

## PAPERS AND ORIGINALS

# Truncal Vagotomy and Drainage for Chronic Duodenal Ulcer Disease: A Controlled Trial

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## Summary

The results of elective truncal vagotomy and drainage in 547 duodenal ulcer patients are reported. Altogether, 204 patients were randomly allocated to pyloroplasty and 200 to gastrojejunostomy. In 101 patients gastrojejunostomy was electively chosen and in 42 patients the duodenum was opened to confirm the diagnosis. Operative mortality was 0.5%, the incidence of proved recurrent ulceration 3.3%, severe dumping 2%, and severe diarrhoea 1.1%. There were no significant differences between the groups, with the exception of bilious vomiting which occurred more often in patients with gastrojejunostomy.

## Introduction

During the past 20 years truncal vagotomy with drainage has gained increasing popularity over partial gastrectomy in the surgical treatment of chronic duodenal ulcer. In recent years various forms of selective vagotomy have been introduced (Amdrup and Jensen, 1970; Johnston and Wilkinson, 1970) with claims, still to be fully substantiated, that the results could be expected to surpass those from complete division of the vagal trunks. The present tendency to abandon truncal vagotomy in favour of selective procedures merits careful consideration, and it is important to establish that the results obtained from the former leave much to be desired.

In this paper we report the current results in 547 patients who underwent total vagotomy with drainage more than two years before the present assessment. These patients were included in a

controlled trial planned to determine the relative merits of pyloroplasty and gastrojejunostomy as the drainage procedure. In any such trial a number of patients are inevitably excluded for a variety of reasons but constitute a most important group of patients, and we also present information on the results of treatment in this group.

We think that the results of truncal vagotomy with drainage, performed by a large number of surgeons of whom more than half were surgical trainees, are such that modifications of the type of vagotomy can at most be expected to give marginal advantages, which could be expected to accrue only after surgeons had acquired the necessary technical expertise.

## Patients and Methods

Of all patients referred either by general practitioners or by hospital physicians to the peptic ulcer clinic for surgical opinion only about half had surgical treatment. Included in the study were all patients undergoing elective surgery for chronic duodenal ulcer disease in the University Department of Surgery at the Western Infirmary, Glasgow, between April 1965 and July 1971. Excluded from the study were patients with combined gastric and duodenal ulcers and all patients undergoing emergency surgery for the complications of duodenal ulceration. Patients were selected for operation on the basis of the usual criteria: failure of conservative treatment or a history of recurring bleeding or perforation, or both.

## DATA COLLECTION

Starting with the first attendance of a patient at the peptic ulcer clinic and continuing throughout the inpatient and out-patient care and assessment, all clinical information is routinely stored in a computer system, SWITCH (Kennedy *et al.*, 1968), developed in the department of surgery for this purpose. The system stores information from initial history, physical examination, results of routine and research investigations, treatment, and findings at operation, and the immediate postoperative course. To this are added details of radiological and endoscopic examinations and of follow-up interviews, examinations, and assessments.

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These clinical data are recorded on specially designed documents so that each outpatient clinician, surgeon in theatre, and laboratory technician collects information in a standard fashion to provide a computer tape available for research analysis. The results presented have been extracted from this computer store, and have been collected and analysed by computer program.

## OPERATION

When the diagnosis was confirmed at operation the surgeon first decided that either form of drainage procedure, pyloroplasty and gastrojejunostomy, would be equally safe and then the patient was allocated at random either to group 1, vagotomy and pyloroplasty, or group 2, vagotomy and gastrojejunostomy. If the diagnosis was in doubt the pylorus was opened to confirm the presence of duodenal ulcer disease and closed as a pyloroplasty; truncal vagotomy was then added, and this group of patients was excluded from the trial and categorized as group 3. If on opening the pylorus there was no evidence of present or previous ulceration the pyloroduodenotomy was simply closed as a pyloroplasty without adding vagotomy. The few patients in this category will form the basis of a later report. When pyloroplasty was regarded as relatively unsafe for technical reasons the patient received a gastrojejunostomy and truncal vagotomy and was allocated to group 4. The numbers of patients allocated to these four groups are given in table I.

