Laparoscopic Heller Cardiomyotomy and Modified Dor Fundoplication for the Treatment of Achalasia of the Cardia

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Abstract

Objective: The aim of this study is to assess the feasibility and effectiveness of laparoscopic Heller's cardiomyotomy and modified Dor fundoplication for the treatment of achalasia of the cardia.

Background: Achalasia of the cardia is the second most common motility disorder of the esophagus, with major impact on the life style of the affected patients.

The goal of the treatment is to relieve functional out flow obstruction caused by loss of relaxation and compliance of LES.

Endoscopic management is proved to be effective and safe modality.

Patients and Methods: This is a retrospective study which was conducted on 10 patients with achalasia admitted in Kasr Al-Aini Surgical Department from January 2003 to January 2005.

Preoperative work up included, history taking and proper physical examination with pre operative investigations including, upper endoscopy, barium swallow and esophageal manometry.

Patients were subjected to laparoscopic Heller's cardiomyotomy and modified Dor Fundoplication.

All operative procedures were recorded and post operative results were tabulated and statistically analyzed to obtain significant data.

Results: The procedure was completed laparoscopically in all patients and post operative follow up showed improvement of symptoms in all patients, without development of gastroesophageal reflux and with comparable results to previous studies, regarding percentages of symptoms improvement, post operative hospital stay and incidence of accepted minor complications.

Conclusion: Our study demonstrated that laparoscopic Heller's cardiomyotomy with modified Dor fundoplication is a feasible and effective treatment for achalasia having the advantages of minimal access surgery.

Key Words: Achalasia – Heller cardiomyotomy – Dor fundoplication.

Introduction

ACHALASIA is perhaps the most common esophageal motility disorder, with an incidence of 0.4 to 1.1 per 100,000 population and a prevalence of 6 per 100,000 population per year [1].

In this disorder there is aperistalsis of the LES to completely relax after swallowing. This results in progressive, obstructive-like symptoms for solids and eventually even for liquids. There is also gradual dilation of the esophagus, with large quantities of food particles often trapped within the thoracic esophagus.

The first reported case of achalasia may have been as long ago as 1672. In that year, Sir Thomas Willis described an individual with a massively dilated esophagus who was successfully treated by dilation with a whale bone [1].

Soon after the reported success of laparoscopic antireflux surgery, many clinicians began applying minimally invasive approaches to the treatment of achalasia. As expected, nearly all of the controversies associated with conventional surgery have again been debated by those clinicians advocating laparoscopic or thoracoscopic surgery. At first, many clinicians advocated the thoracoscopic approach because of the easier visualization of the esophagus and the perception that a concomitant antireflux procedure was not necessary [2].
Although short esophageal myotomy (<8.0 cm) is the usual treatment for achalasia, various modifications have been reported in both the open and minimally invasive literature [3], these include (a) Division of the LES musculature with sparing of the esophagogastric junction, (b) Division of the lower 5.0 cm of esophageal musculature and continuing through the gastroesophageal junction and onto the proximal 1.0 cm of the stomach, (c) Division of the lower 5.0 cm of esophageal musculature and continuing for several centimeters onto the gastric cardia, and (d) Long esophageal (>8.0 cm) myotomy continuing distally onto the proximal gastric cardia [4].

Although myotomy significantly reduces LES pressure, it does not necessarily eliminate the associated high pressure zone at the gastroesophageal junction necessary to prevent reflux in all patients [3].

The decision whether to combine an antireflux procedure with a myotomy has been one of the most controversial aspects concerning the surgical treatment of achalasia for several decades. The reasons for this controversy are many: The small number of patients available at any one institution for study, surgery performed at different stages of the disease, variations in technique among different surgeons and the inconsistent appearance of gastroesophageal reflux following myotomy.

In North America, and especially in Europe, the Dor anterior fundoplication has been very popular with many minimally invasive surgeons because it was fairly easy to perform and had the advantage of covering the exposed esophageal mucosa with the mobilized gastric cardia [5].

As mentioned previously, minimally invasive surgical techniques have had a profound impact on the treatment of achalasia over the past decade, and several modifications of both the myotomy and the concomitant antireflux procedure are currently advocated. Interestingly, nearly all of the more contemporary published articles report a 90% or greater success in relieving dysphagia. Therefore, it appears that there are only minor differences in outcomes among these various techniques.

Unfortunately, it will be some time before data are available documenting long-term results of these various minimally invasive approaches to achalasia. Therefore, until more convincing information becomes available it will be up to the individual surgeon to decide which approach he or she believes will offer the best results and is appropriate for their level of technical expertise.

