LAPAROSCOPIC TREATMENT OF GASTROESOPHAGEAL REFLUX

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Gastroesophageal reflux is the most frequent esophageal disease and scores amongst the most common problems in gastroenterology. Ten to twenty percent of the general population present with heartburn. However, the majority of patients with typical GERD symptoms do not have visible lesions in the esophagus at endoscopy. This category of patients can be treated symptomatically without expensive investigations.

In case of macroscopic lesions (esophagitis), short-term treatment is effective and allows for a cure rate of 78 to 97% after eight weeks. Unfortunately, recurrences are frequent and occur in 80% of the patients within six months.

Long-term treatment however is very effective and provides remission rates of 85% at one year and of less than 80% at two years. Pathological gastroesophageal reflux is a chronic disease which necessitates a long-term if not lifelong treatment.

Since laparoscopy greatly simplifies the postoperative course, surgery seems to be a very viable alternative to the proton pump inhibitors (PPI) in the long run.

MOTS CLÉS : Gastroesophageal reflux, Nissen, Laparoscopy.

❏ TECHNIQUE

The procedure itself is the same as with the "open" operation. The access, the technique of dissection and the means of calibrating the valve are however entirely new.

POSITIONING OF THE PATIENT

The patient is put under general anesthesia with endotracheal intubation. A nosogastric tube (Salem N° 18) is inserted. The patient lies supine, thighs fully abducted and slightly bent. The operation table has a 20° reversed Trendelenburg tilt.

The surgeon stands between the patient's legs. The first assistant is standing on the patient's left side, the second assistant on his right side.

PLACEMENT OF TROCARS

Five trocars[①] are needed for the operation : a 10 mm trocar (T1) well above the umbilicus, a 5 mm trocar (T2) in the right subcostal area, a 5 mm trocar (T3) in the left subcostal area, a 10 mm trocar (T4) between the first and the third one and a 10 mm trocar (T5) under the xiphoid process.
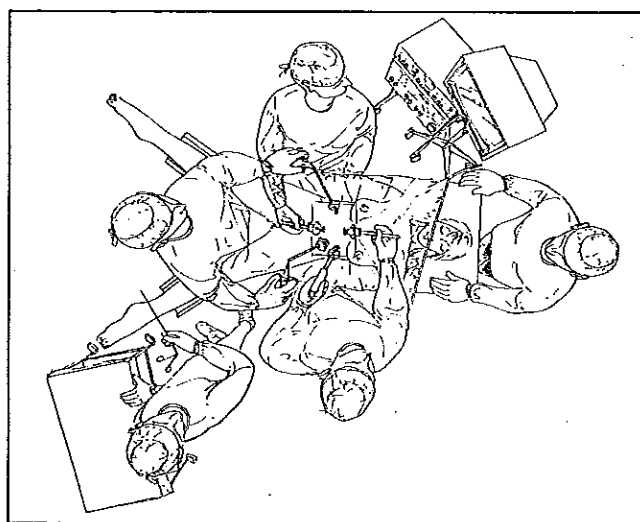

Fig. N° 1   Disposition of the patient

They allow the introduction of a 30° angled laparoscope, a liver retractor, a coagulation hook and a second grasping forceps.
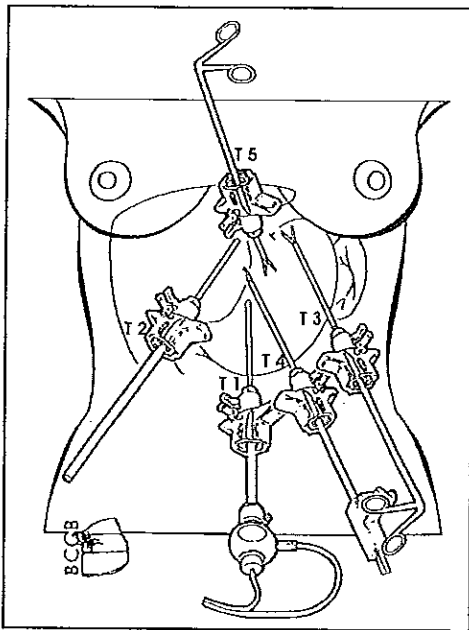
[①] *Ethicon Endo-surgery*

Fig. N° 2   *Trocar placement*

EXPOSURE OF THE ESOPHAGEAL HIATUS

The second assistant retracts the left liver lobe, thus exposing the esophageal hiatus. The right pillar is readily seen through the peritoneal covering of the gastrohepatic ligament. Cirrhosis or hypertrophy of the left liver lobe are relative contraindications since cephalad retraction of the liver can be impaired and good exposure of the hiatus rendered difficult. On the contrary, no problems are encountered in obese patients, more specifically in the female patients with a more peripheral distribution of body fat.