A standard transabdominal truncal vagotomy was performed by excising a short segment from each anterior and posterior trunk for subsequent histological confirmation and then cutting any residual small fibres to denude the oesophagus just below the diaphragm. At operation various measurements were made and entered in the operation document in all cases. Where pyloroplasty was the drainage procedure a Heineke-Mikulicz type of operation was performed by making a longitudinal incision across the pylorus, the mean length of incision being 7 cm. This incision was then sutured transversely with a single layer of interrupted catgut sutures. Where gastrojejunostomy was the method of drainage a retrocolic transverse isoperistaltic anastomosis was made with two layers of stitches at the most dependent part of the stomach with a "comfortable" length of afferent loop. The mean width of the stoma was 5 cm and the mean length of the afferent loop 8 cm. Gastric drainage was effected during the first 24 to 48 hours after operation either by means of a nasogastric tube or a gastrostomy tube according to the personal preference of the surgeon; in the series 57% of patients had a nasogastric tube and the remainder an indwelling gastrostomy tube.

The operations were performed by 45 surgeons, 61% being performed by surgeons in training and the remainder by consultants. Surgeons in training operated initially under the supervision of a senior surgeon and later without supervision after what was thought to be adequate training. All operations were performed with the discipline of taking nerve fibres for histological confirmation and with the knowledge that the completeness of vagotomy would be assessed by a postoperative insulin test.

## ACID STUDIES

Maximal acid output was measured preoperatively in 86% of patients and again postoperatively in 67% before their discharge from the ward. Some patients received histamine and others pentagastrin as the stimulus, but since the responses are similar (Multicentre Study, 1967) the results are considered together. The acid response to insulin was measured before leaving hospital in 84% of patients. The results were classified as early positive if a response according to Hollander's (1948)

criteria was obtained in the first hour after insulin, and late positive if a response occurred in the second hour.

## FOLLOW-UP AND ASSESSMENT

The patients were routinely seen for follow-up at the peptic ulcer clinic. At each visit, both before and after operation, the severity of symptoms was recorded and a clinical assessment made on a modified Visick scale. Patients without symptoms were graded Visick 1, patients with mild symptoms Visick 2, patients with poorly controlled symptoms Visick 3, and patients with symptoms which interfered with the enjoyment of life or work, or symptoms which were no better after operation than before, were graded as Visick 4. Although these patients were of necessity seen by many different surgeons at the clinic the same group of questions on the form was posed at each visit to minimize observer variation. The current result was taken from the most recent clinical assessment provided that this was more than two years after operation.

## Results

A pyloroplasty was necessary to confirm the diagnosis in 42 patients (8%) (see table I). Pyloroplasty was thought to be

TABLE I—Distribution of the Patients in the Four Groups

Group	Operation	No. of Patients
1	Random vagotomy and pyloroplasty	204
2	Random vagotomy and gastrojejunostomy	200
3	Pyloroplasty with vagotomy added (excluded from random trial)	42
4	Gastrojejunostomy chosen as drainage and vagotomy added (excluded from random trial)	101
Total		547

relatively unsafe in a further 101 patients (20%). The remainder were allocated randomly so that 204 received pyloroplasty as the drainage procedure and 200 gastrojejunostomy.

For the comparison of means an unpaired Student's *t* test was used, and in comparing incidences a chi-square or a Fisher's exact test was used.

The four groups of patients were compared with regard to their preoperative condition (table II). There was no statistically significant difference between the groups as regards length of history, sex, body weight, incidence of diarrhoea, acid output, or clinical assessment of the severity of the symptoms. Group 4 patients were significantly older ( $P < 0.001$ ) and had had more preoperative bleeds ( $P < 0.001$ ) and more perforations ( $P < 0.05$ ) than the others. Group 3 patients had fewer preoperative bleeds ( $P < 0.005$ ) and perforations ( $P < 0.05$ ) than the others. It will be apparent from table II that 28 patients with Visick grading 1 and 2 (minimal symptoms) were subjected to operation: the reason for this in most cases was that such patients had had one or more bleeds or perforations or both although they had little or no dyspepsia in the intervening period.