Material and Methods

Our study which was conducted on 10 patients with achalasia presented to Kasr El Eini Hospital during the time period of the study (24 months).

After a comprehensive preoperative evaluation including: Careful history taking, proper physical examination, and appropriate investigations, patients were scheduled for laparoscopic esophago-cardiomyotomy with modified Dor anterior fundoplication as a prophylactic method to prevent postoperative gastroesophageal reflux.

This study aimed at assessing feasibility and effectiveness of the technique. Patients were followed-up for a period of 6-18 months postoperatively by a symptom questionnaire about dysphagia, heart burn, regurgitation, and chest pain.

Patients were subjected to the following:

- Preoperative work up:

History and physical examination to assess:
- Dysphagia.
- Heart burn.
- Regurgitation.
- Atypical symptoms: e.g. chest pain, chest symptoms caused by chest infections.
- Fitness for surgery.

Preoperative investigations including:
- Routine laboratory investigations.
- Upper endoscopy.
- Barium swallow.
- Esophageal manometry.

N.B.: Correction of anemia, electrolytes and acid-base imbalance (if present) was also a major concern.

- Operative work up:

Patient preparation and room set up:

Patients will be placed in a modified lithotomy position with the surgeon standing between the legs in a 25 to 35 degrees reverse Trendelenberg position, with the video monitors near the head of the operating table.

Intermittent compression stockings are applied as a prophylaxis against deep venous thrombosis. Patients are prepared and draped as done routinely.
A flexible endoscope is introduced together with a nasogastric tube into the distal esophagus and stomach to empty from any gas or fluid, and the endoscope can be used later to transilluminate important anatomic landmarks such as the distal esophagus and esophagogastric junction.

A single dose of a prophylactic broad spectrum antibiotic such as cephalosporins was given prior to the first incision.

Operative technique:

The procedure starts with creation of pneumoperitoneum though a 1-2mm incision done though the upper fold of the umbilicus and then percutaneously a Veress needle is inserted into the peritoneal cavity, the abdomen is fully insufflated with CO2 with a maximum pressure of 15mm Hg.

A 12mm incision is then made in the upper midline at the junction of the lower 1/3 and middle 1/3 of the distance between the xyphoid process and the umbilicus. A 10mm port is then inserted into the peritoneal cavity, a 10mm laparoscope with attached video camera is then inserted and the abdominal cavity is explored.

An angled scope (30 to 45 degrees) is used because of the great versatility in viewing the upper abdominal structures.

The remaining 4 cannulas are inserted under vision as follows:

- A 10mm port is inserted in the midline about 2cm below the xyphoid process though which a fan shaped liver retractor is applied to retract the left lobe of the liver.
- Two 5mm ports are inserted in the right and left upper abdomen in the midclavicular plane about 5cm from the costal margin (These sites are individualized according to the body build of the patient), laparoscopic instruments introduced through the patient’s upper right cannula are maneuvered under the falciform ligament to reach the hiatus, these two upper abdominal cannulas are used for the majority of the operative dissection and suturing.

N.B.: As we will use two 5mm ports for dissection and suturing, the needle is introduced through one of the 10mm ports inserted before.

- A 5mm port is inserted in the left flank (At the level of the umbilicus) and is used for retraction or insertion of suction-aspiration device.

N.B.: Sites of placement of the ports are illustrated in (Fig. 1).

The procedure starts by exposing the hiatus by applying traction on the fundus of the stomach usingatraumatic grasping forceps through the left flank port, which exposes the gastrohepatic ligament and its thin transparent part, the pars flacida, which is incised to expose the right crus (Fig. 2). The peritoneum of the phrenoesophageal membrane is then opened using the ultrasonic dissector (Harmonic scalpel) to expose the right sling and the distal esophagus. This step can be facilitated by transilluminating the distal esophagus using the flexible endoscope.

Dissection is advanced to the right side exposing the right vagus, and to the left side is facilitated by reversing the traction on the fundus of the stomach to the opposite side (The right side).

At this stage the anterior surface of the distal esophagus is exposed extending to its right and left limits, and the left vagus should be also identified, usually adherent to the anterior surface (Fig. 3) slightly to the left. Dissection is performed by blunt dissection or by the ultrasonic dissector (Harmonic scalpel) to minimize bleeding.

Dissection is then continued cephalad to mobilize the distal esophagus till the dilated part of the esophagus is visualized, exposing at least the distal 6cm of the esophagus, which is facilitated by downward traction on the esophagogastric junction using the left flank instrument by the assistant. By these steps a large portion of the thoracic esophagus can be visualized through the hiatus.

