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## A PRELIMINARY REPORT ON THE ADVANTAGES OF A SMALL STOMA IN PARTIAL GASTRECTOMY FOR ULCER\*

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IN THE TREATMENT OF CHRONIC PEPTIC ULCERATION, it is now generally accepted that partial gastrectomy consistently gives the most satisfactory results. Although the results on the whole have been satisfactory, inasmuch as the predominant symptom—pain—has been relieved and the chances of stomal ulceration greatly reduced, there is no doubt that gastrectomy has often left the patient with other less severe disabilities. We feel that many of these can be almost completely eliminated by a minor modification in the type of operation carried out.

Clavel<sup>5</sup> and many others believe that the most physiological type of gastrectomy is the Hofmeister-Finsterer operation. This operation has certain advantages attributable to the valve which is made to prevent regurgitation of food into the duodenum.

Many believe that the size of the stoma has no effect on the final results of the operation and this assumption is largely based on the experimental work of Mehring and McCann.<sup>8</sup>

Hofmeister recognized the danger of leakage occurring at the upper angle of the anastomosis of a full length gastro-jejunal stoma after sub-total gastrectomy, and in order to avoid this leakage and thus reduce his mortality rate, he advised the infolding of the upper end of the gastric remnant for 2 or 3 cms.

Finsterer<sup>2</sup> made the observation that unpleasant symptoms after gastrectomy often occurred as a result of the reflux of gastric contents into the afferent jejunal loop. Wright<sup>3</sup> in 1929, described two cases where barium could be seen entering the proximal duodenal loop, and both these cases complained of discomfort. Ogilvie<sup>4</sup> in 1947, stated that this reflux is the commonest cause of postoperative discomfort. Finsterer's early recognition of this cause of postoperative discomfort led him to advocate the closure of the upper part of the gastric remnant, so as to leave 10 cms. of the lower end open. The valve so formed was intended to prevent reflux into the afferent loop, in addition to making the anastomosis safer from leakage.

One of the authors (P) undertook to make the stoma much smaller than is usual in order to increase the emptying time.

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Since emptying time appears to have direct bearing on the clinical end results, as shown by Strauss<sup>6</sup> and others, we have carried out a series of cases making the stoma much smaller than is usual in an endeavour to delay emptying time. Mehring in 1897, from experimental work with dogs, concluded that the pyloric sphincter does not control the emptying time of the stomach, and after its removal the emptying time of the remnant is the same as that of the intact stomach. Since then, others have repeated his experimental work, and confirmed his results. McCann<sup>8</sup> 1939, repeated this experiment and came to the same conclusions but added the important fact that the quantitative emptying time is definitely affected, and showed that although the total emptying time remains the same after the removal of the pyloric sphincter, the quantitative emptying time is reduced. In other words, the volume of the gastric residue 30 minutes after a meal in the resected stomach, is much less than that in the intact stomach. This latter observation appears to have been ignored by most writers on the subject, with few exceptions. Shay and Gershon-Cohen<sup>9</sup> recognized this factor, making a clear differentiation between the total emptying time, in which the pyloric sphincter plays very little part, and the quantitative emptying time, in which the sphincter plays a definite role. Thus theoretically, if a sphincteric-like action could be obtained at the gastrojejunal stoma, the likelihood of a delayed quantitative emptying time should be increased, although the total emptying time might remain unaffected.

McCann<sup>8</sup> from experimental work on dogs in which he resected increasing amounts of stomach, connecting the gastric remnant to the small intestine, came to the conclusion that the size of the stoma had no relation to the emptying time of the gastric remnant. Ravdin<sup>11</sup> and others came to the conclusion that the new stoma, regardless of size, is not the reason for the rapid gastric emptying. By these statements, various writers in the literature have confirmed the impression that the size of the stoma will not control the emptying time of the gastric remnant. Recently Kennedy, Reynolds and Cantor<sup>12</sup> have pointed out that the factor which controls emptying time of the stomach is not the size of the stoma but the size of the jejunal lumen. This, however, only applies when the size of the stoma is greater than the size of the jejunum, and also presumes that the stoma has no sphincteric action.