## OPERATIVE MORTALITY AND MORBIDITY

Details of the operative mortality and morbidity are given in table III. Three of the 547 patients died in the immediate postoperative period, giving an operative mortality of 0.5%. One patient developed superior mesenteric arterial occlusion and died three weeks after vagotomy and gastrojejunostomy. A woman aged 72 died 10 weeks after vagotomy and gastrojejunostomy with profuse diarrhoea due to ischaemic colitis. The

TABLE II—Preoperative Data of the Patients in all Four Groups

	Group 1 (n = 204)	Group 2 (n = 200)	Group 3 (n = 42)	Group 4 (n = 101)
Mean age at operation $\pm$ 1 S.E. (range 15–75 years)	41.0 $\pm$ 0.8	40.9 $\pm$ 0.8	43.4 $\pm$ 2.0	46.2 $\pm$ 1.2
Mean length of history $\pm$ 1 S.E. (range 0–50 years)	12.6 $\pm$ 0.6	12.7 $\pm$ 0.6	12.9 $\pm$ 1.2	13.0 $\pm$ 0.8
Sex (M./F.)	178/26	164/36	32/10	86/15
Mean weight $\pm$ 1 S.E.				
Males (range 40–97 kg)	64.9 $\pm$ 0.7	65.2 $\pm$ 0.7	67.7 $\pm$ 1.9	66.3 $\pm$ 1.3
Females (range 38–88 kg)	53.5 $\pm$ 2.1	54.3 $\pm$ 1.6	56.3 $\pm$ 3.9	56.0 $\pm$ 3.9
Mean bowel habit $\pm$ 1 S.E. (range 2–30 motions/wk)	7.1 $\pm$ 0.2	6.9 $\pm$ 0.2	6.0 $\pm$ 0.3	6.5 $\pm$ 0.3
Mean basal acid output $\pm$ 1 S.E.				
Males (range 0–18.0 mEq/peak $\frac{1}{2}$ hr)	2.5 $\pm$ 0.2	3.2 $\pm$ 0.3	2.2 $\pm$ 0.8	3.3 $\pm$ 0.3
Females (range 0.1–9.6 mEq/peak $\frac{1}{2}$ hr)	2.1 $\pm$ 0.4	1.8 $\pm$ 0.3	2.0 $\pm$ 0.7	3.2 $\pm$ 1.0
Mean maximal acid output $\pm$ 1 S.E.				
Males (range 0–44.8 mEq/peak $\frac{1}{2}$ hr)	19.8 $\pm$ 0.5	19.9 $\pm$ 0.6	18.1 $\pm$ 1.8	21.0 $\pm$ 1.0
Females (range 2.4–37.9 mEq/peak $\frac{1}{2}$ hr)	14.2 $\pm$ 1.6	12.0 $\pm$ 0.9	14.3 $\pm$ 2.3	16.4 $\pm$ 2.0
Clinical Assessment:				
Visick 1 and 2 (6%)	10/173	11/175	2/39	5/91
Visick 3 (39%)	71/173	65/175	20/39	31/91
Visick 4 (55%)	92/173	99/175	17/39	55/91
History of diarrhoea (9%)	15/194	16/183	6/37	8/88
History of bleeding (30%)	54/202	55/193	5/32	44/98
History of perforation:				
Males (14%)	22/177	28/158	1/31	22/82
Females (4%)	1/25	1/35	0/10	0/14