Dissection is done mostly by the ultrasonic dissector (Harmonic scalpel) with careful identification of the pleura to avoid its injury.
At this stage we prepare for esophageal myotomy at the anterior surface of the esophagus which is guided by the site of the anterior vagus starting just above the esophagogastric junction.

The ultrasonic dissector (Harmonic scalpel) is also used for the myotomy which starts by elevating the outer musculature of the esophagus and dividing it using the Harmonic scalpel (Fig. 4). This step is aided by the endoscopy in the distal esophagus helping the surgeon to stop division of the muscles short of the mucosa (Fig. 5). This precaution is further aided by insufflating air by the endoscope to distend the esophageal mucosa to detect any mucosal perforation after irrigating the operative field with saline. Minimal bleeding is usually encountered and is controlled by the Harmonic scalpel.

The myotomy is continued proximally for a distance of 6cm using a combination of blunt and sharp dissection. The myotomy is then continued distally though the gastroesophageal junction and into the musculature of the gastric cardia which is usually more adherent to the mucosa than the esophageal musculature. Again this is aided by the endoscope which can locate the esophagogastric junction accurately.

This distal part of the myotomy is continued for about 2cm on the gastric cardia (Fig. 6).

Again integrity of the mucosa is checked by distending the distal esophagus and stomach with air by the endoscope and irrigating the operative field with saline to detect any bubbling showing the site of full thickness mucosal perforation which should be dealt with. Hemostasis is checked and then we proceed to the next step which is the modified Dor anterior findoplication.

The fundoplication starts by checking the integrity of the hiatus which if found to be wide, it should be approximated by interrupted non absorbable sutures so that the esophagus is occupying 1/3 the circumference of the hiatus to avoid tight approximation which may result in dysphagia.

The modified Dor fundoplication is constructed by wrapping the anterior wall of the gastric fundus over the myotomy (Fig. 7) with 2-3 interrupted non absorbable sutures (Silk 3/0) or (Ethibond 3/0), fixing the fundus of the stomach to the right side of the esophagus.

The procedure is ended by checking again the hemosatsis and the integrity of the esophageal mucosa. A tube drain is left at the site of the hiatus to monitor any postoperative complications as bleeding or evidence of perforation.

- Intraoperative monitoring:

During the procedure the following points were observed:

- Intraoperative complications such as,
  - Bleeding.
  - Esophageal mucosal perforation.
  - Pleural injury.
  - Completion of the procedure laparoscopically (rate of conversion).

- Operative time.

- Post operative work up:

Patients are maintained on intravenous fluids and nothing is allowed by the oral route for 48 hours and on the third day, a gastrografin swallow is performed to check integrity of the mucosa and to ensure free passage of the dye to the stomach.

Patients then start liquid diet which should be maintained for 2-3 weeks postoperatively. Medications in the pill form which may cause esophagitis should also be avoided. Three weeks postoperatively, soft liquid diet is allowed which will be advanced gradually to regular diet.

Post operative follow-up:

During the follow-up period the following points were assessed:

- Immediate post operative complications such as,
  A- Bleeding.
  B- Surgical emphysema.
  C- Mucosal perforation.

- Post operative hospital stay.

- Late post operative complications as,
  A- Persistence of dysphagia.
  B- Development of gastroesophageal reflux.

Patients were followed-up for a period of 6-18 months postoperatively in the form of weekly visits during the first month, every two weeks during the second month, and monthly visits during the remaining period. All the above will be tabulated and statistically analyzed to obtain significant data.
Fig. (2): Exposure of the right crus after incision of the gastrohepatic ligament.

Fig. (3): Identification of the left vagus on the anterior surface of the esophagus.

Fig. (4): Myotomy is done by elevating the esophageal musculature and dividing it using the Harmonic scalpel.

Fig. (5): Division of the esophageal musculature short of the mucosa.

Fig. (6): View at the end of esophagocardio-myotomy.

Fig. (7): The modified Dor anterior fundoplication is constructed by wrapping the gastric fundus over the myotomy.

**Results**

This study was conducted on ten patients with primary achalasia and the following results were obtained.

- **Preoperative workup:**
  
  **Routine laboratory investigations:**
  
  There was no abnormality detected in our patients that might contraindicate general anesthesia apart from dehydration and electrolyte disturbance, which was encountered in 2 patients and corrected by intravenous fluid therapy.

  **History and examination:**
  
  Patients were questioned about gastrointestinal symptoms and they mainly complained of the following symptoms:
- Dysphagia.
- Heartburn.
- Regurgitation.
- Atypical symptoms, e.g. chest symptoms in the form of cough and expectoration.

