

A Critical Evaluation of Radical Subtotal Gastric Resection as a Definite Procedure for Antral Gastric Carcinoma*

HENRY W. MAYO, JR., M.D., JENNINGS K. OWENS, M.D., AND MILTON WEINBERG, M.D.

Charleston, South Carolina

From the Department of Surgery, Medical College of South Carolina, and the Roper Hospital, Charleston, South Carolina

CANCER OF THE stomach is recognized universally as a highly lethal disease, particularly because surgical efforts to control the progress of the disease, or to eradicate it in individual cases, have so commonly failed. Conservative estimates have indicated that the over-all five year survival rate in all cases of cancer of the stomach in this country is probably in the neighborhood of 5 per cent. This is, no doubt, partly due to the insidious nature of the disease and the resulting delay in definitive diagnosis. However, the question has been raised repeatedly as to the adequacy of present methods of surgical treatment of carcinoma of the stomach.

The usually acceptable operation of radical subtotal gastric resection for carcinoma of the stomach has been employed less frequently as more surgeons have advocated the more formidable total gastrectomy with removal of the gastro-hepatic, gastro-colic, and gastro-lienal omenta, as well as the spleen. As surgical technics have improved, and the mortality of the latter operation has declined, some authorities have felt that total gastrectomy is more desirable as a routine procedure for cancer of the stomach because it may be possible to remove more adequately the areas of primary lymphatic spread. Thus, Lahey and Marshall⁶ have suggested that total gastrectomy should be done for most cases of

early cancer of the stomach. This position is supported by the studies of McNeer and associates,⁹ who noted that in 92 cases of cancer of the stomach with recurrence after subtotal resection, there was recurrence in the gastric remnant in 50 per cent, recurrence in the duodenum in 14 per cent, and metastases to peri-gastric lymph nodes that had not been removed in 22 per cent. The latter writers believed that these findings indicated that removal of the entire stomach and resection of a more liberal portion of the duodenum was indicated.

However, this position is not accepted universally. Ransom¹¹ recorded a 29.0 per cent five year survival rate for distal resections of the stomach for carcinoma, but the five year survival rate for total gastrectomy in his series of cases was only 6.7 per cent; it must be recognized that in the latter group of cases, there were several in which total gastrectomy was carried out in a rather desperate effort to achieve palliation. Ochsner and Blalock¹⁰ think that radical subtotal resection is adequate for lesions of the gastric antrum, and that total gastrectomies should be reserved for lesions of the upper portions of the stomach, or lesions diffusely involving the entire stomach. Similarly, ReMine¹² and his co-workers were convinced that total gastrectomy was the procedure of choice in most cases of gastric cancer. To date, there is no large series of cases published which indicates a definite superiority of total gastrectomy as regards five year survival rates.

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TABLE I. "Curative" Resections.

(Ast = Average Survival Time)

	No. of Cases	Hospital Deaths	Died Later (Presumably of Cancer)	Alive With Recurrence	Alive Without Recurrence	Died of Other Causes	
Lymph Nodes not Involved	No Serosal Invasion	10	0	2 (Ast 27.5 mos.)	0	7 (Ast 63 mos.)	1 (5.5 yrs.)
	Serosal Invasion	3	0	0	3 (Ast 96 mos.)		
	No Serosal Invasion	6	1 (Ast 27 mos.)	4 (Ast 27 mos.)	0	1 (11 mos.)	
Lymph Nodes Involved	Serosal Invasion	3	0	0	2 (Ast 14.5 mos.)	1 (36 mos.)	
Total		22	1 (5%)	6 (Ast 27.2 mos.)	2 (Ast 14.5 mos.)	12 (Ast 59.8 mos.)	1 (5.5 yrs.)

13 (59%) of 22 patients have had no recurrence to date.

It must be recognized that the mortality of total gastrectomy is likely to be higher than that of radical subtotal gastric resection, and, if the patient survives the former operation, he is likely to become a nutritional cripple who is unable to maintain his optimum weight. Recognition of the latter fact has prompted surgeons to devise various types of substitute gastric reservoirs, the formation of which necessarily would add to the complexity of the operative procedure.

