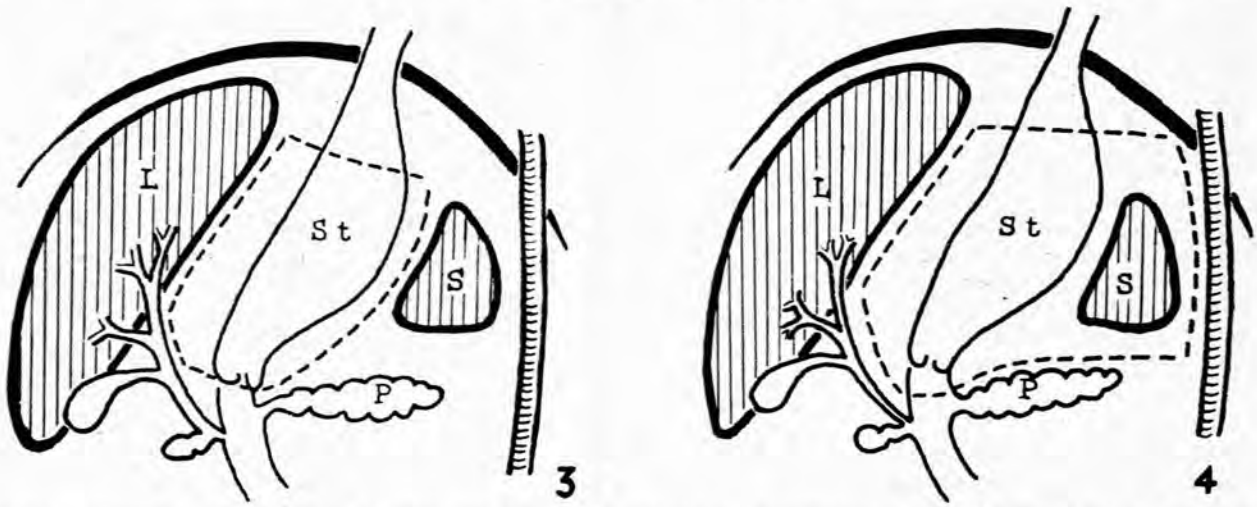

Fig. 3. Schematic sagittal section of embryo to show the foregut and the dorsal mesogastrium. The dotted line indicates the limits of the usual resection for cancer of the stomach. P=pancreas.

Fig. 4. As above; the dotted line indicates the scope of the proposed 'Modified Radical Gastrectomy'.

tion for the undoubtedly worse immediate effects with problematical remote improvements resulting from a more extensive procedure.

Obviously the problem can be settled only by trial. If we can show an increased proportion of successes and a more comfortable survival time for a greater percentage of our resections, this operation is justified.

Where there has been extension of the growth to adjacent organs, is the condition hopeless? Certain facts seem to indicate that it is not quite hopeless. Thus when the growth has spread onto the peritoneal surface of the stomach, analysis has shown that about the same survival times, and about the same proportion of 5-year cures are obtained (Pack and McNeer, 1948).

Again, adhesion of the growth to adjacent viscera is often due to inflammation because a zone of inflammation precedes the spread of carcinoma, and in many cases the primary can be peeled off the liver or the transverse mesocolon through this inflammatory zone.

When separation through the inflammatory zone is not possible, resection of the left lobe of the liver, of the transverse colon and of the transverse mesocolon can be performed without adding very much to the difficulty of the operation. Pack (1951) has noted that 'it is a striking fact that where the surgeon is forced to perform a radical local excision, owing to invasion of adjacent organs, his results have been surprisingly improved.' This too has been our experience, and we have not noticed any difference in the comfort or behaviour of patients when the abdominal wall or viscera