Recognizing these facts, we have made a stoma 2.5 cm. in length in a series of 118 sub-total gastrectomies for ulcer. The indications for operation have been:

*Repeated Perforations—*

1	—	30 cases	
2	—	7 cases	
4	—	1 case	— 38

*Hemorrhage—*

Acute Massive	—	8 cases	
Multiple	—	9 cases	— 17
<i>Failed Medical Treatment</i>			— 63      118

and we have found the following advantages:

- (1) *The advantages of the Hofmeister-Finsterer Valve.*
  - (a) Decreased incidence of leakage at the upper end of the anastomosis.
  - (b) Decreased incidence of retrograde influx into the proximal jejunal loop.
- (2) *Bulging of the jejunum after food is prevented.*

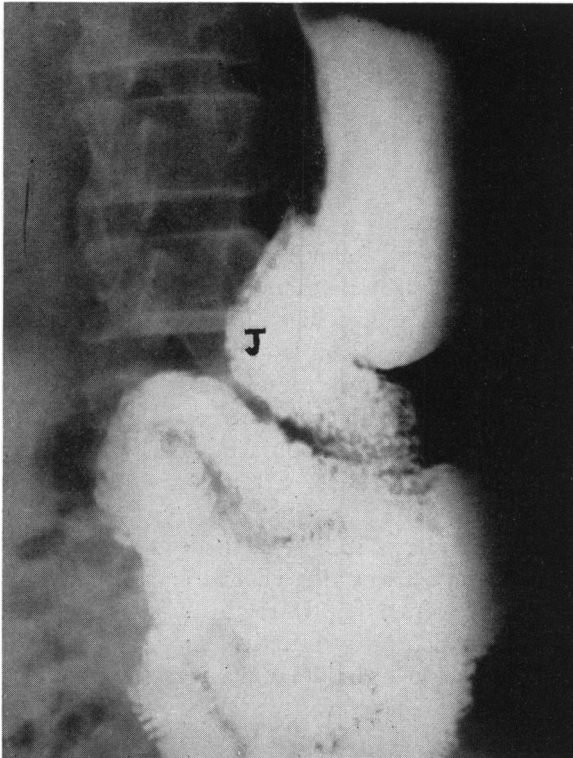


FIG. 1.—A. X-ray showing the bulging of the jejunum (J) opposite the wide anastomosis after a Polya gastrectomy.

Kennedy, Reynolds and Cantor,<sup>12</sup> in a review of 90 cases of Polya type of gastrectomy, found a uniform roentgen ray finding of jejunal dilatation and show a post-mortem specimen drawing, which clearly indicates the jejunal dilatation that occurs with the wide gastro-jejunal type of stoma. (Fig. 1). They say that this jejunal bulge prevents the patient from eating a normal volume of food and is one of the causes of postprandial discomfort—with this we are in full agreement. This tendency to bulging was also recognized by Vitkin,<sup>7</sup> Gordon Taylor<sup>13</sup> and others. In our series, where 90 cases have been followed up radiologically, there was no jejunal bulge in 84 cases, and only slight fullness in six. In no instance was the jejunal bulge present to the degree indicated by Kennedy<sup>12</sup> *et al.*

(3) *The risk of postoperative hemorrhage is diminished.*

The source of hemorrhage after gastrectomy is from the cut edges of jejunum and stomach. As the jejunum is only incised for a length of  $2\frac{1}{2}$  cms. the risk of hemorrhage is correspondingly reduced. Allan and Welch<sup>14</sup> in a series of 151 cases of gastrectomy with long stomas reported four fatal hemorrhages. Reinhoff<sup>15</sup> reports 10 per cent of hemorrhage (non-fatal and fatal) occurring after a Polya type gastrectomy in 260 cases. In this series of 118 cases, there has been no case of serious hemorrhage from the stoma; six cases had slight hemorrhage but these improved with conservative treatment.

