Review

Laparoscopic Highly Selective Vagotomy

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ABSTRACT

BACKGROUND/AIMS: Ten percent of our population has had a gastroduodenal ulcer. Medical treatment heals ulcers in 90% of the cases but they recur in 50-70% of the patients. We present a proposal of surgical treatment for patients with recurrent ulcer after a long-term medical treatment or whose ulcer reappears as soon as medical treatment ceases.

METHODOLOGY: Thirty-three patients underwent highly selective vagotomy (HSV) laparoscopic between April 1992 and March 1993. There were 26 male patients and 7 female patients aged 19-65 years (mean age: 38 years). Twenty-six patients were operated electively and preliminary medical treatment lasted an average 5.4 years (range: 0.5-26 years) and the disease had lasted 1-30 years (mean duration: 8.4 years). For patients with a chronic peptic ulcer disease, pre-operative assessment involved a recent gastroscopy, isotopic gastric study and a selection test.

RESULTS: HSV proved feasible in 100% of the cases in spite of a history of previous surgery and peritonitis in patients with a perforated ulcer. There were neither conversions nor intra-operative complications. There was no mortality or morbidity. The mean hospital stay was 2 days (range: 1-5 days) for selectively operated patients and 7 days (range: 6-10 days) for patients operated for a perforated ulcer. Twenty-two patients were rated Visick I and II and 3 with Visick III after re-examining. The BAO had decreased by 61% to 89% and the MAO by 60% to 80%.

CONCLUSIONS: The treatment of choice for gastro-duodenal ulcer is highly selective vagotomy. The laparoscopic approach shortens the hospital stay and improves patient's comfort.

INTRODUCTION

Ten percent of our population has had or will have a gastroduodenal ulcer (2/3 gastroduodenal, 1/3 gastric). Medical treatment is remarkably effective in the management of acute phases but does not prevent recurrences (Omeprazole heals ulcers in 90% of the cases but they recur in 50-70% of the patients). Apparently, the arrival of medical treatment has not altered the frequency of severe complications and therefore that of the accompanying mortality: 5% of perforations and 15-20% of hemorrhages are observed, 20% of which require surgical treatment, itself marred by a 50% mortality rate (1-3). On the reverse, surgical treatment acts on ulcer diathesis itself, thus protecting most patients from severe complications (4). It therefore seems advisable to propose surgical treatment not only to those patients whose ulcer will not heal after a second period of 6-8 weeks of appropriate medical treatment, but also to the patients who suffer from recurrent ulcer in spite of a long-term medical treatment, or whose ulcer reappears as soon as medical treatment ceases.

CHOICE OF PROCEDURES FOR THE MANAGEMENT OF DUODENAL ULCER

The various types of surgical procedures used in the treatment of gastroduodenal ulcer are the following:

- subtotal gastrectomy,
- truncal vagotomy with or without gastric drainage,
- selective vagotomy,
- truncal vagotomy plus antrectomy,
- highly selective vagotomy (HSV),
- posterior vagotomy plus anterior seromyotomy.

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TABLE 1 Comparison of Results between Gastrectomy and Three Forms of Vagotomy

Length of study	Interventions	Number of patients	Mortality	Visick (%) (I+II)	Visick (%) IV	Recurrences Total	Recurrences Proved	Dumping (%)	Diarrhea (%)
5-8	SG	117	0	77	6	4.7	1	21.5	6.5
	TV+GE	126	0	70	11	8.4	2.5	17.9	26.3
	TV+A	132	0	78	8	5.2	0	8.3	23.2
	TV+PP	192	0	68	14	14	6.7	11.09	21.7
10.16	SG	117	0	80	5.7	2.8	1.4	14.2	15.7
	TV+GE	126	0	74.4	10.6	9.6	4.2	13.1	16
	TV+A	132	0	83.2	5.9	1	0	11	11.8
	TV+PP	192	0	70	16.4	15.7	10.4	13.4	25.2

SG: subtotal gastrectomy; TV: truncal vagotmy; GE: gastro-enterostomy; A: antrectomy; PP: pyloroplasty
Recurrences have been proven by laparotomy or laparoscopy