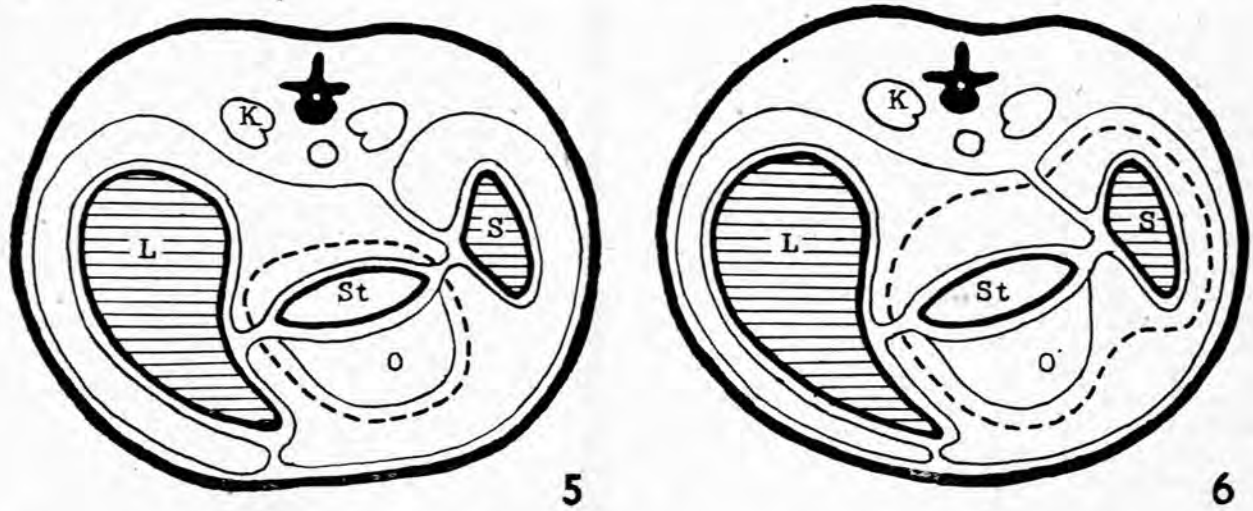

Fig. 5. Schematic transverse section of embryo to show within the dotted lines the limits of the usual resection for cancer of the stomach. K=kidney, o=omentum.

Fig. 6. As above; the dotted line indicates diagramatically the scope of the proposed 'Modified Radical Gastrectomy'.

adjacent to the stomach have been simultaneously removed.

Where does 'resectability' end? The answer to this is a purely personal one and it is necessary that we should clarify our own position. We feel that a large quantity of ascitic fluid, diffuse secondary metastases of the liver and peritoneum, or adhesions of the primary to the aorta or vena cava are contra-indications to anything except purely palliative procedures. Irremovable involved glands, or a few secondaries in the pelvis or liver, do not justify giving up hope. The adequate removal of the primary has occasionally, in our own experience, enabled obviously involved glands to be controlled by some natural process whose mechanism we do not as yet understand. It is the hope for such an occasional case of cure or natural arrest that encourages one to continue doing radical removals in border-line cases.

Local extension of the primary growth to the root of the mesentery and around the superior mesenteric vessels has been our major source of difficulty. Sometimes the vessel may be felt pulsating in a secondary mass of glands and these latter can then be subdivided and transected and the primary freed. It has rarely been necessary to abandon the more radical procedure, because we have cut across carcinoma tissue freely once the vessels have been identified. While this cutting across of carcinoma tissue is repugnant to the pathologically minded operator, the palliation has not been any the less effective. One feels that 2 or 3 hours' hard work is a small price to pay for at least 6 months relief, and this belief has, in general, been our guide.

OPERATIVE TECHNIQUE

The abdomen is opened by a mid-line incision which extends from the xiphisternum to an inch below the umbilicus. The smaller incision, through which an ulcer-gastrectomy can be so readily performed, is not advised. The peritoneum is opened and the position assessed. In uncomplicated cases the first step is to mobilize the greater omentum by detaching it from its almost adventitious attachment to the transverse colon. This can be practically bloodless and should extend from the hepatic to the splenic flexure. The detachment is commenced at the hepatic flexure, and the lesser sac is thus entered from the right and after the root of the transverse mesocolon is exposed; the anterior surfaces of the pancreas and of the duodenum are exposed before the lesser sac is opened. In this way that part of the transverse mesocolon which has developed embryologically from the greater omentum is stripped up and left attached to the greater omentum and the stomach. The lesser sac is then entered and the duodenum mobilized; at this time any sub-pyloric glands which are encountered are removed in continuity. After the peritoneal reflection from pancreas to duodenum is divided, and the vessels crossing this reflection have been severed, the upper border of the duodenum is mobilized. At that point there are several supra-pyloric glands which should be included in the procedure as the lesser omentum is stripped down. The right gastric artery is caught and divided. A deliberate incision through the peritoneum is now made to the right of the convexity of the duodenum and this enables one, in the majority of cases, to free its upper and outer borders and to lift this organ with the common bile-duct and the head of the pancreas well out on to the surface of the abdomen.

