Comparative Study of Standard Fundoplication (Nissen and Toupet) vs. Modified Toupet Fundoplication for GERD Repair

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Abstract

Introduction: Failure following anti reflux surgery for GERD is reported from 3% to 30%, predominantly from reflux recurrence. Modified Fundoplication follows the principles of standard Nissen or Toupet Fundoplication. The difference is in the fixation of esophagogastric junction intraabdominally, technically with two retro esophageal Fundo-crural muscle stitches and a retroesophageal fundo-right crus stitch. No stitches in the esophagus are used.

Aim: A comparative study of modified fundoplication vs. standard (Toupet or Nissen) fundoplication was carried out.

Material and Methods: Patients with documented gastroesophageal reflux entered a prospective nonrandomized, feasibility study. Patients who underwent a different type of operation were comparable for age, gender, BMI, functional esophageal test before operation, number of hiatal stitches, and hiatal hernia presence at operation and hospitalization time.

Aim: To compare modified Toupet with standard Fundoplication with respect to functional postoperative results.

Results: A total of 70 patients, 42 female and 28 male patients, were operated on laparoscopically for GERD. Standard Fundoplication was carried out in 61 patients and modified Toupet in 9 patients. After 2-5 years of follow up 4(6%) patients from the standard Fundoplication group underwent re operation, among them one for reflux recurrence. No patients from the modified Toupet group needed repeat surgery. In the same postoperative period 37(69%) patients were without PPI from the standard group in comparison to 6(75%) patients from the modified Toupet group.

Conclusion: The modified Toupet Fundoplication is technically simpler to perform, is not inferior to standard Fundoplication and is feasible with promising results. The importance of GEJ fixation to crural muscles and plastics of Gastroesophageal flap valve is discussed.

Keywords: Gastroesophageal reflux; Antireflux surgery; Reflux recurrence; Modified Fundoplication

Introduction

In surgical therapy, despite clear operative principles, short and long-term failures following Fundoplication for GERD still remain a serious problem. Failure following Antireflux surgery for GERD is reported from 3% to 30%, predominantly from persistent or recurrent symptoms [1,2]. This variability may be explained by differences in the definition of failure from center to center.

Over the past 15 years, arrays of innovative surgical and endoscopic techniques have been developed for the treatment of Gastroesophageal Reflux Disease (GERD) [3]. The basic operative principles in GERD or Hiatus Hernia (HH) repair is Retro-esophageal cruroplasty and fixation of the stomach within the abdomen, namely posterior attachment of the Esophagogastric Junction (EGJ) [4-7]. The predominant operative approach for fixation at present appears to be laparoscopic circumferential Fundoplication, such as the Nissen or Toupet procedures [8].

Some years ago at the demanding operation of a patient with recurrent HH an improvisation of the Fundoplication was carried out as an exit from force. Only firm stitches of the Retroesophageal gastric fundus to the crural muscles were made without fundus –esophagus stitches. After a good
outcome, this simplified Fundoplication was taken into consideration. This is 180° fundoplication and follows Toupet principles with some modifications.

Two big bite stitches are done posteriorly between the gastric fundus in the retroesophageal position and crural muscles medially as caudally as possible followed by one stitch between the retroesophageal gastric fundus and right crus. No Esophago-fundoplicate stitches are made. The aim is solid fixation of the EGJ and gastric fundus extra abdominally and reinforcement of potential weak crural muscles with alive, vascularized tissue, namely the gastric fundus. Simple modification was later recognized as a potential and good approach for better laparoscopic fixation of EGJ intra abdominally with anti-reflux power in patients with GERD and HH.

**Aim:** The aim of the study was to compare the feasibility and late results of standard fundoplication namely Nissen or Toupet fundoplication with the modified Toupet procedure. Postoperative course and postoperative results 2-5 years after operation were registered. Postoperative reflux recurrence rate and dysphagia were the primary endpoints of the study.

**Material and Methods**

From January 2012 to January 2014, a prospective nonrandomized study of consecutive patients undergoing operations for GERD was made at a single tertiary institution. The indication for surgical treatment of GERD was documented Gastroesophageal reflux that was made at a single tertiary institution. The indication for surgical treatment of GERD was documented Gastroesophageal reflux that would create a fundoplication-like effect to control reflux and HH recurrences and PPI consumption after 2-4 years follow up. 2-5 years. PPI consumption, reflux recurrence, dysphagia and hiatus hernia advent were registered.