McNeer and his associates⁸ have further extended the scope of the operative attack on cancer of the stomach by including the distal portion of the pancreas and the spleen in operations on those cases in which metastases might occur to the pancreatico-lienal nodes, and, for lesions of the greater curvature in the lower portion of the stomach, they advocate resection of the transverse mesocolon, and perhaps part of the transverse colon. Harvey and his associates,⁵ dealing with a series of cases in which the incidence of antral carcinoma was high, thought that the results in the management of antral gastric carcinoma were poor because of metastases to the subpyloric nodes along the right gastro-epiploic vessels. These might not be recognized, or might not be removable because of adherence to

the head of the pancreas or the duodenum, and might drain via the lymphatics passing between the pancreas and duodenum to the hepatic, celiac, and para-aortic nodes. Harvey proposed an extension of the usual radical subtotal gastric resection by removing the head of the pancreas and the duodenum, as might be done for carcinoma of the ampulla of Vater.

The conflicting opinions of those who are enthusiastic about total gastrectomy as a routine procedure for carcinoma of the stomach, and of those who believe that subtotal gastric resection of a radical nature is adequate in most cases, suggested a review of the experience in the Roper Hospital, particularly since it was known that in this institution a high percentage of cases were antral carcinoma, to determine if a change in the operative approach to patients with gastric malignancy was indicated. In the past, it has been our usual policy to employ radical subtotal gastric resection for lesions of the antrum and lower half of the stomach. This operation involves removal of two-thirds or more of the stomach as well as a generous portion of the first part of the duodenum, removing in continuity the greater omentum, the greater portion of the gastro-colic omentum, and practically all of the gastro-hepatic

TABLE II. *Palliative Resections.*

(Ast = Average Survival Time)

	No. of Cases	Hospital Deaths	Died Later (Presumably of Cancer)	Alive With Recurrence	Alive Without Recurrence
Scirrhus Carcinoma.....	4	0	4 (Ast 5.2 mos.)	0	0
Acute Free Perforation.....	3	0	2 (Ast 19 mos.)	1 (46 mos.)	0
Distant Metastases or Irremovable Involved Nodes.....	3	0	2 (Ast 26 mos.)	1 (37 mos.)	0
Involvement of Adjacent Organs.....	21	6	10 (Ast 8.6 mos.)	3 (Ast 20 ms.)	2 (Ast 58 mos.)
Total.....	31	6 (19%)	18 (Ast 10.9 mos.)	5 (Ast 28.6 mos.)	2 (Ast 58 mos.)

TABLE III. *Extent of Carcinomatous Involvement.*
(96 Cases)

	Lesser Curvature Nodes	Greater Curvature Nodes	Serosal Invasion	Hepatic Metastases	Pancreatic Invasion	Mesocolon Invasion	Ascites	Invasion of Colon
Explorations (77)								
Not Resected...	65	65	44	43	41	38	26	14
Diagnosed at Autopsy (19)...	13	13	5	8	6	4	2	4

omentum. Total gastrectomy has been reserved for cases of scirrhus carcinoma with diffuse involvement of the gastric wall, and for cases in which there is invasion of the upper portion of the stomach. In the latter instance, proximal radical subtotal gastric resection has been employed occasionally. In regard to supposedly benign gastric ulcers, since the major reason for the surgical removal of these lesions is to rule out the possibility of occult carcinoma, we have employed routinely the radical type of subtotal gastric resection as advocated for such benign lesions by Welch and Allen¹⁴ in 1948. It has been our feeling that if an adequate margin is given to the tumor in dividing the stomach, and if considerable effort is expended in removing the gastrohepatic ligament and the nodes in the neighborhood of the left gastric artery, subtotal resection should be sufficient for most cases.