**Dysphagia:**
Patients complained of dysphagia which was manifested to liquids and/or solids. The following table (Table 1) demonstrates number of patients experienced dysphagia to solids or liquids at time of history taking.

**Heartburn:**
Heartburn was experienced by almost all patients. These results are shown in (Table 2).

**Regurgitation:**
The following table (Table 3) demonstrates number of patients experienced regurgitation.

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Regurgitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
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<tr>
<td>2</td>
<td>+</td>
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<tr>
<td>3</td>
<td>+</td>
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<tr>
<td>4</td>
<td>–</td>
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<tr>
<td>5</td>
<td>–</td>
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<tr>
<td>6</td>
<td>+</td>
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<tr>
<td>7</td>
<td>+</td>
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<tr>
<td>8</td>
<td>+</td>
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<tr>
<td>9</td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>+</td>
</tr>
</tbody>
</table>

Regurgitation was experienced by 60% of cases.

**Atypical symptoms:**
These include: Chest pain, chest symptoms in the form of cough and expectoration up to chocking episodes which are caused by aspiration. Weight loss was also encountered in some patients. Occurrence of these symptoms is illustrated in Table (4).

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Chest pain</th>
<th>Chest symptoms</th>
<th>Weight loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>7</td>
<td>–</td>
<td>+</td>
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<td>8</td>
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<td>+</td>
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<td>9</td>
<td>–</td>
<td>–</td>
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<tr>
<td>10</td>
<td>–</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Chest pain 40%. Chest symptoms 60%. Weight loss 50%.

**Investigations:**

**Endoscopy:**
The following findings were investigated during endoscopic examination:
- Esophageal dilatation.
- Esophagitis.
- Associated pathology (as a cause of pseudoachalasia).
- Associated hiatus hernia. These findings are illustrated in Table (5).

During endoscopic examination of our patients 2 suspicious lesions in the distal part of the esophagus were encountered in 2 patients. Endoscopic biopsies were taken and sent for pathological examination which revealed non-specific esophagitis in both biopsies.
Table (5): Endoscopic findings found in the patients.

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Esophageal dilatation</th>
<th>Associated pathology</th>
<th>Hiatus hernia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+++</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>++</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>+++</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>–</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>+++</td>
<td>–</td>
<td>–</td>
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<td>7</td>
<td>++</td>
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<td>8</td>
<td>–</td>
<td>+</td>
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<tr>
<td>9</td>
<td>++</td>
<td>+</td>
<td>–</td>
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<tr>
<td>10</td>
<td>++</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

(–) No dilatation 20%. (++) Moderate dilatation 30%. (+) Mild dilatation 20%. (+++) Severe dilatation 30%.

Contrast radiology (Barium swallow):
The following findings were investigated in barium swallow films:
- Esophageal dilatation.
- Tapering of the lower end of the esophagus (Bird’s beak appearance).
- Associated pathology (as a cause of pseudoachalasia).

These findings are illustrated in Table (6).

Table (6): Contrast radiology findings in the patients.

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Body peristalsis</th>
<th>LES pressure</th>
<th>Response to swallowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aperistalsis</td>
<td>50mm Hg</td>
<td>Failure of relaxation</td>
</tr>
<tr>
<td>2</td>
<td>Nearly absent</td>
<td>44mm Hg</td>
<td>Failure of relaxation</td>
</tr>
<tr>
<td>3</td>
<td>Nearly absent</td>
<td>32mm Hg</td>
<td>Incomplete relaxation</td>
</tr>
<tr>
<td>4</td>
<td>Aperistalsis</td>
<td>45mm Hg</td>
<td>Failure of relaxation</td>
</tr>
<tr>
<td>5</td>
<td>Nearly absent</td>
<td>29mm Hg</td>
<td>Incomplete relaxation</td>
</tr>
<tr>
<td>6</td>
<td>Aperistalsis</td>
<td>40mm Hg</td>
<td>Failure of relaxation</td>
</tr>
<tr>
<td>7</td>
<td>Aperistalsis</td>
<td>33mm Hg</td>
<td>Incomplete relaxation</td>
</tr>
<tr>
<td>8</td>
<td>Nearly absent</td>
<td>31mm Hg</td>
<td>Incomplete relaxation</td>
</tr>
<tr>
<td>9</td>
<td>Aperistalsis</td>
<td>38mm Hg</td>
<td>Failure of relaxation</td>
</tr>
<tr>
<td>10</td>
<td>Aperistalsis</td>
<td>41mm Hg</td>
<td>Failure of relaxation</td>
</tr>
</tbody>
</table>

Aperistalsis 60%. Nearly absent 40%. LES pressure elevated in 100%.
Failure of relaxation of LES on response to swallowing 60%.
Incomplete of relaxation of LES on response to swallowing 40%.