**Surgery**

Antireflux operation was performed following the standard technique: laparoscopy, resection of the hernia sack from the mediastinum but not from the abdomen, if present, elevation of the EGJ with retroesophageal window creation and cruroplasty with Teflon pledges. Then fundoplication followed: either the Nissen or Toupet fundoplication as the standard fundoplication or modified Toupet fundoplication. Modified Toupet was carried out using two firm big bite retroesophageal fundo-crural stitches, the first approximately 1 cm from the angle of Hiss on the anterior aspect of the gastric fundus to the crural muscle medially as caudally as possible where hiatus stitches were already in place. The second Toupet fundoplication. Modified Toupet was carried out using two firm big bite retroesophageal fundo-crural stitches, the first approximately 1 cm from the angle of Hiss on the anterior aspect of the gastric fundus to the crural muscle medially as caudally as possible where hiatus stitches were already in place. The second retroesophageal fundo-crural stitch was made about 2 cm cranially. The distance between the first and second stitches was the size of an open standard grasper jaw. The third big bite stitch was a regular Toupet retroesophageal fundus- right diaphragmatic crus stitch (Figure 1). The logic behind this method was that these stitches would create a fundoplication-like effect to control reflux and

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**Table 1: Patient's characteristics of two fundoplications.**

<table>
<thead>
<tr>
<th></th>
<th>Standard fundoplication group (Nissen or Toupet) (n=61)</th>
<th>Modified Toupet group (n=9)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female n</td>
<td>39</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Male n</td>
<td>22</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Age (years, mean, range)</td>
<td>48.5 (16-75)</td>
<td>46.7 (26-65)</td>
<td>0.37</td>
</tr>
<tr>
<td>BMI (kg/m²), mean, range</td>
<td>27.6 (17-37)</td>
<td>27.0 (19-33)</td>
<td>0.36</td>
</tr>
<tr>
<td>&quot;Number of stitches for hiatus closure (mean, range)</td>
<td>2.7 (1-4)</td>
<td>2.2 (2-3)</td>
<td></td>
</tr>
<tr>
<td>De Mesteer (mean, range)</td>
<td>25.1 (2-160)</td>
<td>17.3 (5-29)</td>
<td>0.15</td>
</tr>
<tr>
<td>Hospitalization time (days, mean, range)</td>
<td>2.1 (1-4)</td>
<td>2.6 (1-3)</td>
<td>0.39</td>
</tr>
<tr>
<td>Hiatal hernia at operation n (%)</td>
<td>30 (50%)</td>
<td>3 (33%)</td>
<td>0.37</td>
</tr>
</tbody>
</table>

**Table 2: HH recurrences and PPI consumption after 2-4 years follow up.**

<table>
<thead>
<tr>
<th></th>
<th>Standard fundoplication (Nissen or Toupet) (n=61)</th>
<th>Modified Toupet (n=9)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiologic hiatus hernia n (%)</td>
<td>8 (13%)</td>
<td>1 (11%)</td>
<td></td>
</tr>
<tr>
<td>Repeat operation</td>
<td>4 (2x dysphagia, 1x reflux, 1x hiatus hernia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPI consumption</td>
<td>no 37 (69%)</td>
<td>6 (75%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>regularly 9 (17%)</td>
<td>1 (12.5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>on demand 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>unknown 7</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
intra abdominal EGJ fixation, obliteration of the retroesophageal or retrofundal space, stable tamponation of the hiatus region and possible adhesion formation of the crural region and reinforcement of the hiatal muscle with vital tissue, namely the gastric fundus.

Figures 2 and 3 show a schematic representation of the Toupet and modified Toupet procedures. All operations were performed without bougie, without dissection of the gastric short vessels, without the Collis procedure and without mesh. All patients were operated on under the same conditions and by the same surgical team, using the same brand of laparoscopic instruments, with an abdominal CO₂ insufflation pressure of 15 mmHg. Modified fundoplication was made by one surgeon and was not selected randomly.

Statistics

Data were analyzed using the Statistical Package for Social Sciences version 16.0 for Windows (SPSS, Chicago, IL) software. Categorical variables were tested for associations using a χ² test. The descriptive data were expressed as a mean and range. For the normally distributed variables, t-test was used. The Sperm and Rho association test was used to measure the relationship between two variables. A p-value of <0.05 was considered statistically significant.

Results

A total of 70 patients participated in the study, of which 42 were female and 28 were male. Standard (Toupet or Nissen) fundoplication was carried out in 61 patients and the modified Toupet in 9 patients. All patients were operated upon laparoscopically. In the standard fundoplication and modified Toupet the mean age of patients was 48.5 and 46.7 years, mean BMI was 27.6 and 27.0 kg/m², mean number of stitches was 2.7 and 2.2, mean hospitalization time was 2.1 and 2.6 days and mean DeMeester score was 25.1 and 17.3 respectively. At operation hiatal hernia or at list dilated hiatus was registered in 30 and 3 patients in the standard and modified Toupet groups respectively (Table 1). The differences were not significant.

After 2-5 years of follow up problems were registered and are shown in Table 2. Four patients from the standard group needed reoperation: dysphagia - two patients, reflux - one patient and symptomatic hiatus hernia - one patient. In the modified group no patients needed reoperation. In the same period in the standard group 9 patients took a PPI regularly and 7 on demand (31%) in comparison with 1 patient who took a PPI regularly and 1 who took a PPI on demand (25%) in modified the Toupet group. These differences were not significant.