RESULTS

In the 14-year period between January 1, 1940 and December 31, 1953, the diagnosis

of carcinoma of the stomach was made in 194 cases. In 37 cases this was a clinical diagnosis only, without proof of the disease by microscopic study, and operation was not carried out because of either the presence of distant metastases, the moribund condition of the patient, or of a defeatist attitude on the part of the attending physician with regard to the possibility of curing this disease. In one case diagnosis was established by Papanicolaou smears obtained by means of the gastric balloon, but this patient refused operation. In seven cases diagnosis was established by biopsy of distant metastases, and in 19 cases diagnosis was established at autopsy. There was thus a total of 64 cases which were not submitted to operation.

In 77 cases, operations other than resection of the stomach were carried out. These included exploration only in 29 cases, gastro-enterostomy in 36 cases, gastrotomy in nine cases, and jejunostomy in three cases. The location of the lesion in each case for which operation was done is tabulated in Figure 1. In view of the high percentage

TABLE IV. *Extent of Involvement in 53 Gastric Resections.*

Superior Gastric Nodes...26	Subpyloric Nodes.....11
Serosal Invasion.....19	Hepatic Metastases..... 9
Mesocolon Invasion.....19	Ascites..... 2
Inferior Gastric Nodes...17	Colon Invasion..... 2
Pancreatic Invasion.....13	Paracardial Nodes..... 1
Pancreatico-Lienal Nodes..... 0	

of cases in which the lesion was located in the gastric antrum, a fertile field for the study of the surgical therapy of such lesions presented itself.

Although the number of resections has increased in recent years, as indicated in Figure 2, perhaps chiefly due to a more aggressive attitude in attempting palliative resections in all cases in which it was thought that the gross primary cancer could be removed, nevertheless there has been little if any increase in the relative number of patients arriving on the operating table in a stage which the surgeon felt was amenable to cure by operation.

There remained for study 53 cases in which resection of the stomach was carried out. The average age of these 53 patients was 57 years, the youngest being 35 years of age and the oldest 87 years of age. Forty-eight of these patients were on the ward service, and only five were private patients. Thirty-five were males and 18 females, and 48 of the 53 were colored, a reflection of the high proportion of colored patients on the ward service. Follow-up is complete on each of these 53 patients at the time of preparation of this article.

Resections were classified as "curative" if the lesion was limited to the stomach and the immediately adjacent regional lymph nodes, if there was no invasion of adjacent organs or evidence of distant metastases, and if there was no evidence that tumor had been left behind at the operation. The results in this group of cases are tabulated in Table I. There was one hospital death (due to a subphrenic abscess) in this group of 22 patients, the mortality rate thus being

5 per cent. There have been no hospital deaths following "curative" resections since 1949. In the 13 patients without lymph node involvement by carcinoma, the results have been excellent. Two of them died at 20 and 35 months after operation, respectively, and one died five-and-one-half years after operation of hypernephroma with metastases. The remaining ten patients have shown no evidence of recurrence, and the average survival time of these ten patients is 72.9 months.

The nine patients in this group in whom lymph node involvement was demonstrated did not fare so well. Four of these are still alive, but two have demonstrable recurrence of their malignancy. The remaining two are apparently free of recurrence 11 months and 36 months respectively after operation. However, in those patients who have succumbed to the disease, or in whom recurrence has developed, the length of survival, as well as the symptomatic course of the individual patient, indicate a good palliative result. It is particularly noteworthy that invasion of the serosal surface of the stomach, demonstrated both grossly and microscopically, appears to make very little difference in the possibility of cure, and it is certainly of much less importance, from the point of view of prognosis, than the status of the regional lymph nodes. One patient, who has survived for eight years without recurrence, was found to have ascitic fluid present in the abdomen in addition to serosal invasion at the time of his operation.