After the bile-duct is carefully visualized, the duodenum is divided at the junction of its horizontal and vertical portion, i.e. between the 1st and 2nd part and its distal part and closed deliberately with 3 layers of sutures. The splenic flexure is now drawn inwards and downwards after an incision is made in the peritoneum on its lateral and superior borders. The splenic flexure and the transverse colon are stripped downwards away from the spleen, and are excluded from the field with a moistened pad.

The xiphoid process is removed. By doing this, the anterior attachments of the diaphragm to the posterior surface of the xiphoid are separated so that the diaphragm and sub-diaphragmatic organs fall away dramatically from the anterior abdominal wall (Saint and Braslow, 1953). The spleen is brought into the wound and mobilized by incising the peritoneum on its left border. The division of the lieno-renal ligament and the phrenico-splenic ligaments enables one to sweep the spleen towards the right. At the same time the hand enters easily into that anatomical layer which lies anterior to the aorta and vena cava and sweeps the spleen, the tail of the pancreas, the splenic pedicle and the lesser sac off the posterior abdominal wall. This is the 'manoeuvre of Gomez and Gomez' and has been adequately described by Torrents (1953). The suspensory ligament of liver is divided and the left lobe of the liver drawn away from its normal position in front of the oesophageal orifice. If necessary, the peritoneum over the lower oesophagus can be divided anteriorly and posteriorly and, by careful stripping, up to 4 inches of oesophagus can be drawn down into the abdomen. The deliberate division of the two vagi permits the oesophagus to come down very freely. The left gastric artery is now caught close to its origin; in many instances there is heavy infiltration of the para-cardial and left gastric glands by neoplasm, but the artery is carefully secured with double non-absorbable ligatures and divided. The splenic artery and vein are cut and divided some distance from the hilum of the spleen and the peritoneum in front of the tail of the pancreas stripped off so that the pancreas is allowed to fall back on to the posterior abdominal wall, while most of its peritoneal surface—anatomically part of the posterior wall of the lesser sac—is stripped off with the stomach.

The remaining attachment of the stomach is to the oesophagus, and its blood supply comes from the oesophageal vessels. The stomach is divided about 1 inch below the oesophagus and the mass of tissue, consisting of the major part of the stomach, the first part of the duodenum, the greater and lesser omenta, the spleen, and if necessary, the body and tail of the pancreas, are resected and removed. Posteriorly, the left kidney and the left adrenal are visible. An ante-colic anastomosis is made between the first loop of the jejunum and the gastric stump. It may occasionally be necessary to divide one or two vascular arcades to lengthen the loop of jejunum in order to relax the line of suture.

No attempt should be made to close the posterior peritoneum post-operatively, but a tube should be left in the abdomen to deal with any ooze that may come from the large raw bed in the posterior peritoneum. The abdomen is then closed.

Although this operation is an extensive one, the post-operative course shows surprisingly little difference from that of an ordinary ulcer-gastrectomy. Patients often develop a positive gastric balance within 36 hours and are out of bed on the third day. Since there has been no interference with the thorax, and the diaphragm has not been incised, thoracic complications do not affect the convalescence.

CONCLUSION

The complete removal of the lymphatic drainage of so complicated an organ as the stomach cannot be undertaken without a clear understanding of the embryological issues involved. When the dorsal mesogastrium and its complicated folds are considered, many apparently contradictory findings and opinions fall neatly into line and are explainable on embryological grounds. Thus the unexpected finding noted above that the results have been improved when the growth has spread on to the adjacent viscera, compelling the surgeon to resect the transverse colon and mesocolon in continuity (Pack, 1951), can be readily explained on the basis that more of the mesogastrium has had to be removed. The observation that 50% of lymph glands in the hilum of the spleen show early involvement in carcinoma of the stomach (McNeer *et al*, 1955) is a clear indication of the persistent importance of the primitive lymph channels.

It may well be that the lack of awareness of the embryological issues involved is responsible for much of the disappointment that has followed the introduction of total gastrectomy. Any operation which relies on more and more extensive local removals of a primary malignancy without taking its lymphatic drainage into consideration is doomed to fail. The literature is full of examples of suggestions for taking bigger or smaller portions of the stomach away (Donald and Donald, 1951) but an editorial comment that 'even extensive excisions which include much of the lymphatic field and the parietal peritoneum, spleen and pancreas may not succeed' (Lancet, 1955) is an outlook that may well be too gloomy; to date it has not been tried out.