Manometry:
Manometric studies were performed for the patients and the following findings were assessed:
- Esophageal body motility.
- Lower esophageal sphincter pressure.
- Response of the lower esophageal sphincter to swallowing.

The previous findings are illustrated in Table (7).

Table (7): Manometric findings in the patients.

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Body peristalsis</th>
<th>LES pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aperistalsis</td>
<td>50mm Hg</td>
</tr>
<tr>
<td>2</td>
<td>Nearly absent</td>
<td>44mm Hg</td>
</tr>
<tr>
<td>3</td>
<td>Nearly absent</td>
<td>32mm Hg</td>
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<tr>
<td>4</td>
<td>Aperistalsis</td>
<td>45mm Hg</td>
</tr>
<tr>
<td>5</td>
<td>Nearly absent</td>
<td>29mm Hg</td>
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<tr>
<td>6</td>
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<td>40mm Hg</td>
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<td>7</td>
<td>Aperistalsis</td>
<td>33mm Hg</td>
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<td>8</td>
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<td>38mm Hg</td>
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<tr>
<td>10</td>
<td>Aperistalsis</td>
<td>41mm Hg</td>
</tr>
</tbody>
</table>

Aperistalsis 60%. Nearly absent 40%. LES pressure elevated in 100%.
Failure of relaxation of LES on response to swallowing 60%.
Incomplete of relaxation of LES on response to swallowing 40%.

- Postoperative workup:

Immediate postoperative complications:
Two of our patients developed surgical and mediastinal emphysema which were managed conservatively and resolved completely within 2 days.

Postoperative management:
Oral fluids were allowed after 48 hours following a gastrograffin swallow which was done for all patients to detect leak from mucosal perforation. There was as an antireflux measure. The procedure was completed Laparoscopically in all patients.

The myotomy extended for 8cm, 6cm on the distal esophagus and 2cm on the gastric cardia. This was guided by endoscopic visualization of the distal esophagus and stomach to ensure adequate length of the myotomy and absence of mucosal perforation. A drain was left at the site of the hiatus to monitor post operative leak or bleeding.

The procedure last for 50-70 minutes with mean value of 60 minutes. In Table (8), the operative time for each patient is illustrated.

Table (8): The operative time for the patients.

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Time of the procedure</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>70 min.</td>
</tr>
<tr>
<td>2</td>
<td>70 min.</td>
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<tr>
<td>3</td>
<td>65 min.</td>
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<td>4</td>
<td>60 min.</td>
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<tr>
<td>5</td>
<td>55 min.</td>
</tr>
<tr>
<td>6</td>
<td>60 min.</td>
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<tr>
<td>7</td>
<td>65 min.</td>
</tr>
<tr>
<td>8</td>
<td>50 min.</td>
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<tr>
<td>9</td>
<td>50 min.</td>
</tr>
<tr>
<td>10</td>
<td>55 min.</td>
</tr>
<tr>
<td>Mean time</td>
<td>60 min.</td>
</tr>
</tbody>
</table>
no radiological evidence of mucosal perforation in our patients.

Following this investigation, oral fluids were started and continued during hospital stay. Patients were instructed to continue on liquid diet for 2 weeks and other instructions concerning diet will be continued during the outpatient follow-up.

The hospital stay period ranged from 3-6 days with calculated mean value 4.3 days. In Table (9) the hospital stay period for each patient is illustrated.

**Outpatient follow-up:**

The patients were asked to visit the outpatient clinic for follow-up weekly during the first month, every 2 weeks during the second month and then monthly during the next months.

During this follow-up the patients were instructed to continue on liquid diet for 2 weeks after which semisolid diet was allowed and progressed to regular, solid diet after 3 weeks.

Follow-up of the patients revealed that dysphagia improved in all patients and no gastroesophageal reflux symptoms were encountered during the period of follow-up which was 6-18 months Table (10).

