Comparative pre- and postoperative results analysis of functional state of the esophagus assessment in patients with various stages of achalasia

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Abstract

Objective: The aim of this study was to evaluate main results of morpho-functional state of the esophagus assessment in patients with various stages of achalasia before and after surgical treatment. Methods: Between 1993 and 2002, a total of 65 patients with achalasia (26 males, 39 females; mean age 44.5 ± 14.0 years; range 16-79) underwent specific type of surgical treatment based on the results of functional state of the esophagus assessment. Barium swallow, manometry and 24-h pH-metry were performed by standard methods; the main parameters of each study were evaluated before and after operation. Patients were divided into three groups according to the esophageal diameter (barium swallow examination data). Group I (n=22, diameter < 4 cm), group II (n = 35, diameter from 4 to 7 cm), group III (n = 8, diameter > 7 cm, with the cardiac stenosis and S-shape deformation of the distal esophagus). All the patients in groups I and II underwent esophagocardioomyotomy with the creation of dilating antireflux cardia by Onopriev (fundoplication + esophageal ligament apparatus reconstruction). Five patients in group III with the cardiac stenosis underwent resection of the cardia with segmental esophagocardioplasty, three patients with the cardiac stenosis and sigmoid esophagus underwent resection of the stenosed cardia, extirpation of the esophageal mucosubmucosal layer with subsequent replacement of it with the left colon placed in saved muscular sheath of the esophagus. Results: There were no deaths or reoperations. The study showed that a decrease of both maximal and residual LES pressures after operation in group I (from 24.3 ± 3.8 to 21.7 ± 2.4 and from 17.2 ± 2.4 to 11.8 ± 1.4, respectively) and group II (from 29.6 ± 2.6 to 21.7 ± 2.4 and from 21.7 ± 3.1 to 11.8 ± 1.4, respectively) of patients with achalasia enables to eliminate obstruction and therefore to decrease esophageal diameter. Conclusions: We suggest that dilating antireflux cardia provides adequate bolus passage and properly realizes antireflux barrier function, maintaining the esophageal distal pH within the physiological ranges even without esophageal peristalsis restoration, and dilating mechanism serve to prevent the recurrence of the disease. Despite excellent relief of dysphagia and functional state of the esophagus improvement, the main values of functional state assessment results in group III of patients were beyond physiological ranges.

Keywords: Achalasia; Esophagocardioomyotomy; Dysphagia; Antireflux cardia

1. Introduction

Achalasia is the most common motor-neuronal disorder of the esophagus characterized by incomplete lower esophageal sphincter relaxation or the lack of it with swallowing and aperistalsis in the distal 2/3 of the esophageal body because of progressive decrease in inhibitory ganglion cell density in Auerbach’s plexus. It has an incidence of 0.5–1 per 100,000 [1,2]. Among other esophageal diseases, achalasia is observed in 3.1–20% of cases [3]. The etiology of the primary achalasia remains controversial and may involve autoimmunity and viral infection [4]. Therapy is directed toward relieving the dysphagia by decreasing the outflow resistance caused by the dysfunctional low esophageal sphincter (LES) and esophageal body, so the force of gravity will be enough to transport food into the stomach. Medical treatment, endoscopic treatment (botulinum toxin injection, dilatation), surgery (open and minimally invasive) are the modalities available to achieve this goal. Pharmacologic therapy and treatment with botulinum toxin injection are principally in value in elderly patients with cardiovascular and respiratory diseases that are severe enough to contraindicate general anesthesia [5]. Pneumatic dilatation is usually the first choice in the treatment of esophageal achalasia [6,7]. Despite widespread use, the current practice of pneumatic dilatation is not standardized [8]. This procedure may lead to serious complications, such as perforation at or above gastroesophageal junction (GEJ) in 4-6% of patients (range 0-15%) [9], high incidence (20% if the score value and 52%, if the percent total time pH less than 4 are considered) [10,11] of abnormal gastroesophageal reflux (GER) on 24-h esophageal pH-metry, though incidence of clinical symptoms of GER after pneumatic dilatation ranges...
The risk for hemorrhage is about 1% [9]. Today the universally accepted procedure for surgical treatment of esophageal achalasia is the Heller myotomy [13], modified by Zaaijer [14]. It can be performed through an abdominal [15] or thoracic [16] approach. Myotomy can be performed by minimally invasive surgery (laparoscopic or thoracoscopic) and it achieves the same results as obtained by open surgery [17,18]. There are a number of antireflux procedures used following esophagocardioomyotomy varying from a simple suture of the fundus to the esophagus, a posterior (Toupet) [19], an anterior fundoplication (Dor) [15], a posterior-left lateral and anterior fundoplication (Pinotti) [20], or a Nissen fundoplication [21]. This is a report on 65 consecutive patients who underwent antireflux cardia creation for achalasia between 1993 and 2002 in our center.