It is submitted that this 'Modified Radical Gastrectomy' should be adopted as a routine procedure in those cases of cancer of the stomach where the operation is feasible. With this in mind, the subject was introduced at a meeting of the surgical staff of the Groote Schuur Hospital in October, 1954. After discussion, many of those present agreed to try it out and to report on the follow-up results of the cases. It is therefore only possible to present the immediate post-operative results of some of the first few cases. These seem to show that while the operation can be carried out with no higher mortality than that following the usual carcinoma gastrectomy, the post-operative convalescence has been as smooth as that of ulcer gastrectomy. The operation, however, takes a little longer time to perform, but it is hoped that increasing experience will overcome this handicap. It will be some time before the long-term results begin to come in. Until then, one can be fortified with the knowledge that a more radical and perhaps a more logical operation is being performed.

CASE RECORDS

1. A.A., Coloured female, aet. 55. Operated on 20 August 1954 for pyloric carcinoma, and the 'Modified Radical Gastrectomy' was performed, with removal of the transverse colon and mesocolon, which were invaded by the tumour. Suction and drip removed on the 2nd day, up on the 4th day, and was discharged on 5 September (15th day).

Pathological Report: Adenocarcinoma. Glands not involved.

2. A.A., Coloured male, aet. 44. On 26 October 1954 the 'Modified Radical Gastrectomy' was performed for carcinoma of the greater curvature. On the 3rd day suction and intravenous were discontinued and on the 6th the patient, who by then was ambulant, overate to such an extent that he required to be placed on suction for 2 more days. He then rapidly recovered his gastric tone and was discharged on 11 November (16th day).

Pathological Report: Adenocarcinoma. Glands not involved.

3. E.M., Coloured female, aet. 69. Operated on 9 November 1954 for carcinoma of the greater curvature 5 cm. in diameter. Massively enlarged retro-peritoneal glands found, which were removed in continuity in the 'Modified Radical Gastrectomy'. On the 2nd day gastric balance was positive and the drip and suction were removed, and on the 6th day she was up and about the ward. The patient was discharged on 9 December after a relatively slow convalescence, which was complicated by her falling in the bathroom and injuring her head on the 8th post-operative day.

Pathological Report: Anaplastic carcinoma. Glands not involved.

4. S.C., European male, aet. 77. Operated on 15 November 1954. Prepyloric carcinoma 9 cm. in diameter involving the pyloric canal was found. The 'Modified Radical Gastrectomy' was performed, removing the spleen, the tail of pancreas, and transverse mesocolon. It was not necessary to remove the transverse colon. Drip and suction were discontinued within 36 hours and the patient was out of bed on the 4th post-operative day and was discharged eating frequent small meals on the 14th post-operative day.

Pathological Report: Spheroidal-cell carcinoma. Glands invaded. Pancreas not involved.

5. H.T., European male, aet. 69. Operated on 7 January 1955 for a lesser-curve carcinoma extending to within 2 inches of the oesophagus. The 'Modified Radical Gastrectomy' was performed Drip and suction came off after 2 days. Ambulant on the 5th day and discharged on the 10th post-operative day.

Pathological Report: Reticulum-celled sarcoma.

6. N.v.Z., European female, aet. 77. Operated on 1 February 1955 for carcinoma of the stomach. The 'Modified Radical Gastrectomy' was performed. Drip and suction removed on the 4th post-operative day. Convalescence was complicated by a transient (?) deep-veined thrombosis of the right calf. Discharged on the 12th post-operative day.

Pathological Report: Anaplastic carcinoma. Glands involved.

SUMMARY

1. The development of the stomach and its mesenteries is outlined.

2. Based on this description a 'Modified Radical Gastrectomy' is proposed for carcinoma of the stomach.

3. The technique of the operation is described.

4. An embryological explanation is suggested for some of the apparently anomalous facts observed in the spread of gastric carcinoma.

It is with particular pleasure that I acknowledge the debt that I owe to my old friend and teacher, Prof. M. R. Drennan, of the Department of Anatomy, University of Cape Town, who helped me with the diagrams used in this paper and under whose meticu-

lous direction Mr. D. J. Coetzee has kindly made the drawings for publication. I also tender my thanks to Prof. J. H. Louw, Mr. G. Sacks and Mr. J. Heselson, of the Department of Surgery, for permission to quote some of their cases and for having actively supported the principle of this operative procedure.

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