DISSECTION OF THE ESOPHAGEAL HIATUS

1) The lesser omentum is widely opened at the expense of extragastric vagal branches, if necessary for exposure. The right pillar of the hiatus can now be seen.

2) The peritoneal sheet covering the phrenoesophageal *ligament* is incised. This ligament is not entirely transsected so as to avoid damaging the anterior wall of the esophagus. Indeed the correct plane of division between ligament and esophagus is not yet visible at this stage.

3) The incision is taken to the left where the phreno-gastric ligament is reached and severed. This latter dissection is facilitated by a 30° angled laparoscope. Once this peritoneal layer has been incised, mobilization of the esophagus can be performed without further dissection of the immediate periesophageal surroundings.

4) The right pillar of the crus is dissected from top to bottom, until the lowermost part of the left pillar is reached. This, again, can only be done if the previously performed incision of the lesser omentum is wide enough.
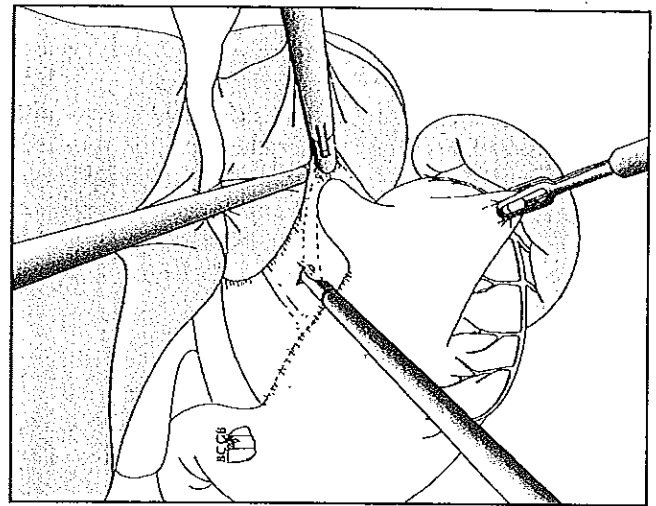

Fig. N° 3   *Exposure of the esophageal hiatus*

A forceps coming from the top trocar is now inserted in the angle between the right crus and the esophagus. The stomach is pulled caudally and laterally. By this manœuvre the left pillar is now dissectable. Localizing the left pillar is essential before any further dissection of the retro-esophagus is undertaken, since it marks the limit between mediastinal and abdominal esophagus.
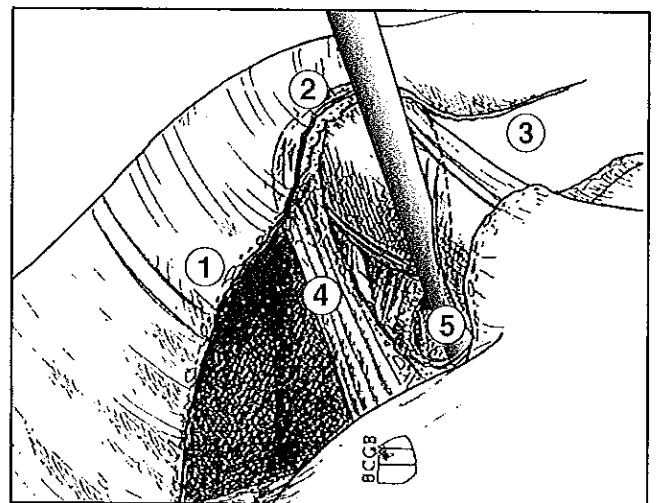

Fig. N° 4   *Dissection of the esophageal hiatus*

Intramediastinal dissection has to be forcefully resisted at this stage if one does not want to injure either the posterior wall of the mediastinal esophagus or the left pleura. The posterior vagus nerve is identified at this stage. The retroesophageal area is dissected well inside the abdomen and, by doing this, the lowermost portion of the phrenogastric ligament is severed.