(4) *Increased emptying time.*

The normal stomach empties in  $3\frac{1}{2}$ –4 hours using a water barium sulphate mixture. It has been shown by Ravdin<sup>11</sup> that varying the solution will affect the emptying time. Vitkin<sup>7</sup> states that the average emptying time after gastrectomy is 20 minutes, and quotes various European authors who point out that the emptying time may be much less. Shay and Gershon-Cohen<sup>9</sup> believe that the decrease in emptying time following gastrectomy is the direct result of achlorhydria. They show that in no cases of gastric resection does the emptying time exceed 30 minutes.

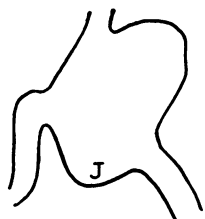


FIG. 1. — B. Line drawing showing the bulging of the jejunum (J) opposite the wide anastomosis after a Polya gastrectomy.

ing time exceed 30 minutes. Gilbert and Dunlop<sup>16</sup> say that it is a well established fact that the gastric remnant empties quickly and that the rate of emptying is increased following a carbohydrate meal. It is interesting to note that the intact achlorhydric stomach empties in 15–90 minutes. Strauss<sup>6</sup> and others reported 25 cases of gastrectomy in which 25 per cent emptied in 15–20 minutes. They state that the slower the emptying time, the better is the clinical end result. It must be noted, however, that the total emptying time was used; no estimation of quantitative emptying time was made.

Quantitative emptying time may be defined as the period taken for the fluid level in the gastric remnant to disappear after a barium meal. Flakes of barium which may be seen adhering to the mucosa after a meal, are disregarded.

In this series in which 40 cases were followed, the average quantitative emptying time was 58 minutes. Only three cases in this series had quantitative emptying time of less than 30 minutes. Two of these cases were followed up one month after operation and the remaining case one year after operation. Eight cases had an emptying time of 30–40 minutes and the remaining 29 cases had an emptying time exceeding 45 minutes. Of these, five cases were followed up less than six weeks after operation and five cases less than three months.

(5) *Sphincteric-like action of the stoma.*

Schindler<sup>17</sup> on following up 52 cases of a Polya type gastrectomy, found that on gastroscopic examination, 48 of the cases had a rigid type of stoma which remained patent throughout. In these cases there was considerable edema with inflammatory change and erosion of the gastric and jejunal mucosa. In only four cases was there a sphincteric-like action at the stoma and these four cases were the only ones with a healthy mucosa and which were

entirely symptom free. We think that the sphincteric-like action is due to contractions of the jejunal musculature rather than that of the stomach, as the first swallow of barium passes straight through the stomach into the jejunum (Fig. 2A) which then contracts and closes the stoma. The stomach then fills (Fig. 2B) and as the jejunum, having emptied, relaxes, more barium flows through the stoma. In 88 per cent of the cases in our series there was roentgenologic evidence of this sphincteric-like action, which usually appeared within six weeks of operation.

The prevention of jejunal bulging and the increased emptying time encourage the early resumption of a normal diet postoperatively. The psychologic effect of a diet, normal in quantity, cannot be over-emphasized. In this series, fluids—milk or sweetened drinks—were given within 12 hours of operation, and within 10 days the patients were receiving a normal hospital diet. This has an important effect in convincing the patient that he has now a healthy stomach. The patient leaves hospital with specific instructions to eat and drink anything he wishes. The vast majority of our patients have been ready to follow these instructions. Of the 112 patients followed, all except two have returned to their former employment, these two having been off work for 15 years before operation. We have also found that weight gain is much more rapid if a normal diet is returned to at an early date, and that there is a very low incidence of post-gastrectomy anemia. If a wide stoma is used, it is generally accepted that frequent small meals and prolonged postoperative medical care with a comprehensive but concentrated diet are desirable. With a small stoma, this careful postoperative care is eliminated.

The reasons for these advantages are:

(a) The stoma functions immediately. (Fig. 3).