2. Patients and methods

Between January 1993 and December 2002, data were collected on 65 consecutive patients (26 males, 39 females; average age 44.5 ± 14.0; range 16–79). Fifty-seven patients with dilatation of the esophagus less than 7 cm and without replacement fibrosis of the esophagogastric junction underwent open Heller myotomy in Zaaijer modification with antireflux cardia creation by Onopriev method. The strategy for surgical management of eight patients in group III with severe achalasia was as follows: five elderly patients at the age of more than 65 years old, with the replacement fibrosis of the esophagogastric junction, S-shaped, dilated esophagus underwent resection of the cardia with segmental esophagocardioplasty and three young patients with the replacement fibrosis of the esophagogastric junction, S-shaped, dilated esophagus underwent resection of the changed cardia, extirpation of the esophageal mucosubmucosal layer with subsequent replacement of it with the left colon placed in saved muscular sheath of the esophagus. All patients failed numerous medical and cardiodilatation therapy before operation or these therapeutic options caused a temporal clinical remission with dysphagia recurrence, it was one of the indications for employing surgical treatment in achalasic patients.

Preoperative evaluation included a history and physical examination, esophagogastrroduodenoscopy, barium esophagram, manometry and esophageal 24-h pH-metry. The main parameters of last three mentioned methods were evaluated before and after operation for this study. Only endoscopic examination and barium contrasts study were performed in patients from group III before and after surgical treatment, except patients with segmental esophagoplasty, who underwent 24-h pH-metry before and after operation. Patients were divided into three groups according to the esophageal diameter, which was defined by the barium study. Group I (n = 22, diameter < 4 cm), group II (n = 35, diameter from 4 to 7 cm), group III (n = 8, diameter ≥ 7 cm, with the cardiac stenosis and S-shape deformation of the distal esophagus). All patients in groups I and II without replacement fibrosis of the esophagogastric junction underwent myotomy with antireflux cardia creation. The operation includes complete mobilization of the fundus, proximal portion of the lesser curvature of the stomach, cardia, abdominal and intrathalral segment of the esophagus using the technique of highly selective vagotomy with division of the short gastric vessels.

We preserve the main vagal trunk and nerves passing to the antral portion, liver and pancreas, and dissect nerves passing to the cardia and esophagogastric junction. The cardia and distal esophagus are mobilized downward. To prevent transdiaphragmatic wrap migration into the chest we create artificial esophagophrenic ligaments (that is especially important in patients with vigorous achalasia) (Fig. 1). Around the brought esophagus an antireflux cardia is formed from the mobilized fundus, the vagal branches are left outside the forming antireflux construction. Only after formation of the ligament apparatus of the esophagus and after the cardia is formed we perform a longitudinal esophagocardioomyotomy 5–7 cm in length with the involvement of 1–1.5 cm of the cardiac portion of the stomach.

The myotomy and fundoplication are performed over 50–60 F lighted esophageal bougie. The posterior wall of the gastric fundus is sutured to the right edge of the myotomized incision, and the anterior to the left edge, it keeps edges of the myotomy apart (Fig. 2). The esophageal mucosal and submucosal layers then are covered with gastric wall by stitching it above them (Fig. 3).

Depending on age, five patients from group III with the replacement fibrosis of the esophagogastric junction, S-shaped, dilated esophagus underwent resection of the cardia with segmental esophagocardioplasty and three patients with the replacement fibrosis of the esophagogastric junction, S-shaped, dilated esophagus underwent resection of the changed cardia (Figs. 4 and 5), extirpation of the esophageal mucosubmucosal layer with subsequent replacement of it with the left colon placed in saved muscular sheath of the esophagus (Fig. 6). The technique of the operation is described briefly below. After mobilization...
Fig. 2. The stage of transversal esophagocardiomyotomy performing: front and back walls of gastric fundus are taken in A1–A5 sutures and front wall is wrapping the defect in the muscular layer of the esophagus; 1, uncovered submucosal layer of the esophagus; 2, celiac trunk with celiac plexus; 3, common hepatic artery; 4, left gastric artery; 5, splenic artery; 6, 7, right and left vagal trunks.

Fig. 3. Common view of optimal reconstruction of cardiac functions: 1, celiac trunk with celiac plexus; 2, common hepatic artery; 3, left gastric artery; 4, splenic artery; 5, 6, right and left vagal trunks.