5) The left pillar is dissected going upwards, care being taken not to injure the vagus nerve. While the esophagus is retracted away from the left pillar, dissection is carried out under direct vision.

As soon as the esophagus has been isolated, the phrenoesophageal ligament is entirely transsected, without endangering the integrity of the esophageal wall.

In case of a large hiatal hernia it is of the utmost importance to dissect the hiatus rather than try to dissect inside the mediastinum, since laceration of the pleura or of the gastric wall will inevitably occur because of impaired visualisation. Strict hiatal dissection will enable progressive reduction of the hernia and hence, safe dissection of the gastroesophageal junction.

SUTURE OF THE PILLARS

A needle-holder and 2/0 silk thread are introduced through a 10 mm trocar under the left subcostal area (**T3**); The grasping forceps is introduced in **T2** thanks to the liver introduced below the xiphoid appendix, the retroesophageal area is exposed. The two pillars are sutured with an intracorporeal knot.'
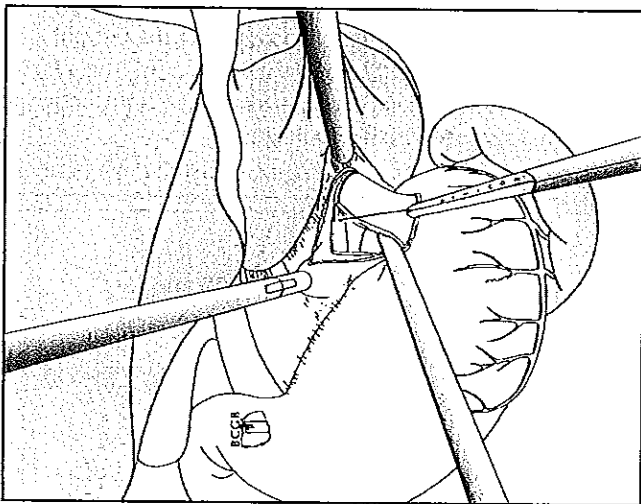

Fig. N° 6   *Mobilization of the greater curvature*

Fig. N° 5   *Suture of the pillars*

MOBILIZATION OF THE GREATER CURVATURE

A grasping forceps pulls the stomach in its middle to the right. By countertraction a second forceps exposes the gastrosplenic ligament. The short vessels are isolated with a coagulation hook.

HEMOSTASIS OF THE SHORT VESSELS

Hemostatic control is performed by placing clips. Mobilization of the greater curvature is carried out by severing the uppermost short vessels (about five). Thus complete mobilization of the fundus is achivied.

LUXATING THE WRAP BEHIND THE ESOPHAGUS

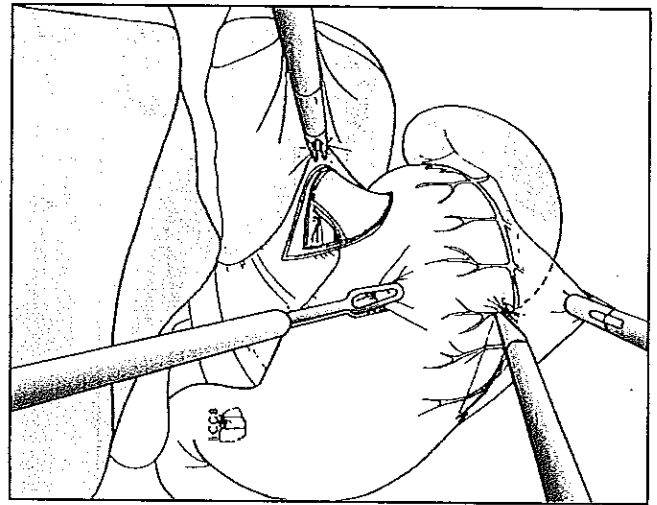A forceps grasps the fundus at the greater curvature and passes it on to a second forceps inserted behind the
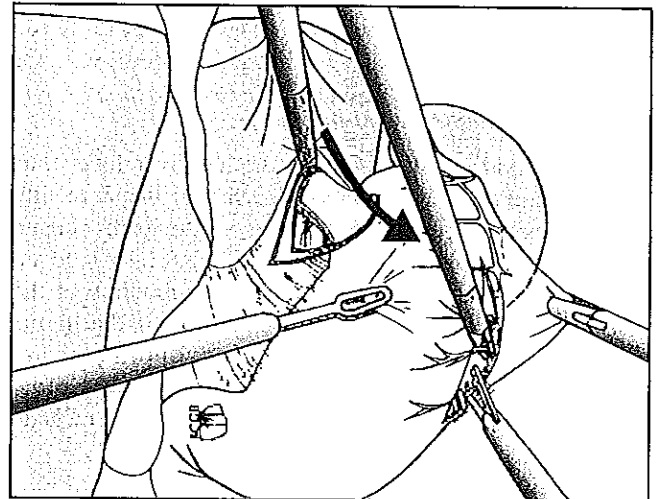