We have several roentgenograms taken between 12 and 24 hours after operation which show the passage of barium through the stoma. Allan and Welch<sup>14</sup> record eight cases of obstruction with a full length stoma in a series of 151 cases. In our series there has been one case.

(b) With the early sphincteric-like action of the stoma, there is rapid dilatation of the gastric remnant and delayed emptying time. This was shown in 60 cases, x-rayed 4–6 weeks after operation, in which the gastric remnant had the capacity approximating that of a normal stomach. Vitkin<sup>7</sup>, who reviewed 45 cases with wide stomas, found that in the first three months six had an average sized gastric remnant and in all of the remainder the gastric remnant was high and small. Strauss<sup>6</sup> *et al.*, discussing the size of the gastric remnant after resection of two-thirds of the stomach, observed that 69 per cent of the remnants remained the same size, 17 per cent decreased and 14 per cent increased in size, and made the statement that the slower the emptying time the better the clinical end results. In 13.2 per cent of the cases in our series the gastric remnant remained the same size and in 86.8 per cent the size was increased. None of the cases showed decrease in size.

(c) Another asset of the small stoma is that it prevents jejunitis by protecting the jejunum from immediate contact with food over a wide surface. Schindler<sup>17</sup> demonstrated jejunitis in 92 per cent of the cases which he exam-

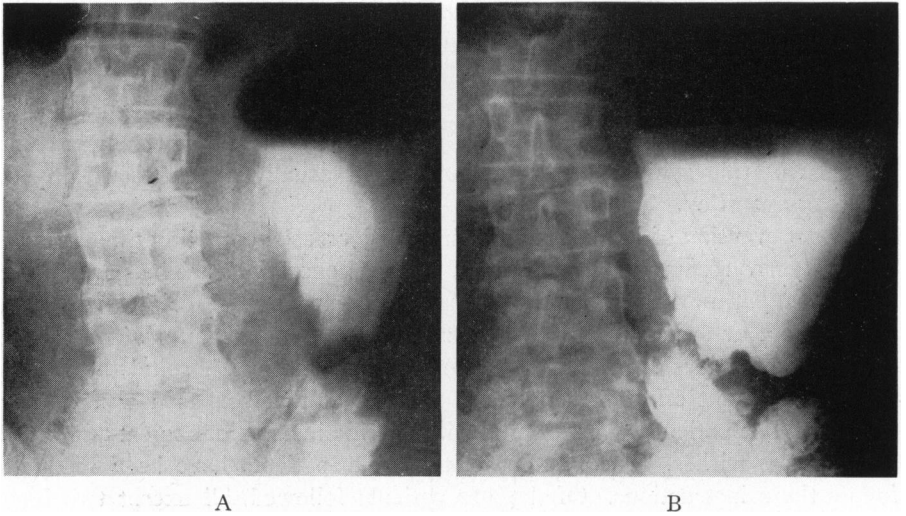


FIG. 2.—X-ray appearance six weeks after a gastrectomy using a small stoma. It will be noticed in (C) and (D) that there is barium in the proximal loop, this has been pushed back by the radiologist. (A) The barium is seen to run straight through the stoma and into the jejunum after taking the first swallow. (B) Some seconds later the stoma is seen to close and the stomach fills and distends. Note the size and the level of the air bubble.