TABLE III—Period in Hospital and Major Complications in the Four Groups Studied

	Group 1 (n = 204)	Group 2 (n = 200)	Group 3 (n = 42)	Group 4 (n = 101)
Time in hospital (7–72 days) (mean $\pm$ 1 S.E. of mean)	11.9 $\pm$ 0.3	12.2 $\pm$ 0.3	12.2 $\pm$ 0.8	12.9 $\pm$ 0.8
Mortality (0.5%)	nil	1 Superior mesenteric occlusion	nil	1 Ischaemic colitis, 1 small bowel fistula
Reoperation	2 Bleeding pyloroplasty, 1 subphrenic abscess	2 Stomal delay, 2 subphrenic abscesses, 2 wound dehiscence	nil	2 Stomal delay
Cardiovascular complications	3 Deep vein thrombosis, 3 pulmonary embolism, 1 myocardial infarction, 1 atrial fibrillation	5 Deep vein thrombosis, 2 pulmonary embolism, 1 pericarditis	1 Cerebrovascular accident	2 Deep vein thrombosis, 2 pulmonary embolism

third patient developed stomal holdup and at reoperation multiple adhesions were divided. He subsequently developed a small bowel fistula and died six weeks after his original vagotomy and gastrojejunostomy.

Eleven patients required reoperation before leaving hospital. In group 1 two patients bled from the pyloroplasty and required resuture; a further patient required drainage of a subphrenic abscess. In group 2 two patients required refashioning of the stoma for stomal delay, two patients had subphrenic abscesses drained, and a further two had resuture for wound dehiscence. In group 4 two patients required refashioning of the stoma for delayed gastric emptying.

Details of the cardiovascular complications are also given in table III. In group 1 one patient developed myocardial infarction, three developed a deep vein thrombosis, three a pulmonary embolus, and one patient developed atrial fibrillation. In group 2 five patients developed deep vein thrombosis, two developed pulmonary embolism, and one pericarditis. In group 3 one patient suffered a severe cerebrovascular accident. Two patients in group 4 developed deep vein thrombosis and two developed pulmonary embolism.

If, therefore, reoperation and cardiovascular complications are regarded as major complications, these occurred in 32 of 547 patients, an incidence of 6%. Chest infection occurred in 23% of patients and wound infection in a further 7%. The high chest infection rate is typical of upper abdominal surgery in Glasgow and reflects the high incidence of pulmonary disease in the population. There was no statistically significant difference between the groups as regards major or minor complications in the immediate postoperative period. It is noteworthy that no patient developed an overt leak from the pyloroplasty closure and in only 1 of 246 pyloroplasties performed was there a subphrenic abscess.

#### CLINICAL ASSESSMENT

A total of 454 patients (83%) were assessed at least two years

after surgery, the mean length of follow-up being just over four years. Except for nine patients living abroad, who were assessed by a postal questionnaire, all clinical assessments were made by interview at the peptic ulcer clinic or in the home. Patients lost to follow-up were found to be significantly younger ( $P < 0.001$ ) with a mean age of 38 years compared to 43 years, and proportionally more males (18%) than females (5%) were lost but they did not differ significantly in any other respect from the group which have been followed up. Nine patients were found to have died, four from myocardial infarction, one from carcinoma of lung, one from carcinoma of pancreas, one from Crohn's disease, one from drowning, and one as a result of gastrectomy performed elsewhere for recurrent ulceration.

In the sequelae discussed below there was no statistically significant difference between the sexes.

**Recurrent Ulcer.**—The incidence of proved recurrent ulceration is shown in table IV. Fifteen (3.3%) of the 459 patients followed up have required a further operation for recurrent ulcer. Although more recurrent ulcers (4.8%) occurred after pyloroplasty than after gastrojejunostomy (3.0%) this difference is not statistically significant ( $P 0.08$ ). No other patient had objective evidence of recurrent ulceration but a further nine patients had suggestive symptoms although in only two were the symptoms severe enough to consider further surgery. All patients with proved recurrent ulceration had a gastric resection, 12 of them in the department of surgery and three elsewhere, at a mean interval of 28 months (range 13–68 months) after the primary operation. There was one postoperative death, nine patients were subsequently classified as Visick 1 or 2 (good result) and five as Visick 3, three having postgastrectomy vomiting and two persistent pain. No patient was classified as Visick 4. The insulin test performed in the immediate postoperative period is a useful indication of potential recurrent ulceration as shown in table V. Altogether, 23.1% of patients who had an early positive response subsequently developed recurrent ulceration whereas only 5.5% and 1.6% of patients who respectively had late positive and negative responses subsequently developed recurrent ulceration.