Fig. N° 7   *Hemostasis of the short vessels*
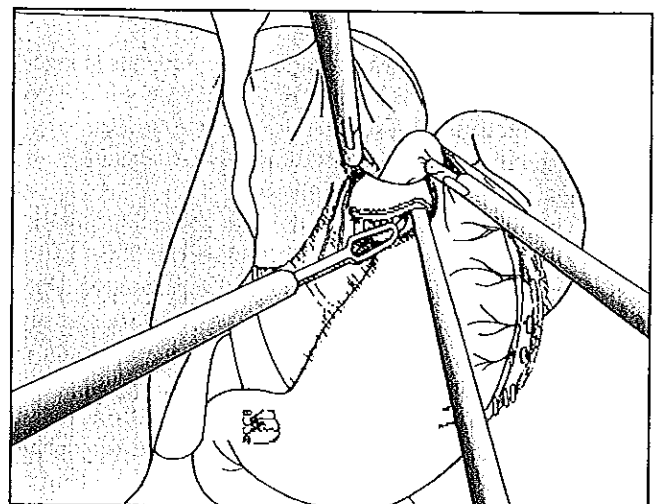

Fig. N° 8   *Luxating the wrap behind the esophagus*
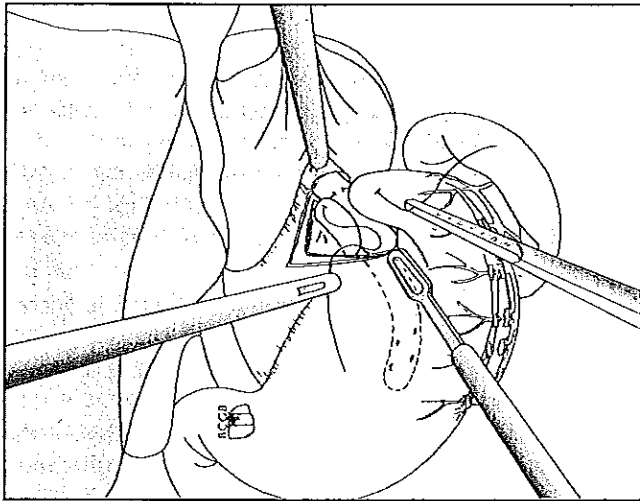
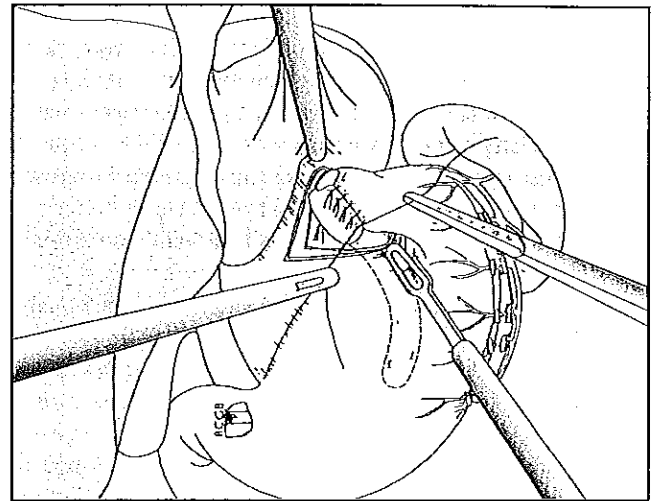Fig. N° 9   *Performing the 360° fundoplication*

Fig. N° 10   *Final aspect of the fundoplication*

esophagus. The latter pulls the fundus until it reaches the right side of the esophagus. Mobilization of the fundus as well as retroesophageal dissection have to be thorough enough for the wrap to stay in place by itself, without further fixation.