The results in the group of palliative resections are tabulated in Table II. The four cases of scirrhous carcinoma are tabulated separately because of the notoriously poor prognosis in this type, which is confirmed by the average survival time of only 5.2 months. In one of these patients, total gastrectomy failed to eradicate the lesion which was found to invade the esophagus at the margin of resection. In the other

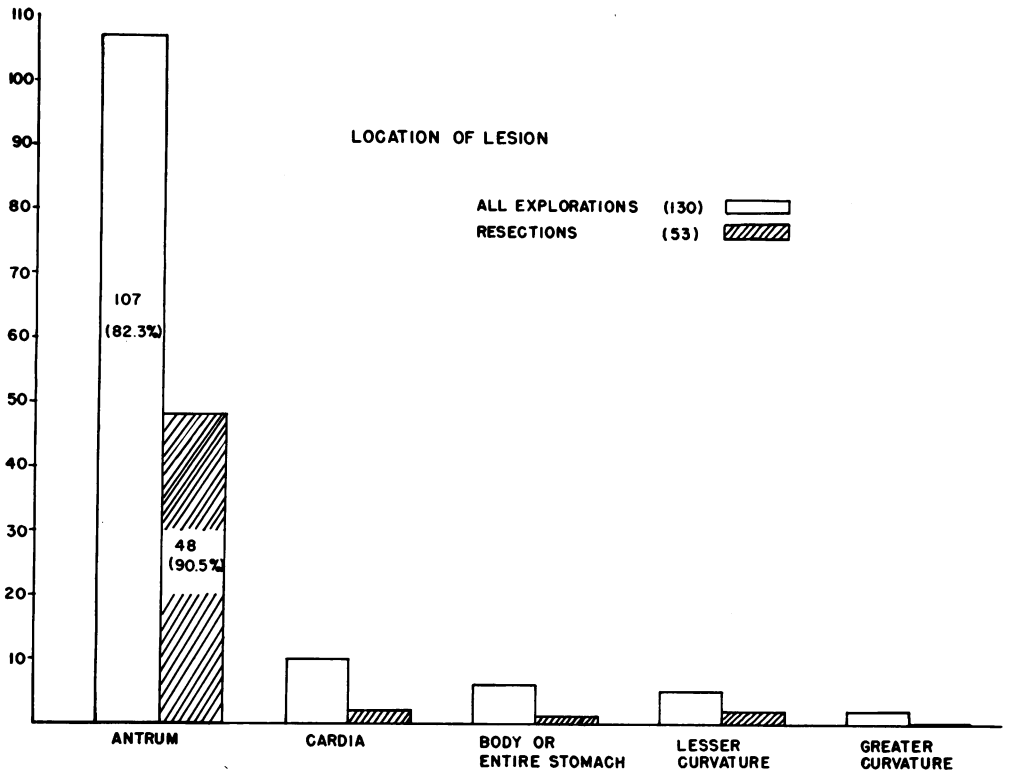


FIG. 1.

three cases there was invasion of either the liver, pancreas, mesocolon, or transverse colon, and subtotal resection was carried out for palliation only. The three cases of acute free perforation are tabulated separately because, to our knowledge, there is no report in the literature of a cure of such a perforation of a gastric malignancy. One of these three still survives, almost four years after resection, but unfortunately, he has recently developed a Virchow's node, microscopic examination of which demonstrated metastatic malignancy. In this group of 31 palliative resections there were six hospital deaths, a mortality rate of 19 per cent. All of the hospital deaths occurred in the group of 21 patients in whom there was demonstrable involvement of adjacent organs for which extended gastrectomy was carried out, including removal of portions of the pancreas, liver, transverse mesocolon,

transverse colon, or small bowel. One patient in this group, who has survived eight years after operation without evidence of recurrence, deserves particular mention because at operation there was contiguous invasion of the left lobe of the liver by the tumor, and this segment of the liver was resected *en bloc* with the stomach. This case illustrates the occasional curative value of heroic attempts to remove all gross carcinoma, despite invasion of adjacent structures.

