

# A controlled, randomized trial of highly selective vagotomy versus selective vagotomy and pyloroplasty in the treatment of duodenal ulcer

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**SUMMARY** The results of highly selective vagotomy without drainage and selective vagotomy with pyloroplasty for duodenal ulcer were compared in a randomized, controlled trial of a series of 100 patients. The frequency of dumping, diarrhoea, and epigastric fullness was significantly lower after highly selective (6, 6, and 8%) than after selective vagotomy (30, 20, and 28%) one year after the operations. Recurrent and persisting duodenal ulcers appearing from one to four years after the operations were significantly more frequent after highly selective (22%) than after selective vagotomy (8%). No significant relationships were found between recurrent ulceration and gastric acid secretion measurements after the two operations. The Hollander response was early positive in 28% and late positive in 30% of the patients subjected to highly selective vagotomy, while the corresponding figures after selective vagotomy were 26 and 32%.

The overall clinical results of the two operations were not different according to the classification of Visick. Excluding the patients with recurrence resulted in significantly better clinical results after highly selective vagotomy.

Recent studies (Humphrey and Wilkinson, 1972; Jensen and Amdrup, 1973) indicate that highly selective vagotomy without drainage in the treatment of duodenal ulcer promotes a low frequency of dumping and diarrhoea without a complementary rise in the risk of recurrent ulceration; indeed the frequency of recurrent ulceration is very low.

An evaluation of the merits of highly selective vagotomy requires a comparison with a conventional operative method in a controlled, randomized trial. As the results of such a trial has not yet been published, in November 1970 a controlled study was begun at Bispebjerg Hospital, Copenhagen. Highly selective vagotomy without drainage was compared with selective vagotomy and a Heineke-Miculicz pyloroplasty.

## Patients and Methods

One hundred patients entered the trial from November 1970 to August 1974. The clinical re-

sults are given at follow up studies one year after operation but recurrent ulcers appearing within four years are included. Ninety-six patients attended the one-year follow-up examination. Four could not be traced, but they were examined six months after the operation. All patients were asked a standard set of questions recorded on a questionnaire. Patients admitted for the trial were not more than 60 years old, had typical symptoms of duodenal ulcer, radiologically demonstrable duodenal ulcer, and no signs of pyloric stenosis. Those with concomitant disease in the gastrointestinal tract and/or evident mental disease were excluded. Only elective operations were considered. When the diagnosis was confirmed during operation, the type of vagotomy was allocated at random using a double-blind, paired sample principle.

Thirty-six men and 14 women were allocated to highly selective vagotomy (HSV). The mean age was 45 and 48 years, respectively. Thirty-four men and 16 women were allocated to selective vagotomy and pyloroplasty (SV). The mean age was 51 and 43 years, respectively.

All patients were subjected to an insulin and an augmented histamine test before and about 10 days

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	Highly Selective Vagotomy		Selective Vagotomy	
	Men	Women	Men	Women
No.	36	14	34	16
Preoperative PAO (m-equiv/h)	48.2	35.6	47.5	34.6
Postoperative PAO (m-equiv/h)	19.7	16.1	20.3	12.3
Postoperative maximum acidity after insulin (MIA)-mean spontaneous acidity				
Postoperative PAO (I)-BAO	31	17	25	26
	4.2	2.0	4.2	1.9
The Hollander response				
Negative	12	9	14	7
Late positive	12	3	12	4
Early positive (60 min)	12	2	8	5

Table I Mean values for gastric acid secretion measurements and Hollander responses

after the operation by a technique described previously (Kronborg and Madsen, 1972b). The acid secretion measurements are presented in table I. No differences were found between the groups, either before or after operation. Ninety-six of the 100 patients had a preoperative early positive Hollander response.

Serum gastrin measurements were performed before and after stimulation with insulin before and after operation in some of the patients (Kronborg, Stadil, Rehfeld, and Christiansen, 1973).