Discussion

After the first description of the 360° esophagogastric fundoplication in 1956, the Nissen fundoplication surgery armamentarium has changed little until now. All is about fundoplication to augment the Lower Esophageal Sphincter (LES). Some modifications are described with the intention to improve upon postoperative complications, late results, cost of the operation and postoperative quality of life. The operation should be safe for the patient, cost-effective and complications free [9-13].

According to the literature the failure rate of open or laparoscopic approaches ranges from 3% to 30% [1,2]. In our study failure that needed reoperation was registered in 4(6%) patients, two for dysphagia, one for severe reflux and gas bloat and one for hiatus hernia. All re-operated patients were from the standard fundoplication group (7%). No patients in the modified Toupet group needed reoperation.

From the patients that presented for follow-up 2-5 years after operation we found that 37(69%) patients from the standard fundoplication group did not require antireflux medication in comparison to 6(75%) patients in the modified Toupet group. It was a short period as recurrences can happen later. According to some reports more than 5 years after the surgery, only 38% of patients were without anti-reflux medications regularly [14]. Recent reports
have criticized the Toupet procedure as having a higher long-term failure rate than the Nissen approach, especially for patients with severe GERD forms [15]. On the other hand Toupet fundoplication should be considered in redo interventions for patients who initially underwent Nissen fundoplication [16].

Some positive effect on reflux control of the modified Toupet can be speculated on the basis of the Gastroesophageal Flap Valve (GEFV) function. The exact means by which fundoplication controls gastroesophageal reflux is still a matter of debate. It is often assumed that reflux is controlled by increased resting Lower Esophageal Sphincter (LES) pressure and intra-abdominal length of the esophagus. However, there are several studies that show that the resting pressure does not always increase after fundoplication and that in the majority of such cases reflux is perfectly controlled. Resting LES pressure may even decrease as the intra-abdominal length of the esophagus [17]. GEFV was established as an important component in the anti-reflux barrier [18]. Three distinct anatomic structures, the clasp and sling muscle fibers, crural diaphragm and LES were identified to form the antireflux barrier [19,20]. Miller et al. [21] report that the basic principle of the most usual antireflux surgeries e.g. Nissen and Toupet is retroesophageal fundus extra position. The angle of his is changed and the gastric oblique muscle of the fundus is strained. It was shown that Nissen fundoplication prevents reflux by artificially bolstering the area of the defective gastric sling fiber/clasp fiber complex and is an important factor in generating the antireflux barrier [22]. Later on it was discovered that the gastric sling fiber/clasp fiber complex is not present in patients with GERD, suggesting that GERD may be a pathophysiologic defect within the gastric clasp/sling smooth muscle fiber complex [23]. The modified Toupet technique, like the standard technique, involves fundus retroesophageal extra position and has the potential to influence GEFV. Hill repair is the only known repair done on firm anchoring of EGJ within the abdominal cavity and accentuating the flap valve [24]. We believe that fundo-crural stitches in the modified Toupet have the same power. Further studies are needed to confirm this statement. The angel of He was pointed to as important objective in the WTP procedure [13].

Two patients from the standard fundoplication group required reoperation for persistent dysphagia. The reason is likely that bougie was not used. Sages recommend the use of an esophageal dilator but use should be weighed against the risk of esophageal injury [25]. In the past we performed bougie but after two consecutive intraoperative perforations we decided to stop using the bouginage. We believe that the reasons behind the problem involved the organization of the team, as there was a high turnover of members in the team responsible for bougie replacement in our tertiary center. We routinely used an esophageal dilator twice, first for hiatus closure and second for fundoplication formation with twice the risk for perforation. Today we prefer to use the Toupet operation, short floppy Nissen and dissent hiatus opening around the esophagus.

One patient underwent reoperation for hernia recurrence from the standard fundoplication group. This patient had a hiatus hernia intraoperatively and a sliding hernia on a barium study preoperatively.

**Conclusion**

To summarize, some advantages of the modified Toupet 180° fundoplication are no esophago-fundoplicate sutures, no intraoperative bouginage, no short gastric artery resection, no possibility of sleep Nissen or malposition of the wrap. It is also technically simpler to perform. The basic idea is to fix ERJ intra abdominally, to obliterate retroesophageal and retrofundal space, to tamponate crural region with fundus, to advance adhesion formation in the hiatus region, to reinforce hiatal muscle by vital tissue and to support the antireflux barrier affecting GEFV. It appears to be a promising alternative and affair compromise to other well-established antireflux operations. This study shows that the modified Toupet fundoplication is not inferior to standard fundoplication. The modification is safe for the patient. Further studies are needed for objectivation of these speculations.

The limitations of the study include the small sample size of comparable patients, non-randomized study, single surgeon experience and short postoperative follow up.

**References**

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