Of the 194 cases to which the diagnosis of gastric carcinoma was assigned, there were 129 diagnosed five or more years before this study was carried out. Ten of these patients survived five years or more, an over-all survival rate of 8 per cent. As noted in Figure 3, the five year survival rate of all resections was 39 per cent. Ten or 67 per cent of the 15 patients in whom

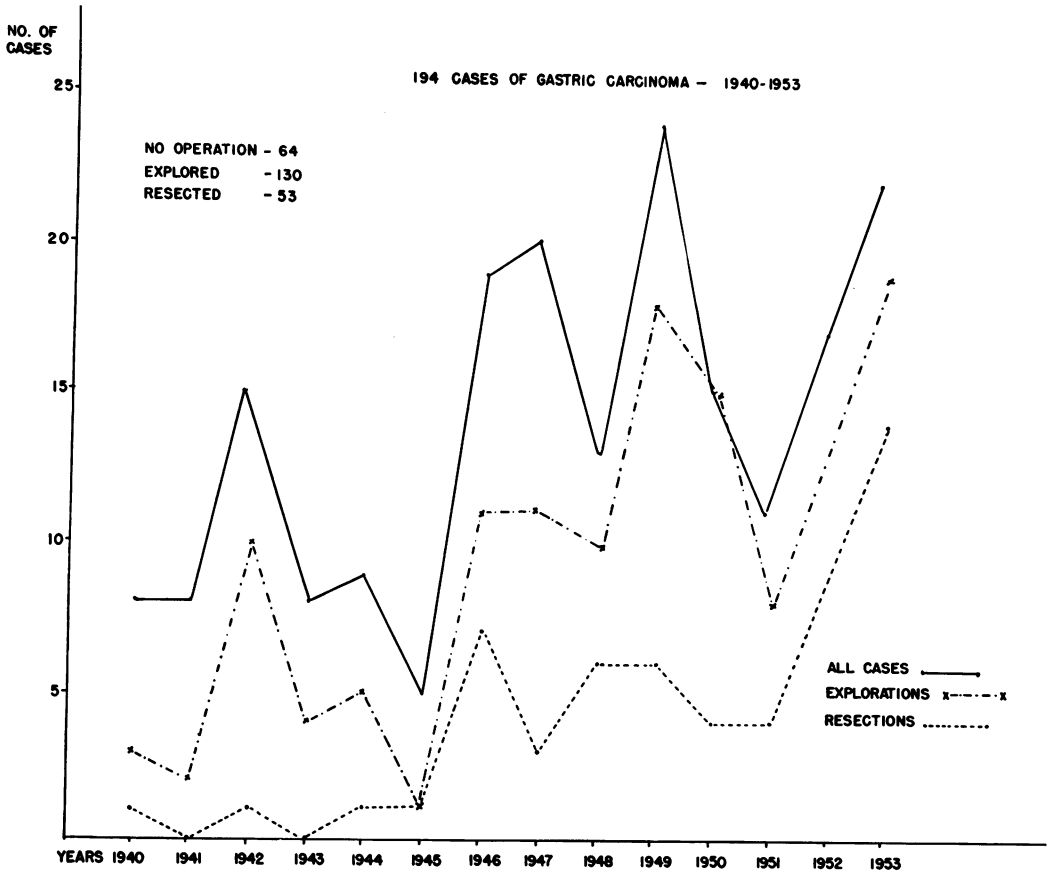


FIG. 2. Operability and resectability.

no lymph node involvement was demonstrable have survived five years or more. In nine of these ten cases the lesion was in the antrum, but the other patient had a cardiac lesion treated by proximal subtotal gastric resection. The most disturbing and pertinent finding, however, is the fact that none of the 11 patients in whom lymph node involvement was demonstrable are still alive. In the group of 22 "curative" resections, 15 were carried out in a radical manner with removal of the greater omentum, and gastro-hepatic and gastro-colic omenta, but in the other seven cases the operation was of lesser magnitude than this standard radical procedure. It is particularly interesting that four of these patients in whom a non-radical subtotal resection was performed have survived five years or more. Obviously, any

kind of resection which encompasses the lesion in the stomach would be satisfactory if there were no lymph node involvement, but it is disturbing that procedures presently utilized appear not to be satisfactory for the cure of lesions which have metastasized to the adjacent lymph nodes.