Highly selective and selective vagotomy were, with only a few modifications, performed as described by Amdrup and Jensen (1970). Atropine was not used before and during the operation. Gastric secretion was stimulated by tetragastrin (Leo) during the induction of anaesthesia. The dose was 10 microgram per kg body weight given subcutaneously. The border between antrum and corpus on the lesser curvature was localized by a pH tube (Rune, 1968). If the borderline could not be identified within 1 to 2 cm a gastrotomy was performed and the mucous membrane stained with Congo red. The mean distance from pylorus to the borderline in 47 HSV patients was 8.6 cm (range 4-17).

The statistical evaluation comprised the unpaired t test, the chi square test, and the rank sum test.

**Results**

Operative mortality was nil. Severe postoperative complications were not seen. No patient died during the one-year follow up.

Dumping was more frequent after SV than after HSV (P < 0.001), considering the sum of severe and slight symptoms and the severe symptoms alone (table II). Acid secretion measurements were not related to dumping after HSV but men with dump-

Dumping	Vagotomy	
	Highly Selective	Selective
	No. of Patients	No. of Patients
With need to lie down	1 (2%)	10 (20%)
Without need to lie down	2 (4%)	5 (10%)

Table II Dumping

	Vagotomy	
	Highly Selective	Selective
	No. of Patients	No. of Patients
Diarrhoea	3 (6%)	10 (20%)
Imperative need of defaecation	1 (2%)	6 (12%)

Table III Diarrhoea and imperative need of defaecation

ing after SV had a lower preoperative PAO than those without dumping (P < 0.02).

Diarrhoea was commoner after SV than after HSV (P < 0.05), while the imperative need of defaecation was insignificantly more frequent (0.10 < P < 0.20) (table III). Men with diarrhoea after SV had a lower acid response to insulin post-operatively than those without diarrhoea (P < 0.005).

Epigastric fullness was more frequent after SV (P < 0.01), while the difference in rate of occasional vomiting after HSV and SV was not significant (table IV). All patients with vomiting except one had epigastric fullness. The acid response to insulin in men with epigastric fullness after SV was significantly less than in those without (P < 0.02). Neither spontaneous nor activated acid secretion was related to occasional vomiting.

Recurrent or persisting duodenal ulcer was seen in 11 patients with HSV and in four with SV (table V). This difference is significant (P < 0.05). Dyspepsia without demonstrable recurrent ulcer was seen in two patients after SV. Twelve of the 15 patients with recurrence were reoperated and a duodenal ulcer was found in all of them. No reoperation was performed in three patients with recurrence

	Vagotomy	
	Highly Selective	Selective
	No. of Patients	No. of Patients
Epigastric fullness	4 (8%)	14 (28%)
Vomiting	2 (4%)	7 (14%)

Table IV Epigastric fullness and vomiting

	PAO (m-equiv/h)		Postoperative PAO (I)-BAO	Postoperative MIA-mean Spontaneous Acidity (m-equiv/l)	Hollander Response
	Before Operation	After Operation			
<i>Highly Selective Vagotomy</i>					
Men	45.8	19.8	8.0	63	Early positive
Men	33.0	13.4	1.4	14	Late positive
Men	46.4	16.4	1.8	19	Negative
Men	39.2	10.6	4.6	57	Early positive
Men	38.8	15.6	1.1	40	Late positive
Men	69.8	22.0	1.6	24	Early positive
Men	53.0	7.6	-0.3	7	Negative
Men	32.8	19.2	12.8	65	Early positive
Men	47.2	32.8	14.1	36	Early positive
Women	17.0	4.2	0.4	13	Negative
Women	24.6	14.8	8.4	29	Late positive
<i>Selective Vagotomy</i>					
Men	46.2	15.6	2.2	30	Late positive
Men	54.4	44.4	28.2	64	Early positive
Men	60.2	40.2	23.7	71	Early positive
Men	60.4	15.2	0.6	16	Negative

Table V Gastric acid secretion measurements and Hollander responses in patients with recurrent or persisting duodenal ulcer

after HSV. The ulcer healed in two, after they had ceased taking salicylic acid; a third ulcer healed spontaneously.