PERFORMING THE 360° FUNDOPLICATION

A 33 F Maloney dilator is introduced in the esophagus. By moving the wrap back and forth behind the esophagus, one can make sure that no torsion of the luxated fundic wrap has occurred. Suturing is initiated only then. The interrupted sutures of 2/0 silk take a bite through the stomach, the anterior wall of the esophagus and the gastric wrap. The lowermost stitch does not include the esophageal wall. Five stitches are put in total.

Before ending the procedure the Maloney dilator is removed and a regular nasogastric tube is inserted. No external drains are left.

The nasogastric tube is removed on the first post-operative day; the integrity of the gastric wrap is checked by barium swallow and a liquid diet is prescribed for three weeks.

☐ PRESENT EXPERIENCE

PATIENTS

Between May 1991 and March 1998, 368 patients not responding to conservative treatment of GERD underwent laparoscopic Nissen fundoplication by our group. Twelve patients underwent concomitant highly selective vagotomy and 47 were operated on abroad. These latter two patients groups were not included in this study.

Amongst the remaining 309 patients (174 males and 135 females) aged 10-85 years (median 45 years), 15 patients presented stage V esophagitis (Barret) according to the modified Savary Millar staging : 4 had stage IV

esophagitis , 24 had stage III esophagitis, 253 had stage II esophagitis and 3 had stage I esophagitis .

The duration of the medical treatment ranged from 6 to 216 months (median 24 months).

The ASA (American Society of Anesthesiologists) operative risk scores were as follows : 288 ASA I, 17 ASA II, 4 ASA III. One hundred and twelve patients had had previous abdominal surgery.

RESULTS

The mean operative time was 60 minutes (39-300).

There were 5 intraoperative complications (1 gastric perforation treated by intracorporeal suture, 3 pleural perforations (only one needed treatment by chest tube) and 1 liver laceration treated by coagulation.

Three conversions to laparotomy were necessary : 1 because of a defective needle holder, 2 because of left liver lobe hypertrophy.

All patients were out of bed on the 1st postoperative day.

Bowel sounds returned between 0 and 7 days (median 1).

Isotopic liquid gastric emptying showed a median residual gastric content of 17 % after half an hour in the 77 patients (out of 100) studied where this gastric clearance was normal preoperatively (< 50%). The hospital stay was between 1 and 14 days (median 2).

There were 4 early complications : 2 pulmonary infections with a hospital stay of 10 days, and 2 re-operations : 1 case of wrap necrosis with peritonitis and 1 case of small bowel perforation. Transitory (1 month) dysphagia was noted in most patients.

Our mean follow-up is 46 months at the present time (range 1-81) :

- 6 patients presented dysphagia for more than 3 months after the procedure : 2 of them had to be reoperated because of intrathoracic migration with obstruction.

- 4 patients presented recurrent heartburn : 1 was reoperated and 3 received Omeprazole treatment.

- 5 patients presented with disabling epigastric pain which led to reoperation in 2 patients with intrathoracic migration and 2 patients with regurgitation.

- As mentioned before, the first ten patients were treated with a wrap maintained by a running suture held by clips. In 1 of the latter patients, suture and clip migrated inside the digestive lumen and were extracted by endoscopy.

- Two patients presented an incisional hernia on a trocar incision.

Gastroscopy was performed in 204 cases during the follow-up : the esophagus was normal in 189 cases, whereas stage I esophagitis was present in 11 cases stage II esophagitis in 3 cases and stage III esophagitis in one patient.

Pre- and postoperative manometry was performed in 63 patients. The median of the lower esophageal sphincter pressure was 10.22 mmHg (range 2.9 -30) preoperatively and 20.00 mmHg (range 8.76 - 40) postoperatively (p < 0.001). The length of the right pressure zone postoperatively was 3.1 cm ± 1 cm. In 25 patients the amplitude of the propulsive waves in the esophagus was measured preoperatively and postoperatively : the median of the amplitude preoperatively was 37.6 mmHg (range 14.6 - 93.8) and increased significantly to 51.1 mmHg postoperatively (p < 001).

A pH-metry was performed in 53 patients pre-and post-operatively : the mean global reflux time was 10 % (range 0 - 52) preoperatively and 1 % (range 0 - 38) postoperatively (p < 0.001). The number of reflux episodes of more than 5 minutes varied from 0 to 20 (median 4) preoperatively and from 0 to 16 (median 0) postoperatively (p < 0.001).

A barium swallow was performed in 160 patients out of 309 and showed 59 intrathoracic migrations (31 %).