In an effort to determine the reasons for the inadequacy of present operative procedures, the extent of involvement by malignancy in each of the cases explored, and in each of the cases diagnosed at autopsy was reviewed, and this information is recorded in Table III. In these cases, it was not possible to determine from the chart the exact sites of lymph node involvement, which are recorded simply as lesser curvature and greater curvature nodes. However, in the cases for which resection was carried out,

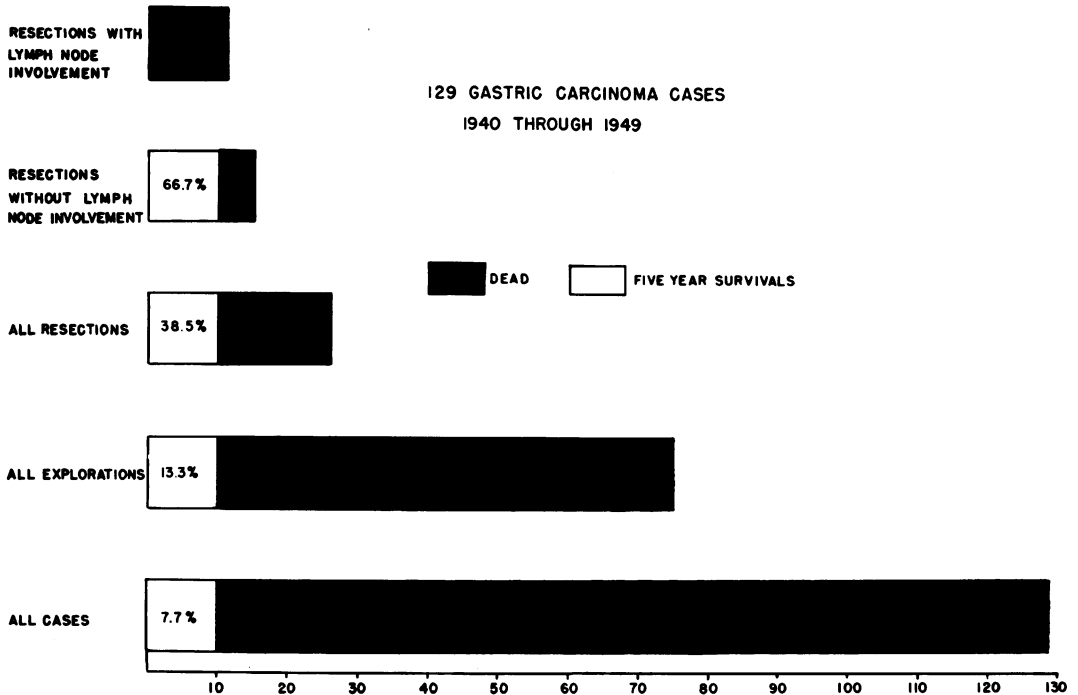


FIG. 3. Five-year-survival rates.

a more detailed study was possible, and this is recorded in Table IV. None of the resected specimens were examined in the pathology department by a clearing technic, and the accuracy of the determination of gross lymph node metastases by the operating surgeon is open to question in some cases. There is reason to believe that in the presence of such a high incidence of antral carcinoma, most of which were rather extensive, the involvement of sub-pyloric nodes was more frequent than recorded in Table IV, and that perhaps such involvement was not recognized. Of particular interest is the relatively high incidence of involvement of the transverse mesocolon and pancreas by direct invasion. It is recorded that the pancreatico-lienal nodes were not involved in any cases, but this is probably meaningless, since it is doubtful that these nodes were removed in the routine type of resection employed. However, the paracardiac area was inspected carefully in most cases, and the finding of only

one case in which metastases occurred to these nodes is probably significant.