TABLE IV—Incidence of Proved Recurrent Ulceration

	Group 1 (n = 167)	Group 2 (n = 167)	Group 3 (n = 39)	Group 4 (n = 86)
Proved recurrent ulcer	8 (4.8%)	5 (3.0%)	2 (5.3%)	0

TABLE V—Relation between Insulin Status in the Immediate Postoperative Period and Subsequent Development of Recurrent Ulceration

Insulin Status	Patients tested	Recurrent Ulcer
Early positive .. ..	26	6 (23.1%)
Late positive .. ..	55	2 (5.5%)
Negative .. ..	304	5 (1.6%)
Missing .. ..	74	2 (2.6%)

**Diarrhoea.**—On direct questioning 121 patients (27%) admitted to having diarrhoea. At first sight this may seem a remarkably high incidence but it is important to emphasize that of these only three (0.7%) were graded as Visick 3 and only two (0.4%) Visick 4 on account of diarrhoea. Therefore, of 449 patients asked about diarrhoea only two could be regarded as complete failures for this reason. There was no significant difference between the four groups as regards incidence of diarrhoea.

**Bilious Vomiting.**—The symptom of bilious vomiting was elicited in 46 patients (10%) but in only 8 patients (2%) was it severe. Bilious vomiting occurred more frequently ( $P < 0.01$ ) in group 2 than in group 1 patients (table VI). Seven of the eight patients with severe bilious vomiting had vagotomy and gastro-

TABLE VI—Incidence of Bilious Vomiting

	Group 1 (n = 163)	Group 2 (n = 160)	Group 3 (n = 37)	Group 4 (n = 84)
Mild .. ..	5	12	1	5
Moderate .. ..	3	6	0	6
Severe .. ..	1	7	0	0
Total	9 (6%)	25 (16%)	1 (3%)	11 (13%)

jejunostomy and were treated surgically by undoing the gastro-jejunostomy and fashioning a pyloroplasty. There were no operative deaths and the final clinical result was good (Visick 1 and 2) in six patients and bad (Visick 4) in one, who continued to have bilious vomiting.

**Dumping.**—As shown in table VII troublesome dumping symptoms occurred in only seven patients (2%). There was no

TABLE VII—Incidence of Dumping Symptoms

	Group 1 (n = 165)	Group 2 (n = 161)	Group 3 (n = 38)	Group 4 (n = 82)
Mild .. ..	36	31	7	10
Moderate .. ..	8	2	0	2
Severe .. ..	1	3	1	2
Total	45 (25%)	36 (22%)	8 (21%)	14 (17%)

significant difference between the four groups as regards the incidence of dumping symptoms and no patient required further surgery for this reason alone. Patients were asked four leading questions with regard to dumping symptoms and this is probably the reason for the apparently high incidence of mild symptoms.

**Overall Clinical Assessment.**—The overall clinical results are given in table VIII. All patients requiring reoperation for late

TABLE VIII—Clinical Assessment of the Patients in all Four Groups

	Group 1 (n = 166)	Group 2 (n = 166)	Group 3 (n = 39)	Group 4 (n = 85)	Total (n = 456)
Good Visick 1 and 2	146	143	36	79	404 (88.6%)
Doubtful Visick 3	8	11	1	4	24 (5.3%)
Bad Visick 4 ..	12	12	2	2	28 (6.1%)

Operative mortality 0.5%.

complications attributable to the original operation are classified as Visick group 4. Altogether, 404 patients (88.6%) were classified as having a good result (Visick 1 and 2) and only 28 patients (6.1%) were regarded as failures. There was no statistically significant difference between the groups. The final clinical assessment after including the results from 22 reoperations for recurrent ulcer or bilious vomiting is shown in table IX. A good result was obtained in 92.1% of patients, and this was achieved despite a further increase in the operative mortality of