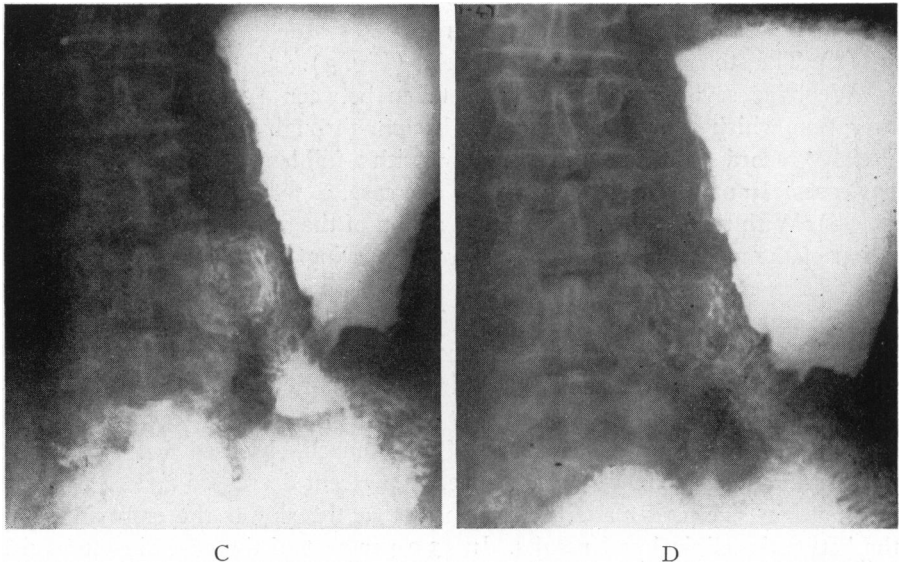


FIG. 2.—(C) The stoma is open and the barium is seen flowing into the jejunum. Peristalsis is taking place in the stomach as shown by the size and the level of the air bubble. (D) The stoma is closed and the stomach is undergoing peristalsis.

ined with the gastroscope. Vitkin<sup>7</sup> believed that out of a series of 132 cases with full length stoma all had a chronic jejunitis, with the exception of five patients where improvement was observed; it persisted in the remaining 127 cases for years. This is responsible for vague abdominal discomfort often not complained of but tolerated by many patients. In our series of 80 cases, followed up radiologically, only one had definite evidence of jejunitis.

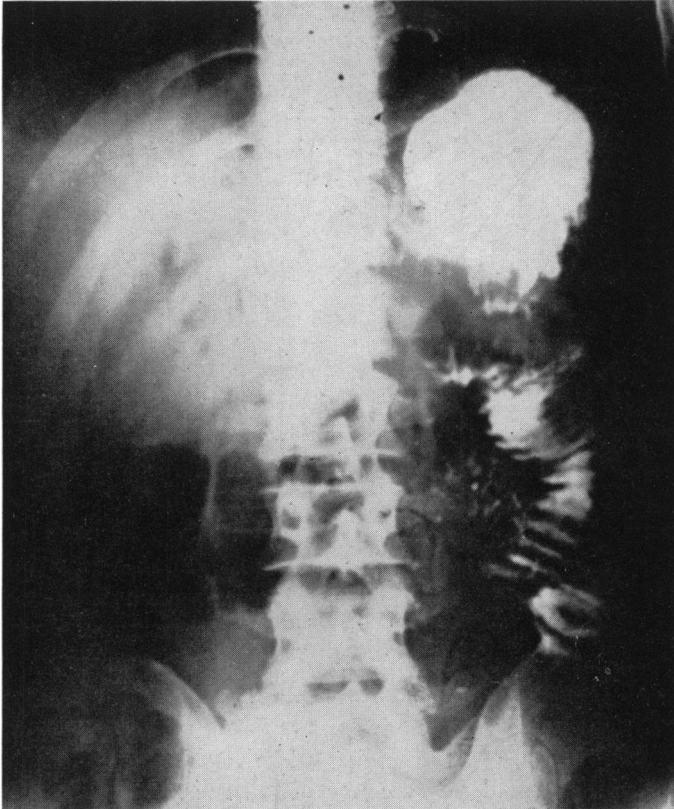


FIG. 3.—Barium meal 20 hours after a gastrectomy using the small stoma and showing the barium passing into the jejunum. Note the position of the esophagus indicating the level of the resection and the size of the remnant before dilatation has occurred.

(d) Leakage at the duodenal stump may be due to faulty closure but we are of the same opinion as Alleson<sup>19</sup> and Tintel<sup>20</sup> that the commonest cause is obstruction of the proximal loop at the site of anastomosis preventing the passage of the normal duodenal and pancreatic secretions (1500 cc. daily). This obstruction may be caused either by kinking at the upper part of the anastomosis or by edema—producing a temporary paralysis of the proximal jejunum.