An attempt was made to ascertain the site of recurrence in all cases in which the tumor was not eradicated. Unfortunately, autopsy studies are available on only one patient who had a palliative resection for antral carcinoma with lymph node metastases and gross invasion of the pancreas and transverse mesocolon; the recurrence in this case involved the duodenal stump, the head of the pancreas, and the hepato-duodenal ligament. In all other patients who subsequently died of recurrent carcinoma, follow-up notes indicated that abdominal masses were noted in most cases, and most often these were thought to represent liver metastases. Rectal shelves were noted in many cases. Upper gastro-intestinal roentgenologic studies were carried out in the majority of these patients, but only in one case in which subtotal gastric resection had been carried out for a multicentric antral lesion did the roentgenogram reveal any

definite evidence of carcinoma recurrent in the gastric stump, suggesting that another center or origin of the tumor had been missed by the resection.

In seven cases in which resection was done for palliation only, re-explorations were performed in an effort to eradicate obvious recurrent tumor at time intervals ranging between three and 37 months after the original operation. Two of these secondary operations followed previous palliative total gastrectomies; in one there was recurrence in the liver and abdominal wall, and in the other, in the remnant of the omentum and transverse mesocolon. At the five re-operations after previous subtotal gastric resection the recurrences were in the following sites respectively:

1. Diffuse peritoneal carcinomatosis.
2. Abdominal wall, transverse mesocolon and transverse colon.
3. Hepato-duodenal ligament and region of head of pancreas (with obstructive jaundice).
4. Para-aortic nodes, transverse mesocolon and pancreas.
5. Transverse colon and at the base of the right lobe of the liver. In none of these five cases was recurrent tumor demonstrable in the gastric stump.

DISCUSSION

Ochsner and Blalock¹⁰ recorded five year survival rates after subtotal gastric resection for carcinoma of the stomach of 87.5 per cent in the absence of lymph node involvement, and 20 per cent in the presence of lymph node involvement. In the series reported by Welch and Allen¹⁴ these figures were respectively 47.6 per cent and 5 per cent, and in Ransom's¹¹ series of cases the same figures were respectively 50 per cent and 16 per cent. The five year survival rate of 67 per cent reported here for gastric carcinoma cases without lymph node involvement appears to be an acceptable figure. It was thought that the absence of any

five year survivors in the small series of 11 resections in which lymph node involvement was found might be a reflection of the high incidence of antral lesions in this series of cases. In six of these 11 cases, the operation was classified as palliative because of invasion of the transverse mesocolon or pancreas, or because of liver involvement. Nonetheless, it would appear that a more radical operative procedure would be desirable to increase the salvage rate in cases of antral carcinoma with lymph node metastases, but there is no evidence to suggest that total gastrectomy would accomplish this purpose.

The findings of McNeer and associates⁹ with regard to recurrence in the gastric remnant are not duplicated in this series of cases, nor is there any evidence that metastases to the pancreatico-lienial or paracardiac nodes are much of a problem in dealing with antral gastric carcinoma. Sunderland and his co-workers,¹³ in reporting the lymphatic spread in 35 cases of gastric cancer, recorded only five cases of antral carcinoma. In three of the latter, metastases to the sub-pyloric and superior gastric nodes are noted, and in two of these three there were in addition metastases to the inferior gastric nodes; the two other cases of antral carcinoma had no metastases. The work of Collier, Kay, and McIntyre³ shows that in a high (26.4 per cent) percentage of cases of gastric carcinoma, there was involvement of the duodenum, and these findings have been confirmed by McNeer and associates.⁹ With these facts in mind, and recognizing the serious significance of sub-pyloric lymph node metastases which might extend downward between the pancreas and duodenum to the para-aortic and hepatic nodes, and which might be irremovable without removal of the head of the pancreas, Harvey's group⁵ proposed a more radical operation for antral carcinoma. In this procedure, the stomach was removed distal to the left gastric ascending branch

and distal to the *vasa brevia*. The left gastro-epiploic artery was removed almost to the point of origin on the splenic artery, removing *en bloc* the greater and lesser omentum and the left gastric artery to the point of origin of the ascending branch. The right gastric and gastro-duodenal arteries were divided at their origin from the hepatic artery, removing the head of the pancreas and the duodenum. In effect, this amounted to a pancreatico-duodenectomy as is usually carried out in the treatment of carcinoma of the ampulla of Vater, combined with radical subtotal gastric resection. Reconstruction of the gastro-intestinal tract is carried out in the same way as might be done after resection for carcinoma of the ampulla of Vater.