Gastric acid secretion measurements in patients with recurrent ulcer did not differ from those in patients without recurrence after HSV (table V). The four patients with recurrence after SV all had a high preoperative PAO, but the number was too small to allow a discrimination between recurrences and non-recurrences. Positive Hollander responses were not more frequent in patients with

recurrent ulcer than in those without, regardless of the operation performed. The distance from the pylorus to the antral borderline was not related to recurrence.

Serum gastrin concentrations were measured in 17 patients with HSV, including four with recurrent ulcer, and in 12 patients with SV, including two with recurrent ulcer. Fasting gastrin concentrations and gastrin responses to insulin were similar in patients with and without recurrence.

No differences were found between HSV and SV in overall clinical results (rank sum test) (table VI). Excluding the patients with recurrence from this evaluation, resulted in significantly better results after highly selective vagotomy ( $P < 0.0002$ ) (table VII).

## Discussion

The results of the trial confirm some of the findings in non-randomized studies; the incidence of dumping and diarrhoea is very low after HSV and lower than after SV. This is probably due to a normal or only slightly accelerated gastric emptying after HSV (Amdrup and Jensen, 1970; Madsen, Kronborg, and Feldt-Rasmussen, 1973). Epigastric fullness was also less frequent after HSV than after SV. The acid response to insulin was higher in SV patients without fullness than in those with, indicating a more intact vagal innervation and therefore better preservation of the receptive relaxation of the stomach in the former. The intact antral innervation after HSV may preserve the receptive relaxation in this part, resulting in no epigastric fullness.

Visick Grading	Vagotomy	
	Highly Selective	Selective
	No. of Patients	No. of Patients
I	34 (68%)	20 (40%)
II	5 (10%)	14 (28%)
III	1 (2%)	12 (24%)
IV	10 (20%)	4 (8%)

Table VI The overall clinical results of highly selective and selective vagotomy according to Visick grading

Visick Grading	Vagotomy	
	Highly Selective	Selective
	No. of Patients	No. of Patients
I	34 (87%)	20 (44%)
II	5 (13%)	14 (30%)
III	0 (0%)	12 (26%)

Table VII Clinical results of highly selective and selective vagotomy according to Visick excluding patients with recurrent ulceration

In a previous study (Kronborg and Madsen, 1972a) we did not find any relationship between preoperative PAO and dumping after truncal vagotomy and pyloroplasty, nor between gastric emptying time and preoperative PAO. However, the postoperative PAO(I) was slightly but significantly lower in patients with fast gastric emptying. The present lower acid response to insulin in patients with diarrhoea after SV than in those without diarrhoea suggests a positive relationship between completeness of vagotomy and diarrhoea, but this relationship is abolished by preserving the antral innervation. This implies that gastric emptying is dominated by the antrum, while denervation of the corpus and fundus only results in a fast gastric emptying rate and diarrhoea if the antrum is denervated and the pylorus destroyed.

The recurrence rate after HSV was surprisingly high. The reduction of PAO (histamine) was on average 59%, a similar figure to those presented by Clarke, Allan, and Alexander-Williams (1972) and Johnston, Wilkinson, Humphrey, Smith, Goligher, Kragelund, and Amdrup (1973). The last mentioned authors found a very high proportion of negative Hollander responses one week after HSV (97 out of 100 responses) and none of their 280 patients had recurrent ulceration in spite of 51% of the responses (27 out of 53) being positive one year after HSV. The last figure is not different from our 58% ten days after HSV.

Recurrent ulceration has been reported in another, smaller series showing an incidence of positive Hollander responses in 28% of patients soon after HSV (Wastell, Colin, MacNaughton, and Gleeson, 1972).

No significant differences were detected in acid secretion measurements after HSV and SV, which could explain the difference in the recurrence rate. Also, no relationship was found between recurrence and gastrin, confirming the findings of Clark and Wyllie (1973).

Several surgeons performed the operations, but

the recurrences could not be related to one or to a few surgeons. Subtracting the three recurring ulcers which healed, a recurrence rate of 16% after HSV remains. It seems that the low frequency of dumping and diarrhoea after HSV has to be paid for by a high recurrence rate. The equally good (or bad) results according to Visick demonstrate the complementary relationships between recurrence and post-vagotomy symptoms in surgery for duodenal ulcer.

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