With a small stoma, the amount of edema is minimal and if the jejunum is stitched to the closed upper part of the gastric remnant, edema and kinking cannot occur at the same place. Slight kinking or edema in themselves may not

be sufficient to cause obstruction but when they occur together, complete obstruction may be precipitated. (Fig. 4).

In the 118 instances in which we have used a small stoma these points have been substantiated. There has been no case of leakage of the duodenal stump and in only nine cases has postoperative gastric suction been necessary.

Seven of these cases had slight postoperative hemorrhage. In one, there was an organic small bowel obstruction for which further operation was necessary on the fifth day, when a loop of small bowel adherent to the inside of the wound, was separated, after which convalescence was uneventful. In one case, the

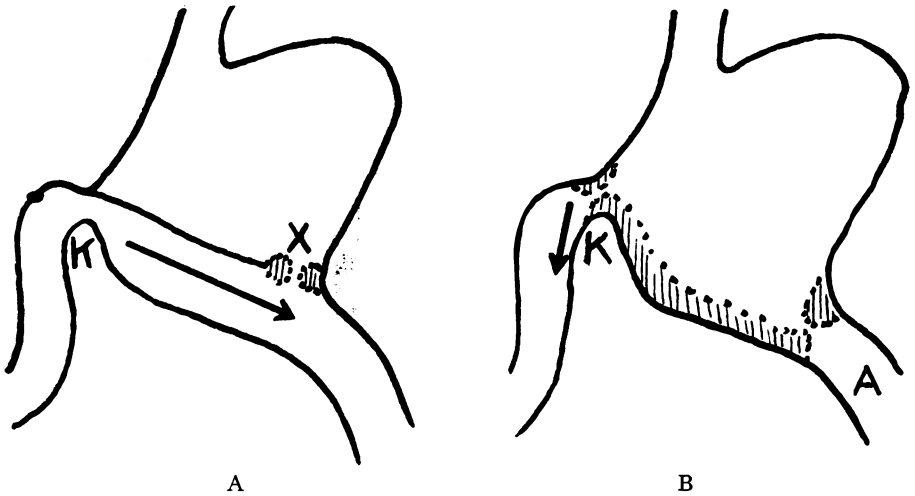


FIG. 4.—(A) Line drawing of a small stoma gastrectomy indicating the sites where edema (X) and kinking (K) may occur, but their positions are held apart.

(B) Line drawing of a large stoma gastrectomy indicating edema and kinking may occur at the same site.

stoma was made too small (1.5 cm.). This also necessitated re-operation on the fifth day, with enlargement of the stoma. It is interesting to note that in this case the small gastric remnant had distended to 40 ozs. on the second postoperative day before suction was instituted, without any ill effects.

#### DUMPING

The dumping syndrome, as defined by Custer, Butt and Waugh<sup>21</sup> of the Mayo Clinic, consists of four cardinal and almost invariable symptoms occurring 15–30 minutes after food.

They are:

- (1) Profound nausea and weakness.
- (2) Generalised unpleasant feeling of warmth.
- (3) A cold sweat especially of the forehead and face.
- (4) Palpitation.



The cause of this syndrome is still debatable. There are three possibilities :

1. *Sudden distention of the jejunum.* While sudden jejunal distention does cause a feeling of fullness immediately after food is swallowed and is exceedingly common after operations of the Polya wide stoma type, it cannot be regarded as the primary cause of dumping because when levulose is used in place of dextrose to distend the jejunum, the flushing, sweating and lassitude do not appear.

2. *Jejunitis.* It has been observed that the majority of cases with the dumping syndrome show radiologic evidence of jejunitis but this may be in itself the result of too rapid emptying. In those cases in this series which have exhibited the syndrome, there has been no evidence of jejunitis.