<table>
<thead>
<tr>
<th>Table (9): Hospital stays periods.</th>
</tr>
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<tbody>
<tr>
<td>Patient number</td>
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<tr>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
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<td>3</td>
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<td>8</td>
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<tr>
<td>9</td>
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<tr>
<td>10</td>
</tr>
<tr>
<td><strong>Mean value</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table (10): Postoperative follow-up.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement of dysphagia</td>
</tr>
<tr>
<td>100%</td>
</tr>
</tbody>
</table>

**Discussion**

Second only to reflux disease, achalasia is the most common functional disorder of the esophagus to require surgical intervention. The goal of treatment is to relieve functional outflow obstruction caused by loss of relaxation and compliance of the LES. This required disrupting the LES muscle. When performed adequately (reducing LES pressure to <10mm Hg), and done early in the course of the disease, LES myotomy results in symptomatic improvement with occasional return of esophageal peristalsis [6].

Reduction in LES resistance can be accomplished intraluminally by hydrostatic balloon dilatation with rupture of the sphincter muscle, or by surgical myotomy that cuts the sphincter. The difference between these two methods appears to be greater likelihood of reducing sphincter pressure to less than 10mmHg by surgical myotomy as compared to hydrostatic balloon dilatation [7].

In performing a surgical myotomy of the LES, there are four important principles: (1) Adequate distal myotomy to reduce outflow obstruction, (2) Prevention of postoperative reflux, (3) Choosing the antireflux technique that provides minimal dissection of the cardia, and (4) Preventing rehealing of the myotomy site.

In the past the drawback of surgical myotomy was the need for open procedure. With the advent of minimal access surgery the myotomy can be performed laparoscopically.

In our study patients were assessed preoperatively by symptom analysis revealing that dysphagia was the main presenting symptom and it was to both liquids and solids demonstrating that the orthodox teaching, which states that patient with achalasia experience dysphagia to liquids and not to solids, is not the fact; actually patients learn to assume certain maneuvers to overcome dysphagia by swallowing more fluids to overcome bolus obstruction. Other studies showed that dysphagia to solids was encountered in all patients and the majority of the patients (85%) experienced dysphagia to liquids [8].

Regurgitation occurred in 60% of patients and it was noticed to be related to long duration and severity of the condition occurring in patients with long history. These results are similar to the previous studies which recorded that regurgitation occurred in 60-90% of patients [8].

Heart burn occurred in 80% of patients and may be related to retention esophagitis or associated reflux. This symptom was experienced by 55% of patients in other studies [9].

Atypical symptoms in the form of chest pain or pulmonary symptoms were encountered. Forty percent of patients experienced chest pain and sixty percent complained of chest symptoms.

Chest pain may be due to associated motility abnormality as simultaneous contractions or attacks
of diffuse esophageal spasm, which is the usual combination of all esophageal motility disorders or simply due to associated esophagitis [10].

Other studies described chest pain and heart burn not responding to either nitrates or antacids in one half of the patients [11].

Sixty percent of patients experienced chest symptoms in the form of cough, choking and aspiration pneumonitis, which was noticed in severe cases with gross dilatation of the esophagus and marked aperistalsis of the body of the esophagus.

Upper endoscopy revealed dilatation of the esophagus in 80% of patients with 30% having hugely dilated esophagus, the so called sigmoid esophagus, with 30% having moderately dilated esophagus and 20% having mildly dilated esophagus; these findings may be related to the severity and duration of the disease.

Markedly dilated esophagus is a strong indication for surgical intervention without any attempt at prior dilatation which carries a high risk of perforation [12].

Results of barium swallow were similar to that of upper endoscopy revealing sigmoid esophagus in 30% of cases and moderate dilatation in 30%. The most important finding was the absence of any associated pathology which may cause pseudoachalasia, such as esophageal carcinoma in which the stricture shows the characteristic shouldering. Approximately 7% of patients develop squamous cell carcinoma after 15-25 years [13].

Esophageal manometry revealed aperistalsis of the body in 60% of patients with nearly absent peristalsis in 40% of patients; these are important findings which determine the degree of the needed wrap, that should not be complete as it may act as an outflow obstructing agent. For this reason we have chosen the modified Dor anterior fundoplication as a prophylaxis against postoperative reflux.

LES pressure was markedly elevated in all patients; presuming that division of the gastroesophageal musculature is a major component of the operative procedure. This important finding was encountered in 60% of patients in a previous study [8], and in 100% of patients in another one [14].

The procedure was completed laparoscopically in all patients denoting that laparoscopic esophagocardiomycotomy is a feasible and safe technique. Myotomy was extended to abut 8cm, 6cm on the esophagus usually till the dilated part is reached and 2cm through the gastroesophageal junction; this was markedly facilitated by the simultaneous use of intraoperative endoscopy which determines the extent of myotomy and accurately localizes the gastroesophageal junction. Also it insures integrity of esophageal mucosa which is checked by saline infusion in the region of the hiatus while the endoscopist insufflates the distal esophagus with air to show that there is no bubbling.