The median of gastric clearance for solid foods in 21 patients examined was 44 % (range 8 - 80) after one hour preopratively and 43 % range 5 - 76) postoperatively (p< 0.01).

Two hundred and thirty-nine patients were interviewed with a follow-up of 46 months : 221 patients were Visick I + II, 13 patients were Visick III and presented with

SYMPTOMS FOLLOW-UP : MEDIAN 41 MONTHS, NBR PATIENTS : 239		
Visick I + II	asymptomatic	221
Visick III	dysphagia	3
	epigastric pain	3
	heartburn	6
	regurgitation	1
Visick IV	dysphagia	1
	epigastric pain	1
	heartburn	2
	atypic pain	1

Table I

dysphagia in 3 cases, epigastric pain in 3 cases, heartburn in 6 cases and regurgitation in 1 case.

Five patients needed reoperation, 1 because of dysphagia, 1 for epigastric pain, 1 fot atypic pain and 2 for heartburn recurrence.

☐ DISCUSSION

The feasibility of the procedure of laparoscopic Nissen fudoplication has been well documented in the literature [2, 6].

The principle of laparoscopic fundoplication is the same as the open procedure. However, the access route as well as the dissection technique itself and the construction of the wrap have completely changed. In classic laparotomy, visualizing the esophageal hiatus and the esophageal area is particularly difficult and demands forceful retraction of the costal edge. Obesity, which is frequently seen in these patients, worsens the problem of exposure.

Laparoscopy on the contrary provides perfect visual access. The use of a 30° angled scope further improves this visibility, especially for the posterior edge and the left side of the esophagus.

Exposure of the esophagogastric junction does not involve severance of the triangular ligament in the laparoscopic approach, since the left lobe of the liver need not be retracted towards the patient's right. Instead, the left liver lobe needs to be lifted entirely which can be problematic in case of cirrhosis.

Two-dimensional viewing may cause errors of judgement. The absence of tactile sensation and the use of sharp ancillary instruments can contribute to esophageal, pleural or stomach perforation. This latter risk is particularly real in case of a sizable hiatal hernia, in which reduction of the stomach as well as dissection of the different planes is difficult.

Three principles have to be respected in the dissection of the esophageal hiatus :

1) Dissection should be kept at a distance from the esophagus, especially at the beginning of the procedure because at that stage the esophagus is hardly visible and prone to be injured by sharp instruments. Dissection should be limited to the hiatal pillars.

2) No dissection should be undertaken except under excellent conditions of visual exposure.

3) Dissection should only close up to the esophagus or be performed inside the mediastinum after the esophagus has been perfectly identified.

A wide incision of the lesser omentum allows for good visualization of the hiatus before tackling the phreno-esophageal ligament. This latter ligament was not incised over its entire depth, in order to avoid endangering the integrity of the anterior esophageal wall, which is little visible at the beginning of the dissection. Incising the anterior peritoneal sheet permits esophageal mobilization

without really isolating the esophagus. Locating the left pillar is of the utmost importance before dissecting the meso-esophagus because it marks the boundary between the intraabdominal and the intramediastinal retroesophageal areas. Intramediastinal dissection should be resisted at the early stage of the procedure, so as to avoid injury of the posterior wall of the esophagus or the left pleura. In case of pleural injury, no serious effects did appear in our series despite a pneumo-peritoneum of 14 mmHg. Only the first patient presenting a pleural perforation required a chest tube.

During mobilization of the greater curvature, dissection can be performed more gently and more accurately than in open surgery. Thanks to the better visual exposure, safer dissection by the surgeon as well as retraction by the assistant can be achieved. In our experience as well as in the FDCL series there was no incidence of splenectomy. On the other hand, a poorly controlled short vessel can cause a local hematoma which spreads in the gastro-splenic ligament and obscures the view, which renders subsequent dissection more difficult. Mobilizing the greater curvature is a must, in order to avoid traction and torsion of the wrap. Torsion can cause dysphagia. In case the gastro-splenic ligament has not been dissected the anterior side of the fundus is passed behind the esophagus and folding of the wrap will occur. Moreover, in this latter technique wrap calibration is impossible. Indeed in laparoscopy the greater curvature cannot be manipulated by the surgeon's hands and the more precise prehension with the grasping forceps may create a twist of the wrap. The wrap should stay in place once positioned and fit like a suit without any traction whatsoever. This is probably the best guarantee for a floppy Nissen.