TABLE IX—Final Clinical Assessment after Reoperation for Recurrent Ulcer or Bilious Vomiting

	Group 1 (n = 166)	Group 2 (n = 165)	Group 3 (n = 38)	Group 4 (n = 85)	Total (n = 454)
Good Visick 1 and 2	150	152	37	79	418 (92.1%)
Doubtful Visick 3	12	12	1	4	29 (6.4%)
Bad Visick 4 ..	4	1	0	2	7 (1.5%)

Overall operative mortality 0.8%.

one patient giving an overall mortality of 0.8%. Seven patients (1.5%) remained as failures of surgical treatment; one had carcinoma of the stomach, one had continuous bilious vomiting despite conversion of gastrojejunostomy to pyloroplasty, two had symptoms suggestive of recurrent ulceration but had no objective evidence, and three were being investigated for multiple symptoms.

**Body Weight.**—The mean body weight ( $\pm 1$  S.E.) rose in all four groups by  $1.3 \pm 0.5$  kg in group 1, by  $0.3 \pm 0.4$  kg in group 2, by  $0.2 \pm 1.1$  kg in group 3, and by  $1.4 \pm 0.7$  kg in group 4. This change was based on the body weight immediately before operation and it did not reach the level of statistical significance. There was no statistically significant difference between the groups.

**Acid Output.**—The maximal acid output postoperatively in males and females together with the percentage cut-down

TABLE X—Postoperative Maximal Acid Output with Percentage Cut-down from Preoperative Results (see Table II) (Figures are Means  $\pm 1$  S.E. of Mean)

	Group 1	Group 2	Group 3	Group 4
Males (mEq/½ hr) ..	$8.0 \pm 0.5$	$6.6 \pm 0.5$	$8.5 \pm 1.5$	$7.0 \pm 0.6$
Females (mEq/½ hr) ..	$5.2 \pm 0.8$	$4.1 \pm 0.9$	$5.5 \pm 1.8$	$5.7 \pm 1.1$
Cut-down percentage	$61 \pm 2$	$65 \pm 3$	$58 \pm 5$	$59 \pm 6$

from the preoperative levels are shown in table X. There was no statistically significant difference between the groups in either the maximal output or the percentage cut-down.

**Other Conditions not Attributable to Peptic Ulceration.**—Eleven patients developed serious or potentially serious conditions not obviously related to their previous operation. Five patients required cholecystectomy for gall stone disease, one developed carcinoma of pancreas, one carcinoma of the stomach, and two carcinoma of the lung. One patient developed Crohn's disease and one developed pulmonary tuberculosis.

## Discussion

After a brief summary of the results of this study, consideration is given to the relative merits of pyloroplasty and gastrojejunostomy as drainage procedures, the fate of the excluded group of patients, the incidence of diarrhoea, the value of an early postoperative insulin test, and, finally, to the likely future of truncal vagotomy and drainage in the surgical treatment of duodenal ulcer.

Our results show that almost 90% of patients undergoing truncal vagotomy and drainage for chronic duodenal ulcer have had a good result from the initial operation, which carried an operative mortality of 0.5%. The incidence of proved recurrent ulceration was just over 3% and the incidence of severe bilious vomiting was 2%: these two complications were the main indications for reoperation. The final clinical assessment after including the results from 22 reoperations was Visick 1 in just over 92%; the death of one patient in this group brought the overall operative mortality to 0.8%. Although the numbers involved are fortunately small the results of reoperation for bilious vomiting tend to be better than for recurrent ulceration. A grading of Visick 1 or 2 was achieved in six of the seven patients with bilious vomiting but in only nine of the 15 with recurrent ulcer. These results are based on an 83% follow-up. While we must have reservations about those who are lost to follow-up it is gratifying to know that this group differed from the others only in being younger and having a higher percentage of males. It is likely that more patients in this group left the area to seek employment elsewhere. There is no reason, therefore, to expect any difference between this group and those who were followed up.