Ultrasonic dissector (Harmonic scalpel) greatly facilitated dissection at the hiatus with careful dissection in the submucosal plane with minimal bleeding. In the case where bleeding occurred from injury to one of the esophageal vessels, control was achieved adequately with this instrument without the need to convert the procedure to an open one.

As an antireflux method we have chosen to perform modified Dor anterior fundoplication in the form of 180° wrap because of the following facts:
1- It effectively prevents reflux.
2- It insures minimal dissection at the hiatus.
3- It acts as a serosal patch that covers and protects against any minor perforation.
4- It prevents rehealing of the myotomy site.

The mean operative time was 60 minutes which is less than that in the literature (1 10 minutes) [6], this may be explained by the fact that the learning curve is not achieved only from performing the procedure, but is shortened by performing the much more common anti reflux surgery, in which the surgeon performs nearly the same operative technique.

A self limiting mediastinal and surgical emphysema occurred in 2 patients and was managed conservatively.

Post operative follow-up reveled improvement of dysphagia, regurgitation and heart burn in all patients which coincides with the previous results which showed improvement in 94% of patients [6]. However our superior results may be due to the relatively shortened period of follow-up which ranged from 6-18 months.

The mean post operative hospital stay period was 4.3 days which is comparable to the previous studies in which the mean period was 4 days [6]. This adds more to the benefits of the minimal access route.

Despite recent progress in our understanding of the etiology of achalasia, treatment of the disease is still based on methods aiming at mechanically
relieving the obstruction at the LES level with a balloon or surgery. The relative rarity of the disease and the similar efficacy of the two most commonly used methods for disrupting the LES (surgery and dilatation) are the reasons why controlled randomized trials are difficult to conduct and conclusions should be drawn only after careful evaluation of prospective case series studies.

The most important parameter to consider in this study is the treatment efficacy, that is the ability of the treatment to relieve symptoms, with little or no risk to the patient, few side effects and little discomfort, perhaps the cost of treatment should also be considered. An additional factor to take into account is the availability of the technique and with regard to surgery, its reproducibility and the fact that it can be taught.

The therapeutic decisions regarding the treatment of patients with achalasia center around four issues. The first issue is the question, whether a newly diagnosed patients should be treated with pneumatic dilatation or surgical myotomy. Long term follow-up studies have shown that pneumatic dilatation achieves an adequate relief of dysphagia and pharyngeal regurgitation in 50 to 60% of patients [15], close follow-up is required and if dilatation fails, surgical myotomy is indicated.

For those patients who have a dilated and tortuous esophagus (Sigmoid esophagus) or an associated hiatus hernia, balloon dilatation, in these conditions, is dangerous and surgery is a better option [6].

Whether it is better to treat a newly diagnosed esophageal achalasia patient by forceful dilatation or by operative cardiomyotomy remains undecided. The outcome of one controlled randomized study on 35 patients comparing the two methods suggest that surgical myotomy as a primary treatment gives better long term results [16].

Recently a prospective study on complications associated with forceful dilatation recorded an incidence of 14% for chest pain lasting several days after the procedure, 12% for traumatic diverticula, 3% for intramural hematoma, and 1.5% for both reflux and perforation [17].

Most of these complications have rarely if ever been observed after surgical myotomy combined with antireflux procedure. Those who favor forceful dilatation claim that, this procedure is performed as an out patient procedure or with a 24 h hospital stay [18].

It should be taken into account however, that many authors perform progressive esophageal dilatation in three or more sessions and even those who perform dilatation in a single session report that a second dilatation is needed in 20% of patients [16].

Probably the cost comparison between endoscopic dilatation and laparoscopic myotomy still favors the former (because of the high cost of the operating room and instrumentation) but the decrease in the hospital stay to a few days and rapid return to work may reduce this difference.

The second issue is the question of whether a surgical myotomy should be performed through the abdomen or the chest. Myotomy of the LES can be accomplished via either an abdominal or thoracic approach. Recent data suggest that a transabdominal approach is preferred, particularly when done using minimally invasive techniques [6].

The third issue and one that has been debated, is the question of whether an antireflux produce should be added to surgical myotomy. The pressure exerted by LES in the distal esophagus is the main barrier to gastroesophageal reflux and weakening of the distal esophagus may lead to abnormal presence of gastrointestinal contents in the gullet, in addition patients with achalasia have poor peristalsis with inadequate clearance and gastroesophageal reflux disease (GERD) is potentially more harmful than it is in normal subjects.