Amongst the various studies comparing gastrectomy with different types of vagotomies, those conducted by Goligher are the most comprehensive **(Table 1)**. The cumulated results of non-prospective studies show that mortality tends to be slightly higher after gastrectomy or truncal vagotomy plus antrectomy than after truncal vagotomy plus pyloroplasty, but recurrence occurs more frequently after vagotomy plus gastric drainage or HSV than after gastrectomy or vagotomy plus antrectomy. So, if the aim is to be efficient, truncal vagotomy plus antrectomy will be performed; if the aim is the patient's comfort, it is preferable to perform truncal or selective vagotomy without antrectomy.

All these studies were carried out before anti-H_2 treatments appeared, which raises the question of possible selection of a population of patients suffering from a particularly severe form of ulcer, partly resistant to simple vagotomy without exeresis. Five studies have examined the possible link between resistance to anti-H_2 and HSV efficiency. Three studies concluded that there was no link whatsoever between the two factors (5-7). Another two studies reached the opposite conclusion (8,9). Three of these studies (6-8) are unfortunately marred by methodological errors, which makes it impossible to interpret them. Consequently, the problem remains unresolved.

Until a clear-cut conclusion is reached as to the link between the resistance to H_2 receptor antagonists or Omeprazole and the efficiency of vagotomy without resection, one should perform truncal or selective vagotomy without antrectomy when the patient's comfort is considered a priority. A comparison of the various types of vagotomies **(Table 2)** leads to the following conclusions:

1 if vagotomy, whatever its type, is performed electively in specialized centers, the attached mortality is extremely low, perhaps even nil,
2 the recurrence rate is lower when vagotomy is accompanied by antrectomy,
3 the recurrence rate is more or less the same after truncal vagotomy, selective vagotomy plus drainage, or HSV,
4 side-effects are less frequent after HSV than after any other form of vagotomy.

According to Taylor and Gomez-Ferrer, neither posterior vagotomy nor anterior seromyotomy have been studied with such a long follow-up and in as many patients as truncal vagotomy or HSV. These procedures offer the theoretical disadvantage of involving complete (10) or partial (11,12) section of the gastric wall, hence a risk of perforation. Dubois's rehabilitation of truncal vagotomy is justified by the fact that this type of procedure is extremely quick, easy to reproduce, and that its side-effects are not due to the vagotomy itself but to the associated procedures of gastric drainage. Comparative studies of HSV plus drainage (20% of dumping syndrome and 20% of diarrhea), HSV only (2% of diarrhea, 2% of dumping syndrome), and truncal vagotomy plus drainage (20% of diarrhea and 20% of dumping syndrome), seem to confirm this theory (13-16) **(Table 1)**. Truncal vagotomy without gastric drainage is justified for the following two reasons: If necessary, it is now possible to associate pyloroplasty performed ulteriorly by laparoscopy, and truncal vagotomy tends to induce gastric atonicity rather than spasms of the pylorus.

TABLE 2 Comparison of the Different Forms of Vagotomies (controlled series)

Authors	Procedures	Mortality	Visick (I+II)	Recurrences	Dumping	Diarrhea
Kronborg	VS+PP	0	78	8	20	12
	VSS	0	60	22	2	20
Kennedy	VSS+GE	0	74	2	37	12
	VSS	0	96	2	8	4
Wastell	VSS+PP	0	77	14.6	5	10
	VSS	0	78	6.5	0	2
Andersen	VS+PP/GE	0.6	84	6	28	4
	VSS	0.7	83	11	4	1
Dorricot	VT+A	1	56	1	9	14
	VSS	0	82	4.3	2.4	4.9
Devries	VT+A	1	61	1.4	19	16
	VSS	0	72	9.9	11	7
Koo	VT+PP/GE	0	86	12	13	15
	VT+A	0	96	0	21	21
Donahue	VS+A	0	-	0	22	13
	VSS	0	83	8.8	2	5
Hohhma	VT+GE	0	70	14	16	23
	VS+GH	0	44	30	37	25
	VSS	0	61	19	11	9
Jordan	VA+A	0	66	2.2	30	10
	VSS	0	88	10	5	5

TV: truncal vagotomy; SV: selective vagotomy; HSV: highly selective vagotomy; A: antrectomy; PP: pyloroplasty; GE: gastro-enterostomy

Until it is demonstrated that the side effects of truncal vagotomy are due to the associated gastric drainage, HSV currently seems to be the best procedure.