Pyloroplasty and gastrojejunostomy were used as drainage procedures on a strictly randomized basis and a careful analysis has been made of the relative merits of these two procedures. The only statistically significant difference related to the incidence of bilious vomiting, this sequel being more likely to occur after gastrojejunostomy when it may be sufficiently troublesome to require conversion to pyloroplasty. It is of interest to note that those patients who were excluded from the controlled trial on the basis that pyloroplasty was thought to be a more hazardous procedure fared just as well as those included in the main trial. It seems, therefore, that a surgeon should not hesitate to select the more easy gastrojejunostomy in circumstances when a pyloroplasty seems likely to be more difficult and therefore more hazardous to the patient; it appears to us reasonable to accept a slightly increased risk of bilious vomiting rather than the risk of increased morbidity or mortality. When this attitude is adopted, as has been done by surgeons involved in the present trial, the performance of pyloroplasty using a single layer of interrupted catgut sutures can be performed without risk of anastomotic leakage.

The two groups of patients excluded from the randomized trial are now considered. Subsequent analysis showed that patients who required opening of the duodenum in order to establish the presence of the duodenal ulcer had fewer previous bleeds and fewer perforations than had the patients in whom the presence of an ulcer was immediately established by inspection and palpation. In all other respects the preoperative findings in this group were entirely comparable with the main body of patients. The other excluded group, those in whom it was deemed inadvisable to perform pyloroplasty, had an excess of bleeds or perforations before elective surgery. These differences, which were entirely in keeping with the operative findings, might almost have been expected.

The incidence of diarrhoea after truncal vagotomy has long been a matter of controversy although there is general agreement about the difficulty in assessing the incidence and severity of this complication. In an attempt to circumvent this difficulty a total of 15 questions relating to bowel habit were included in the

form and, perhaps not surprisingly, this very close inquiry produced an apparently high incidence of very mild symptoms (21%). However, diarrhoea sufficiently troublesome to demand a Visick 3 or 4 grading occurred in 1.1%, a value now generally accepted from reliable reported studies (Barnes and Cox, 1969).

Many patients initially showing a negative response to an insulin test within the 10-day postoperative period subsequently showed conversion to a positive response, the time of conversion usually being within six months of operation (Gillespie *et al.*, 1970). This finding, supported by the work of others, has led to criticism of performing an insulin test before the patient leaves hospital. There are, however, advantages in performing the insulin test in the immediate postoperative period. Firstly, not all patients are willing to return to hospital for a gastric function test and, secondly, the surgeon is likely to be more careful about the performance of the vagotomy when he is aware that the result of an insulin test will shortly be forthcoming. Our data show a clear correlation between the existence of a positive insulin test in the immediate postoperative period and the subsequent development of recurrent ulceration, and it is suggested that the immediate test should not be discarded.

Duodenal ulcer disease is common. It is therefore important that an operation used in its management should be capable of performance by surgeons who are devoting only part of their time to gastric surgery. The operations in this study were performed by 45 different surgeons, 61% of whom held the grading of senior registrar or below. It should be noted, however, that trainee surgeons operated under direct supervision of a more senior surgeon until adequate experience had been gained, and that each operated with the knowledge that the efficiency of his work would be assessed objectively by an insulin test the result of which would be made known to all members of the team. This is the background to the results of the study, which we suggest indicates that truncal vagotomy with drainage should be retained as the operation of choice in the surgical management of duodenal ulcer. This operation is simple, safe, and able to be more quickly performed than the several variants of selective vagotomy. We recognize that the follow-up period is relatively short, a mean of just over four years with a minimum of two years, but this is longer than follow-up studies available for the currently promoted operation of proximal vagotomy. Finally, while the results of carefully controlled trials including proximal gastric vagotomy will be awaited with interest, it is suggested that a success rate of 90% probably takes us to the point of diminishing returns in the quest for an ideal operation for the treatment of duodenal ulcer.

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