Electrical stimulation and insulin tests used with bilateral selective vagotomy

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SUMMARY Completeness of vagotomy has been assessed by use of the electrical stimulation test and the insulin test in 50 patients suffering from chronic duodenal ulceration. A positive result from either was taken as evidence of incomplete vagotomy. The electrical stimulation test provided such evidence more often than the insulin test.

No early positive insulin test result was encountered in any vagotomy performed with the aid of the electrical stimulation test. The number of late positive insulin results increased as the postoperative interval lengthened. It is believed that the routine use of the electrical test in this study increased the incidence of adequate nerve section.

Vagotomy has an established place in the treatment of duodenal ulcer. A well recognized difficulty exists in ensuring adequate division of all major gastric branches of this nerve. It is estimated that in as many as 30% of cases this is not achieved. To overcome it two tests of vagal function are available, viz, the insulin test of Hollander (1946) for post-operative use, and the electrical stimulation test of Burge and Vane (1958) used at the time of operation.

The aims of the present study are twofold: first, to compare the result of the insulin test 10 days after vagotomy with that performed six to 30 weeks later; secondly, to investigate the usefulness of the routine application of the electrical test, and to compare the result of this with the insulin test from the same patients.

Patients and Methods

CLINICAL MATERIAL

This consisted of 50 patients suffering from chronic duodenal ulceration. Six of these also had a hiatus hernia, and three had gallstones. Each was given a bilateral selective vagotomy using the electrical stimulation test. Seventeen underwent a concurrent pyloroplasty, six a Nissen repair, and three a cholecystectomy; the remainder had a vagotomy without drainage.

INSULIN TEST

This was based on the recommendations of Hollander

(1946). Each test was performed under the supervision of the author. Patients received a fluid meal the evening before the test and fasted after midnight. The following morning a nasogastric tube was passed, without the aid of x-ray positioning, and gastric juice was aspirated at half hourly intervals for two hours. These samples provided the base-line acid secretion. Soluble insulin (0.14 units per kilogram body weight) was then given intravenously, and a further four samples were aspirated as before. Venous blood was sampled half hourly for two hours commencing immediately after insulin was administered. In all cases blood glucose fell below 25 mg/100 ml, as estimated by the glucose oxidase method using the Boehringer Biochemica test kit. Gastric acidity was measured by titration with N/10 sodium hydroxide against thymol blue indicator, and was expressed as milliequivalents of free hydrochloric acid per litre of gastric juice.

Insulin tests were carried out 10 to 14 days after surgery. Twenty-seven patients agreed to undergo a second test between the sixth and thirtieth post-operative weeks, and three had a third test not less than 26 weeks after operation. Interpretation was according to the criteria of Hollander (1948). These require a post-insulin elevation of at least 20 milliequivalents per litre of free acid above mean resting values for a positive response. If the base-line specimens contain no free acid a 10 milliequivalent per litre rise is sufficient. The results were divided into early and late positive responses after the criteria of Ross and Kay (1964). An early response is a significant rise in acid secretion occurring within

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45 minutes of insulin being injected while a late response is a rise taking place between 45 and 120 minutes.

ELECTRICAL STIMULATION TEST

The electrical stimulation test and technique of bilateral selective vagotomy were described by Burge and Frohn (1969). A rise of intragastric pressure greater than 2 mm of water was taken as evidence of incomplete vagotomy and further nerve branches were sought. Care was taken to ensure that no patient received any anticholinergic drug while in hospital.

Results

Results from the electrical stimulation and first insulin test are presented in Table I. In five cases the electrical stimulation test indicated that the surgeon had been unable to achieve complete vagotomy, and these are subsequently described as having a positive electrical test result. The first insulin test, on or about the tenth postoperative day, provided one late positive response only. This occurred in a patient whose electrical test was negative.

Test	50 Cases	
	Positive Response	Negative Response
Electrical	5 (10%)	45 (90%)
Insulin (10 days)	1 (2%)	49 (98%)

Table I *A comparison of the result of the electrical stimulation test with that of the insulin test applied 10 days postoperatively in 50 cases of chronic duodenal ulceration*

Twenty-seven of the original patients agreed to a second insulin test, the results of which appear in Table II. The electrical stimulation test was positive in two of these cases. This group included the one

Test	27 Cases	
	Positive Response	Negative Response
Electrical	2 (7%)	25 (93%)
Insulin I (10 days)	1 (4%)	26 (96%)
Insulin II (6-30 weeks)	9 (33%)	18 (67%)

Table II *Results of the electrical stimulation and insulin tests applied at both 10 days and six to 30 weeks postoperatively in 27 cases of chronic duodenal ulceration*

late positive response from the first insulin test. At the second test this patient again produced a late positive result together with eight other patients who were previously insulin negative. Of the eight cases becoming positive only one had a positive electrical stimulation test result.

A third insulin test was performed on three patients. Each maintained a similar response to that exhibited at the second test. No example of an early positive insulin response was encountered in this work.

Discussion

A comparison has been made between insulin test results obtained 10 days after surgery and when the patient's recovery was complete, ie, six to 30 weeks later. The incidence of late positive responses rose from 2% at the first insulin test to 33% at the second (Table II). Similar observations have been reported by Gillespie, Elder, Gillespie, and Kay (1969). Such figures appear to support the opinion that the insulin response 10 days after surgery is unreliable, probably due to recent operative trauma. Further, it would appear that because of the shift towards increasing positivity with the passage of time the comparison of insulin test results, from similar groups of post-vagotomy patients, is invalid unless each group has undergone the test at an equivalent postoperative time. Any discussion as to the reasons for this increasing positivity would be purely speculative and outside the scope of this paper.

Using the same patients, a comparison of the electrical stimulation test and the insulin test has also been made (Table I). Incomplete vagotomy was indicated in 10% of cases by the electrical test, but in only 2% by the insulin test 10 days after vagotomy. This, plus the fact that the early insulin test yields few positive results compared with the same test some weeks later, suggests that the electrical test may be the more reliable means of detecting those patients liable to recurrent ulceration through incomplete nerve section. Further follow up will be required to confirm this statement.

Both figures (2% and 10%) represent a reduced incidence of incomplete vagotomy when compared with the results of other workers. This is shown in Table III where insulin test results from three other sources are offered for comparison with the present figures. In each group the tests were carried out about the tenth postoperative day. If the conclusion of Ross and Kay (1964) is correct, that late positive insulin responses are of no significance, then it appears that adequate vagotomy was achieved in every case of the present series. This is ascribed to the careful use of the electrical stimulation test.

Series	No. of Cases	Early Positive Response	Late Positive Response	Negative Response
Ross and Kay (1964)	100	9	29	62 (62%)
Lythgoe (1961)	25	2	4	19 (76%)
Graham <i>et al</i> (1968)	50	5	5	40 (80%)
Present	50	0	1	49 (98%)

Table III Comparison of results from insulin tests applied 10 days postoperatively in four separate groups of patients

In a previous comparison of electrical and insulin tests by Lythgoe (1961), it was concluded that the routine use of the electrical test did not reduce the incidence of incomplete vagotomy. This was because vagotomy was considered incomplete only if the intragastric pressure rose above 10 mm of water on stimulation. By this standard complete vagotomy appeared to be achieved in all cases after the first attempt at nerve division. In the present study, vagotomy was not considered complete until the pressure rise was reduced to below 2 mm of water. In only 26% of cases was this achieved at the first attempt, the remainder requiring from one to five further attempts with a mean of three.

It is believed that the present work supports the view that a significant increase in the quality of vagotomy can be achieved by the careful, routine use of the electrical stimulation test.

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