We disagree with certain authors and do perform a long (5 cm) wrap, which corresponds to a high pressure zone (20 mmHg) of a length of 3 cm (± 1 cm). Thanks to this wrap dysphagia was shorter than reported in the literature.

The lack of adhesions seen in laparoscopy places the wrap at risk of disruption more than after open surgery. This, to our opinion, makes it recommendable to anchor the wrap to the esophageal wall with at least 5 stitches in order to avoid the dreadful complication of a slipped Nissen.

The operating time is extremely important, because in laparoscopic surgery metabolic acidosis, decreased venous return, alteration of pulmonary compliance can occur. The length of the procedure depends on the surgeon's experience. The median operating time in the last 50 cases of our series was 80 minutes.

Postoperative pain appears to be less as compared to thez classic fundoplication procedure. The absence of a large incision and traction on the wound margins is probably responsible for this improvement. Similar improvements have been noted in other procedures. In our experience, all patients were out of bed and working on the first postoperative day, which obviously benefits the pulmonary function.

The median hospital stay was 2 days compared to the 10 days after an open Nissen fundoplication as seen in Europe. Since gastric liquid emptying seems normal on the first postoperative day, we pull out the nasogastric tube immediately after the procedure, which further decreases the patients discomfort.

The efficacy of the laparoscopic procedure was demonstrated by the reduction of the number of episodes at pH < 4 within 24 hours as well as the number of reflux episodes > 5 minutes. As demonstrated by endoscopy esophagitis was cured in 91 % of the cases, with disappearance of the reflux, regurgitation and heartburn.

The efficiency of the procedure is probably due to a significant increase of the lower esophageal sphincter pressure (from 10 mmHg to 20 mmHg in our series). Another contributing factor may be the improvement of gastric clearance as showed in our series. Moreover, esophageal propulsive waves are on the average stronger postoperatively. This latter improvement might be caused by the healing of esophagitis or by the necessity to surmount the lower esophageal sphincter pressure.

Thirty four percent of the patients presented an intrathoracic migration at barium swallow. This is in accordance with Watson's series and this condition is apparently much more frequent than in open surgery. In most cases, intrathoracic migration does not require reoperation since only 5 patients had to be reoperated.

Side-effects in our series consisted of gas-bloat and dysphagia, epigastric pain and diarrhea. Six cases of long lasting dysphagia were recorded. They were due to intrathoracic migration in three cases, to too tight a wrap in two cases and to esophageal dyskinesia in one case.
The feasibility of the laparoscopic Nissen procedure need no more be demonstrated and this technique appears to be safe if well-performed.
The postoperative discomfort and the mean hospital stay are reduced compared to the open procedure. However, despite the good control of reflux obtained in this study, some patients do have less perfect an outcome, and they will settle the place of antireflux surgery.

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SUMMARY

Between May 91 and March 98, 368 patients were treated by laparoscopic Nissen fundoplication (LNF). Three hundred and nine patients were included in this prospective study. Fifteen patients presented wiyh stage V esophagitis (Barrett); 4 had stage IV esophagitis ; 24 had stage III, 253 had stage II and 13 had stage I.

Five trocars were needed for the operation. After mobilization of the greater curvature, a fundic wrap of 5 cm was created and fixed on the oesophagus. The median operating time was 60 min (39 - 300). There were 5 intraoperative complications (1 gastric perforation, 3 pleural perforations, and 1 liver laceration treated by coagulation). Three conversions to laparotomy were necessary. There were 4 early complications : 2 pulmonary infections and two reoperations; 1 case of wrap necrosis with peritonitis, and 1 case of small bowel perforation.

Gastroscopy was performed in 204 cases. The esophagus was normal in 189 cases, 1 stage I esophagitis was present in 11 cases, stage II esophagitis in 3, stage III esophagitis in one.

The median lower esophageal sphincter pressure was 10 mmHg (2.9 - 30) preoperatively and 20 mmHg (9-40) postoperatively. The median reflux time was 10 % (0 - 65) preoperatively and 1 % (0 - 38) postoperatively.

Two hundred and nine patients were interviewed with a median follow-up of 46 months : 221 patients were Visick I + II, 13 Visick III and 5 patients needed reoperation : 2 for dysphagia, 2 for epigastric pain and 1 for heartburn recurrence.

From these results, we conclude that LNF seems to be an attractive alternative to long-term medical treatment.