HOW TO IMPROVE HSV? HOW TO REDUCE POST-HSV RECURRENCES?

The disadvantages of HSV are the length of the procedure (especially by laparoscopy) and the recurrence rate. The frequency of recurrences as expressed by the current method increases from 10% after 5 years to ±25% after 15 years (17-22). Lower rates have however been reported by some authors (23). When interpreting those results, one should bear in mind the fact that the somewhat frightening 25% rate of recurrence represents in fact a cumulated recurrence rate. A patient who has once experienced one acute phase during that period will all the same be put down as a "recurrence". And yet, the peptic ulcer disease observed after HSV often presents the same cyclic and irregular character as the original disease. When one interprets the frequency of post-operative recurrences, one should also take into account not only the absolute number of patients who experience acute phases but also the degree of seriousness of these phases; there is no extensive literature on the subject. However, it seems that, unlike the original disease which is serious enough to require surgery, post-HSV ulcer is significantly less serious (3,24-27).

No predictive criterion indicates if HSV will be effective or not in a given patient. The predictive value of BAO (Basal Acid Output) and MAO (Maximal Acid Output) tests for one particular patient considered individually has not been established (9,23,28-32) and these tests cannot guide the surgeon in his decision to associate antrectomy to vagotomy.

Neither age, sex, duration of the peptic ulcer disease, nor preexisting complications (hemorrhage or perforation) seem to influence the recurrence rate (17,23,28). The only two factors that are known to influence post-HSV recurrence are smoking (recurrences are 3-5 times more frequent in smokers than in non-smokers) (17,33,34) and the surgeon's ability. The quality of the vagotomy varies from one surgeon to the next and for one same surgeon it improves with experience (9,18,35).

In certain HSV series the cumulated frequency after 10 years varies from 5-50% depending on who performed the operation. Several methods have been developed to detect the presence of residual fundic vagal fibers that would justify further dissection (Grassi's, Burge's, Donahue's tests) (36-38). The interest of these tests in the prevention of recurrences remains a matter of controversy.

Therefore, the surgical technique does influence HSV quality. Dissection of the abdominal esophagus and detection of vagal fibers in an atypical location should be done extremely carefully. Hallenbeck (39) has shown that if the esophagus is dissected over a length of 2cm, the recurrence rate is 15%, whereas if the dissection is done over a length of 6cm, the rate drops to 6%. The distal limit of denervation is similarly important, although less crucial than proximal dissection. The distal fundic zone should be denervated as thoroughly as possible, without altering the motility of the gastric antrum (40). Johnson (41) has shown that if the distance from the distal limit of dissection of the lesser curvature to the pylorus is 10cm, 98% of the vagotomies remain incomplete, whereas this percentage drops to 2% if the distance is 6cm. Some surgeons divide the right gastro-epiploic artery along which a vagal branch issued from the pyloric zone is found. This branch innervates the distal part of the fundic zone of the greater curvature.

THE ADVANTAGES OF LAPAROSCOPY

The laparoscopic approach improves the surgeon's vision thanks to its magnifying effect, and makes it possible to easily explore the posterior aspect or the esophagus thanks to the mobile optical system. It therefore contributes to improving the quality of the dissection. Systematic use of the technique together with experience bring the length of the procedure down to an average of 90min (mean duration of the last procedures in our personal experience, after 30 laparoscopic HSVs). This approach should also achieve a lower morbidity rate than conventional surgery where 10-30% of complications are due to parietal injury (wound infection, pulmonary infection, venous thrombosis). What emerges from this is that laparoscopic HSV is currently the best method for the surgical management of gastroduodenal ulcer (until truncal vagotomy without drainage has been studied). It induces less side effects than any other form of treatment. However, the recurrence rate is 25% after 15 years; the only known way to lower this rate is to prevent the patient from smoking and to perform the operation with extreme care, which implies complete dissection of the abdominal esophagus over a length of at least 6cm and division of one or of the two proximal branches of the crow's foot if they are more than 6cm proximal of the pylorus. Considering the time needed by a well-trained laparoscopic operating team to perform HSV, it seems that the length of the procedure should no longer act as a deterrent.