3. *Hypoglycemia.* It has been recognized for a considerable time that after gastrectomy or gastro-enterostomy, carbohydrates are more rapidly absorbed than usual.

This rapid absorption results in an over-stimulation of the production of insulin which in turn leads to a sudden drop of blood sugar level and results in hypoglycemia 1-1½ hours after food. Severe hypoglycemia may induce the excessive secretion of adrenalin which may simulate in every respect the dumping syndrome.

Since, however, the dumping symptoms usually occur within half an hour after food, it will be seen that there is some room for doubt as to the validity of this theory. It may be, however, that the rate of fall in blood sugar level from hyper- to hypoglycemia is associated with the upset.

The one constant feature which is present in all these theories is too rapid emptying of the stomach.

Gilbert and Dunlop<sup>16</sup> reported that 35 per cent of patients who had had gastrectomy of various types carried out presented the dumping syndrome.

In this series, there have been 17 patients (15 per cent) from whom the history of the dumping syndrome could be elicited by asking leading questions. Twelve of these patients were symptom free within three months of operation. Of the remaining five, three have only had a three months' follow-up and are improving; in one case the syndrome has persisted for two years; and in one case for one year. Both of these, however, are able to work. We think these figures compare very favorably with those to be found in Gilbert and Dunlop's<sup>16</sup> series in which 10 per cent of their gastrectomy patients were unfit for any form of employment because of the dumping syndrome.

It is interesting to note that a number of patients who presented themselves for operation had symptoms identical with the dumping syndrome preoperatively. All except the five already referred to have completely cleared up after operation. It has been found by Abrahamson<sup>23</sup> that patients suffering from duodenal ulcer have a low blood sugar level. This is an interesting observation which we hope to investigate further.

It is probable that the small incidence of persistent dumping in this series is due to the delayed emptying time of the gastric remnant due to the early development of a sphincteric-like action of the small stoma.

While many people believe that the size of the stoma has no influence on the emptying rate and that this is controlled only by the size of the lumen of the jejunum, this view is not borne out by our experience. Forty cases have had a follow-through barium series and the average time taken for the stomach to empty has been 58 minutes. That is the time taken for the fluid level in the stomach to disappear as opposed to 15–20 minutes in patients who have had a full length anastomosis performed.

This delayed emptying time is not due to any organic obstruction as during the first few days barium flows straight through into the jejunum and the

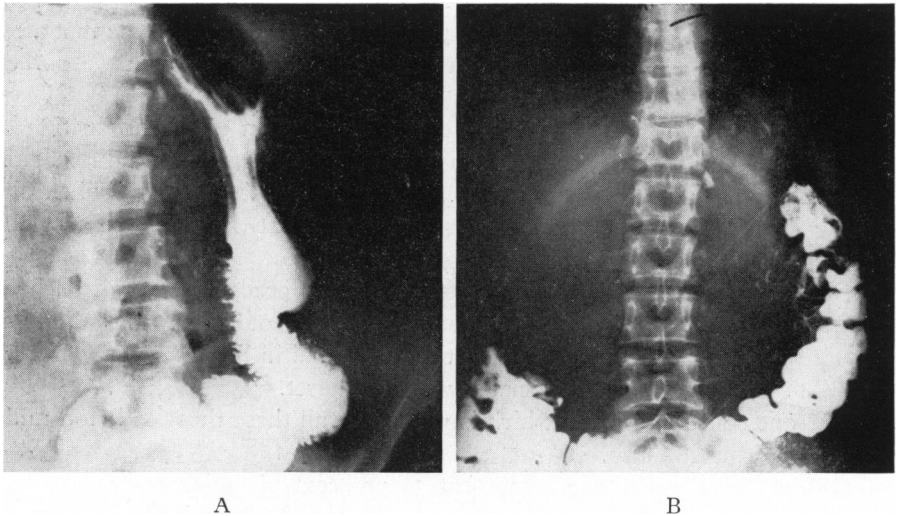


FIG. 5.—Barium meal 18 months after a Polya full length stoma gastrectomy. (A) Immediately after meal showing very rapid emptying of the stomach and jejunal bulging. (B) One hour after meal showing the stomach and small bowel completely empty.

stomach empties rapidly. The majority, however, have developed delay and sphincteric-like action within six weeks.