RÉSUMÉ

Patients : Entre mai 91 et mars 98, 368 patients ont été traités consécutivement par une fundoplicature selon Nissen. La fundoplicature a été associée à une vagotomie supra sélective chez 12 patients et 47 patients ont été opérés à l'étranger. Ces 2 groupes de patients ne sont pas inclus dans cette étude. Parmi les 309 patients restant (174 hommes et 135 femmes) ,âgés de 10 à 85 ans (médiane 45 ans) porteurs d'un reflux gastro-œsophagien pathologique (RGOP) rebelle au traitement médical, comprenant au moins des anti-H2, depuis 6 à 216 mois (médiane 24 mois), 288 patients avaient un status ASA I, 17 patients un status ASA II, et 4 patients un status ASA III. Quinze patients, selon la classification de Savary Miller modifiée, présentaient une œsophagite grade V, 4 patients une œsophagite grade V, 24 patients une œsophagite grade III, 253 une œsophagite grade II. Parmi les 13 patients présentant une œsophagite grade I, 7 souffraient de pyrosis intenses, 3 présentaient une hernie hiatale volumineuse avec cardia béant, 3 présentaient une régurgitation accompagnée d'une symptomatologie respiratoire. Cent douze patients avaient des antécédents de chirurgie abdominale.

Méthode : L'intervention est réalisée à l'aide de cinq trocarts. Le ligament phréno-œsophagien et le petit épiploon sont incisés au crochet coagulateur. La dissection de la paroi postérieure de l'œsophage de droite à gauche jusqu'au-delà du pilier gauche est aisée grâce à une acuité visuelle remarquable. La section des vaisseaux courts de la grande courbure entre deux clips permet une mobilisation complète de la grosse tubérosité. La fundoplicature est réalisée sur une longueur d'au moins cinq centimètres par 5 points séparés à la soie 2/0.

Résultats : Il y a eu 5 complications peropératoires (2,39 %) (1 perforation gastrique, 3 perforations pleurales et 1 perforation hépatique) et 3 conversions en laparotomie (1,27 %). L'aspiration gastrique a été maintenue pendant 1 à 4 jours (médiane 1). Durant la période postopératoire, 2 patients ont présenté une broncho-pneumopathie, 1 patient une nécrose de la valve avec péritonite, 1 patient une perforation du grêle et 1 patient une migration complète de l'estomac dans le thorax accompagnée d'obstruction. La durée d'hospitalisation a été de 2 à 14 jours (médiane 2).

Le recul est actuellement de 46 mois. Deux cent quatre endoscopies ont été réalisées en postopératoire et ont montré une muqueuse normale dans 189 cas, une œsophagite grade I dans 11 cas, une œsophagite grade II dans 3 cas et une œsophagite grade III dans 1 cas. Une manométrie pré et postopératoire a été réalisée chez 63 patients. La médiane de la pression du sphincter inférieur de l'œsophage était de 10,22 mmHg (extrêmes 2,9 à 30) en préopératoire et de 20 mmHg (extrêmes 8,76 à 40) en postopératoire (P < 0,001). Deux cent trente-neuf patients ont été revus : 221 patients (92 %) étaient Visick 1+2, 13 patients (5,4 %) étaient Visick 3 : 3 cas de dysphagie, 3 cas de douleurs épigastriques, 6 cas de pyrosis et 1 cas des régurgitations. Cinq patients (2 %) ont dû être réopérés : 2 pour dysphagie, 2 pour des douleurs épigastriques, 1 pour douleurs atypiques et 1 pour une récidive de pyrosis. Deux patients ont présenté une éventration sur orifice de trocart.

Conclusion : La fundoplicature selon Nissen est réalisable par cœlio-vidéoscopie. La morbidité opératoire et la durée d'hospitalisation sont diminuées par la cœlioscopie. La fundoplicature augmente la pression du sphincter inférieur de l'œsophage, accélère la vidange gastrique et améliore la clearance œsophagienne. Toutes les réopérations sont dues à des migrations intrathoraciques. La fundoplicature selon Nissen par cœlioscopie est probablement une bonne alternative au traitement à l'Oméprazole au long cours.

MOTS CLÉS : **Reflux gastroesophagien, Nissen, Cœlioscopie.**

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Organisateurs : **Pr. Jean-Charles Le Huec, Pr. Jean-Louis Husson**

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