PATIENTS

Thirty-three patients were operated consecutively by the first author between April 1992 and March 1993 and underwent laparoscopic HSV. There were 26 male patients and 7 female patients aged 19-65 years (mean age: 38 years), eutrophic, (Body Mass Index inferior to 30:100%) and in good physical condition (ASA I and II: 100%). Eight patients had abdominal surgery previously, gastric surgery in 2 cases: one pyloroplasty and one suture for perforated ulcer treated laparoscopically. Eighteen patients were operated for chronic peptic ulcer disease. In 8 patients the main indication was pathological gastroesophageal reflux. These latter patients also had a history of previous gastroduodenal ulcer. In the 26 patients operated electively, preliminary medical treatment lasted an average of 5.4 years (range: 0.5-26 years) and the disease had lasted 1-30 years (mean duration: 8.4 years). In 7 other patients with a perforated ulcer, HSV was performed during the same session as the suture.

METHODOLOGY

For patients with a chronic peptic ulcer disease, pre-operative assessment involved a recent gastroscopy (25 cases out of 25), isotopic gastric clearance study (13 cases out of 25), and a secretion test (12 cases out of 25). In addition, patients with pathological gastroesophageal reflux underwent manometry and pH-metry over 24 hours.

Technique

The patient is under general anesthesia and lies in a supine position with legs apart. The operating table is tilted 20° feet down. The surgeon sits or stands between the patient's legs. Five trocars are necessary:

- one 10mm trocar inserted 2cm above the umbilicus allows introduction of a 300 scope,
- one grasping forceps is introduced in a 5mm

trocar under the right costal margin, immediately to the right of the ligamentum teres of the liver,
- one 10mm trocar inserted under the left costal margin on the mammary line allows introduction of a grasping forceps that will be used to seize the lesser curvature of the stomach,
- the diathermy hook is inserted through a trocar situated midway down the line formed by the first and third trocar, and
- finally, a clip-applier for small hemostatic clips (5mm) is inserted through a 10mm trocar placed infraxyphoidally. This is used to retract the liver, and also to perform hemostasis of the larger vessels of the lesser curvature.

Once the nerve of Latarget and the crow's foot have been identified, the two grasping forceps are used to seize the stomach and the anterior peritoneal leaf of the hepaticogastric ligament immediately above the proximal branch of the crow's foot, just before it merges into the stomach. Ideally, dissection should be started 1 or 2cm above the crow's foot, and completed downward later on. Once the dissection of the anterior peritoneal leaf has been completed, down to the angle of Hiss, dissection of the lesser omentum is continued along the lesser curvature. The major vessels are clipped, then divided with the diathermy hook. As soon as the posterior leaf has been incised and the posterior cavity opened up, the grasping forceps is placed under the posterior wall of the stomach in order to lift it against the abdominal wall. Dissection of the esophagus begins with its posterior aspect. The 30° scope allows for a careful check that the abdominal esophagus, which is dissected over a length of at least 6cm, has been thoroughly denervated. Over the last 2cm before the crow's foot, dissection is performed with scissors, without coagulation. All the vessels are clipped and one makes sure, by means of a measuring instrument, that the distance from the pylorus to the most distal part of the dissection is of 6cm at most. An associated 360° fundoplication was performed in 15 patients. The length of the wrap is 4-5cm and it is fastened by 5 stitches tied intracorporeally, which take a bite successively of the stomach, the esophagus and the free edge of the valve. No gastric or peritoneal drainage is installed.