In addition we have recently had a patient who had had a full length Polya type gastrectomy carried out 18 months previously with such severe postprandial dumping symptoms that it was necessary for her to lie down for one hour after every meal: She was also afraid to eat in a public place for fear of fainting. Accordingly a second operation was performed and the size of the stoma was reduced to  $2\frac{1}{2}$  cms. The patient's symptoms were completely relieved by this operation and within 14 days she was able to take a full normal diet. A barium meal on the 11th day showed sphincteric-like action of the stoma and emptying time of over one hour. (Fig. 5). Three months later this patient had gained 10 lbs. in weight and appeared to be in perfect health.

*Arguments against the use of the small stoma are as follows:*

(1) It may be said that regurgitation of alkaline juices into the gastric

remnant with neutralization of any remaining free hydrochloric acid is prevented, but it is now generally accepted that if the resection has been adequate, stomal ulceration is exceedingly rare. In any case, most recurrent ulcers are jejunal and not gastric.

(2) Obstruction might occur later at the site of the stoma. We have followed some of these patients for over five years and we have had no single case of delayed postoperative vomiting or any evidence of late stenosis.

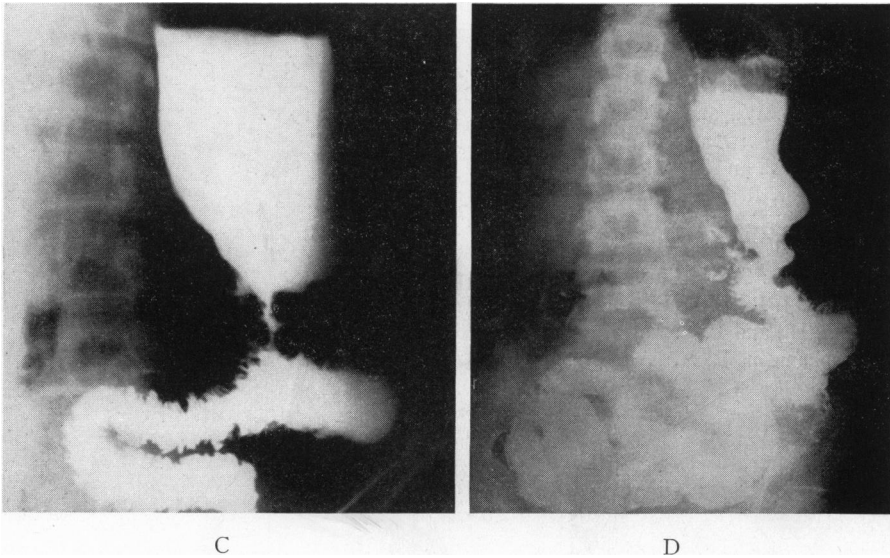


FIG. 5.—(C) Barium meal 11 days after a reconstructive operation on the stoma reducing its size to  $2\frac{1}{2}$  cms. Lateral x-ray 5 minutes after the meal.

(D) One hour after the barium meal.

#### CONCLUSIONS

Evidence is produced from a series of 118 partial gastrectomies for peptic ulcer to show that a stoma of 2.5 cm. long has the following advantages:

- (1) The small stoma with a Hofmeister-Finsterer valve reduces the risk of incidence of—
  - (a) leakage at the duodenal stump.
  - (b) leakage at the anastomosis.
  - (c) postoperative hemorrhage from the anastomosis.
  - (d) the necessity for routine postoperative suction.
  - (e) jejunitis.
- (2) The small stoma encourages—
  - (a) sphincteric action at the stoma.
  - (b) delayed emptying time.
  - (c) the ability to eat a full normal diet at an early date, shortening convalescence.
- (3) The small stoma reduces the incidence of the dumping syndrome.

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