Harvey⁴ reports ten patients on whom such an operation was performed. Four of these died in the hospital, a mortality rate of 40 per cent. One patient died four and one-half months after operation and his sudden death suggested the possibility that the death was not due to recurrent carcinoma. One patient died two years after operation, of recurrent carcinoma. The remaining four patients are alive and well without recurrence at intervals of seven months, 12 months, 15 months, and three years and ten months after operation. In each of these cases there was involvement of lymph nodes that could not have been removed with the accompanying lymphatics without resection of the head of the pancreas.

Compared with the well standardized procedure of radical subtotal gastric resection with its low mortality rate, this operation is an unquestionably radical approach to the problem, and questions of morbidity and mortality rates will arise immediately. Actually, such a procedure is little more than would be done in the treatment of carcinoma of the ampulla of Vater or carcinoma of the head of the pancreas since, as pointed out by Lynch and Rosenberg,⁷ it is

desirable to remove a considerable portion of the stomach in performing pancreatico-duodenectomy if the postoperative complication of marginal ulcer is to be avoided. Cattell and Warren² have reported 102 cases of pancreatico-duodenectomy, with an acceptable mortality rate of 12.7 per cent. Since the mortality of uncontrolled gastric carcinoma is 100 per cent, limited efforts in this direction appear to be justified to determine if the five year survival can be improved. It is our intention to utilize this procedure experimentally in selected cases of antral gastric carcinoma in which there are obvious gross lymph node metastases, and no distant metastases. For the present, we shall be content with radical subtotal gastric resection as the procedure of choice for antral carcinoma without obvious gross lymph node metastases, since the results in such cases have been satisfactory. It is not the intention of this communication to suggest pancreatico-duodenectomy as a definitive procedure for antral carcinoma; it is suggested as a subject for further clinical investigation and trial in selected cases.

There seems to be little evidence that the employment of total gastrectomy for antral lesions would increase survival rates. In our opinion, total gastrectomy, perhaps combined with distal pancreatectomy and splenectomy as advocated by Brunschwig¹ and McNeer and others,⁸ is the procedure of choice for all cases of scirrhous carcinoma, as it would be for lesions in the body of the stomach, or lesions in the fundus. Some consideration should be given to proximal subtotal gastric resection with distal pancreatectomy and splenectomy in the latter group of cases.

SUMMARY

In a series of 194 cases with a diagnosis of gastric carcinoma, 53 resections of the stomach were carried out. Twenty-two of these operations were classified as "curative" resections, and the remaining 31 were

classified as palliative procedures. The over-all five year survival rate in 129 cases diagnosed five or more years before this study was undertaken was 8 per cent. Of 15 patients for whom resection was carried out in the absence of demonstrable lymph node involvement, ten, or 67 per cent, survived five years or more, including one patient with contiguous liver involvement, which was also removed. There were no five year survivors in 11 cases with demonstrable lymph node involvement.

Radical subtotal gastric resection, as presently employed, appears to be inadequate to salvage those patients harboring antral carcinoma which has already metastasized to the regional lymph nodes. In view of the sites of metastasis and recurrence noted in this and other studies, total gastrectomy appears to have little to offer for these patients. Consequently, the procedure originally proposed by Harvey, which combines pancreatoduodenectomy with radical subtotal gastric resection, is suggested as a possible approach in an effort to increase the salvage rate in cases of antral carcinoma with lymph node metastases.

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