RESULTS

The HSV proved feasible in 100% of the cases in spite of a history of previous surgery and peritonitis in patients with a perforated ulcer. There were no conversions or intra-operative complications. There was no mortality or morbidity. The HSV itself lasted 90-270min (mean duration: 155min). The HSV plus 360° fundoplication lasted 90-210min (mean duration: 139min), and the HSV plus suture for perforated ulcer lasted 110-240min (mean duration: 160min). Oral feeding was resumed after 2 days on average (range: 1-4 days), and the mean hospital stay was 2 days (range: 1-5 days) in patients operated selectively. In patients operated for a perforated ulcer, oral feeding was resumed after an average 5 days (range: 4-7 days) and the mean hospital stay was 7 days (range: 6-10 days). The follow-up varies from 1-10 months. Twenty-five patients have been re-examined: 22 of them were rated Visick I and Visick II. Three more were rated Visick III for the following reasons:
- One patient suffered from heartburn after undergoing suture for a perforated ulcer plus HSV. Esophagitis was discovered at gastroscopy. Cisapride was prescribed and 5 months after the operation the symptoms were gone. Gastroscopy showed that esophagitis had disappeared.
- One patient kept on complaining of ulcer-related pain after simple HSV. Anti-H_2 treatment was started again but has failed to calm the symptoms 6 months after the operation. Gastroscopy has shown that multiple gastric ulcers persist.
- One patient complained of regurgitation. Gastroscopy performed 4 months post-operatively revealed an apparently continent valve, gastric stasis, a wide open cardia and a gastric ulcer centered on a migrating clip.

Post-operative objective assessment involved gastroscopy in 16 patients, 13 of which were normal and 3 abnormal, which are described above. Post-operative gastric acid sampling was performed in only 4 patients out of 18. The BAO had decreased by 61% to 89% and the MAO by 60% to 80%.

DISCUSSION

Dissection is started 2cm above the crow's foot; indeed, many vessels are found there which are

difficult to coagulate because of the proximity of the nerve of Latarget. If hemorrhage occurs, ulterior dissection will be more difficult. It is easier to return to this zone at the end of the dissection when the nerve of Latarget has already been dissected in its proximal part and therefore away from the gastric wall. In some cases, inserting a Faucher probe has the advantage of spreading out the lesser curvature and lowering the stomach, thus obviating the need to recline the liver. On the other hand, it makes the esophagus more difficult to dissect as it becomes more rigid.

Our last HSVs were associated to a 3600 valve. Destruction of the anatomical links between the angle of Hiss and the esophageal hiatus may, in theory, facilitate reflux as the valvular system of the antireflux barrier is no longer there (Hill's theory). Although Johnston has never described reflux after HSV in an important series of cases, in our experience 2 asymptomatic patients showed reflux at barium swallow, and symptomatic esophagitis was diagnosed in one patient at endoscopy. One case of clip-migration within the stomach was observed, which was probably due to over-zealous hemostasis of the lesser curvature. The application of small clips on a well-exposed pedicle should prevent this type of incident.

Systematic association of HSV to ulcer suture in young patients who were not on non-steroidal anti-inflammatory drug (NSAID) treatment and who may prove non-compliant to medical treatment increased the operative time by 60min and made it necessary to insert one additional trocar (5 instead of 4). Dissection was never made more difficult by peritonitis, even severe. The patient who complained of regurgitation post-operatively had probably undergone accidental truncal vagotomy that caused stasis for solid food. MAO and BAO gastric acid samplings are difficult to obtain, but in any case, long-term assessment of functional results needs to be clinical and endoscopic.

In the classic operation, the surgical procedure itself is only a minor one as the gastric lumen is not opened up and the gastric wall is left intact. However, it is a major operation mainly because approaching the esophageal hiatus involves parietal damage and heavy traction on the sub-costal margin. The laparoscopic approach reduces parietal invasion and makes the post-operative course more straightforward. The patient's comfort is improved and the hospital stay shortened.

CONCLUSIONS

According to the literature, the treatment of choice for gastroduodenal ulcer is HSV. The laparoscopic approach shortens the hospital stay and improves patient comfort. More studies will have to be carried out with a larger number of patients to assess long-term functional results. As the intraperitoneal procedure is basically the same as in conventional surgery, results should be very similar.

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