The incidence of GERD and methods for its prevention have been (and still) a controversial issue. Ellis reported effective control of dysphagia (90%) with a very low incidence of reflux (5%) using only a transthoracic myotomy without fundoplication [18].

Andreollo N., et al. [19] in their extensive review of literature concluded that GERD occurred in 7% of patients after thoracic myotomy and in 13% after laparoscopic approach, if no anti reflux surgery is added concluding that the cause of reflux was a myotomy extending too far towards the stomach.

Mattioli and associates demonstrated, however, that this part of the operation (sectioning of the sling gastric fibers) and extension of the myotomy 1.5-2 cm towards the stomach is essential to reduce LES pressure [20].

In most of the previous studies, assessment of reflux was based only on the presence of symptoms which are not reliable marker of reflux [21].
When objective measurements of reflux were performed using 24h pH monitoring after a thoracotomy or laparoscopic approach, a much higher incidence was reported ranging from 21% to 60% [22,23].

The selection of a particular type of fundoplication was based on certain pathophysiologic and technical considerations. First, fundoplication should not create a new obstacle to the passage of the bolus through the cardia especially in those patients who have virtually no esophageal body motility. So partial fundoplication rather than a full 360 degree fundoplication seems more appropriate; the two most commonly used antireflux techniques after Heller myotomy are partial anterior 180 degree Dor fundoplication [24] and partial posterior 270 degree Toupet fundoplication [25]. Both procedures have been reported to prevent reflux after myotomy. From a technical stand point, posterior fundoplication holds the myotomy open and probably offers better reflux control in supine position [9], but it requires full mobilization of the abdominal esophagus, along with mobilization of the gastric fundus, which is not routinely performed.

On the other hand modified Dor anterior partial fundoplication protects the mucosa and covers any undetected small Perforations and holds the myotomy site opened. There is no evidence to support either choice however, only a trial comparing the two most commonly used techniques will resolve this issue.

The fourth issue is the reasons for failure after myotomy, three main mechanisms have been postulated; incomplete myotomy, scarring of myotomy and reflux esophagitis [6]. Manometry provides us with little information since the pressure during swallowing is recorded only at one point of the myotomized sphincter, and small areas where muscle fibers still present (incomplete myotomy) are difficult to demonstrate with this test. Patients even if they undergo incomplete myotomy, report an improvement of their dysphagia which returned a few months after the operation [26].

The reasons for failure can better be investigated with barium swallow video fluoroscopy and by careful review of the videotape of the operation [6].

Another important issue centers on whether cure of this disease is achievable or not. Long term follow-up studies after myotomy have shown that late deterioration in results occurs after this procedure regardless of whether an antireflux procedure is done or not and also after balloon dilatation even when sphincter pressure is reduced to below 10mm Hg.

Ellis, [27] reported his lifetime experience with transthoracic esophageal myotomy without antireflux procedure, he analyzed 179 patients at a mean follow-up of 9 years, ranging from 6 months to 20 years. Overall 89% of patients improved at 9 years mark. He also observed that the level of improvement deteriorated with time, as with excellent results (patients continued to be symptoms free) which decreased from 54% at 10 years, to 32% at 20 years [27].

Malthanen, et al., [28] documented nearly identical results 10 to 15 years following transthoracic esophageal myotomy with an antireflux procedure and also reported deterioration over time probably due to progression of the underlying disease.

The outcome of laparoscopic myotomy and hemifundoplication has been well documented. Meshkinpour, et al., [29] reviewed published report including 254 patients with an average success rate of 93% at 2.5 years and 70% at 8 years.

It may be that even though a myotomy or balloon rupture of the LES muscle reduces the outflow obstruction at the cardia, the underlying motor disorder in the body of the esophagus persists and deteriorates further with passage of time, leading to increased impairment of esophageal emptying. The earlier and effective reduction in outflow resistance to be accomplished, the better the outcome will be and more likely some esophageal body function can be restored [28].

The most common criticism voiced against the wide spread use of laparoscopic myotomy for the treatment of achalasia is that it is a difficult operation to perform and properly trained surgeons are not readily available.

Zaninotto, et al., [6] showed that the learning curve for laparoscopic Heller myotomy is steep to 20 patients and given the rarity of the disease, this figure is probably higher than the number of achalasia patients observed during the average career of most surgeons. However data also demonstrated that the institutional learning curve is relevant and that adequate proctorship can reduce the learning curve for individual surgeons. It is probably wise, therefore, to perform this operation only at designated referral centers, where experience can be gained and these centers can serve as learning centers for residents and other surgeons.
References