Fig. 4. A, abdominal part of the esophagus after resection of stenosed precardiac segment; B, fundus of the stomach; C, submucosal layer of the esophagus and stomach; Nos 1–4, 8-shape sutures (artificial esophagodiaphragmatic ligaments); 1, flap of the gastrohepatic omentum is pulled upright; 2, sero-muco-submucosal esophagocardiac sutures; 3, celiac trunk; 4, common hepatic artery; 5, splenic artery; 6, 7, anterior and posterior vagal trunks; 8, distal portion of Latarjet nerve.

Fig. 5. Anterior and posterior wall of the stomach are taken in stitch with suture-ligament No. 4; A, B, sero-muscular additional sutures are fixing the anterior and the posterior walls of the stomach.
Over the 10-year period from 1993 to 2002, a total of 65 patients with achalasia (26 males, 39 females; average age 44.5 ± 14.0; range 16-79) underwent operative treatment in our center. Of these 41 were available for postoperative evaluation.

All patients had preoperative dysphagia. One (1.7%) patient demonstrated it after operation, which was due to hypercorrection responsible for high LES pressure (53 mmHg). It was successfully improved by endoscopic dilatation. There were no intraoperative complications, reoperations or deaths. There were no herniation of the wrap into the chest or slipping of the wrap down around the stomach. Barium transit revealed dilatation of the esophagus in all cases before operation, whereas postoperative barium transit revealed a decrease in esophageal diameter already after 10 postoperative days in patients from group I to 3.2 ± 0.9 cm, from group II to 4.5 ± 1.0 cm and from group III to 9.1 ± 0.9 cm (Fig. 7). Twenty-four-hour esophageal pH monitoring was performed with three-channel pH probe. The probe was positioned with its distal sensor in fundus, central 5 cm above the upper margin of the LES or wrap and proximal sensor 15 cm above the LES/wrap. Patients activated the event markers to indicate the onset of symptoms, meals, smoke, recumbence, and also recorded the information in the diary for confirmation. No patients had gastroesophageal reflux after operation, but in patients after segmental esophagealplasty from group III mean pH of the distal esophagus (5 cm above upper margin of the wrap) was beyond physiologic ranges on 24-h pH-metry. Esophageal manometry was performed with a 6-lumen Dentsleeve silicone catheter. LES pressure before operation and wrap pressure after operation were determined by the station pull-through method at the end of expiration. The patient took 10 swallows of water, spaced 30 s from each other to assess residual LES/wrap pressure and contractile function of esophageal body. Contraction wave amplitude in patients from group I increased from 18.4 ± 1.3 to 24.8 ± 37 mmHg (25.8% compared to preoperative level) and the duration of contraction wave decreased to a mean of 8.5 ± 1.8 s, that is 48.2% less (P < 0.01) in comparison with preoperative duration (16.4 ± 2.3 s). Contraction wave amplitude in patients from group II increased from 11.3 ± 1.2 to 20.3 ± 2.9 mmHg (44.3% compared to preoperative level) and the duration of contraction wave decreased to a mean of 16.4 ± 3.1 s, that is 37.9% less (P < 0.05) in comparison with preoperative duration (26.4 ± 3.3 s). It was not possible to perform esophageal manometry in patients from group III due to structural changes of the esophagus. Mean wrap length was 4.5 ± 1.2 cm. The results observed at 1-year follow-up remain practically unchanged after 3, 6 and 9 years after surgery.

Despite excellent relief of dysphagia and functional state of the esophagus improvement, the main values of functional state assessment results in group III of patients were beyond physiological ranges. Results of functional state of the esophagus before operation and 1 year after operation in patients with achalasia are presented in Table 1.

3. Results

Fig. 6. (A) Nos 1-5, artificial esophagodiaphragmatic ligaments; A, extirpation of the muco-submucosal layer; B, prepared and dissected muco-submucosal layer of the esophagus on the neck; C, saved muscular layer of the esophagus; 7, 8, anterior and posterior vagal trunks. (B) Stage of conduit placement in saved muscular sheath of the esophagus. A, transplanted (left colon); B, middle colic artery; C, muscular sheath of the esophagus; D, proximal stump of the esophagus. (C) A, esophagocolo anastomosis; B, transplant; C, antireflux cardia; D, gastrotoma; 1, celiac trunk; 2, left gastric artery; 3, common hepatic artery; 4, middle colic artery; 5, splenic artery; 6, distal portion of Latarjet nerve.

Fig. 7. Barium swallow before (A) and 1 year after (B) muco-submucosal layer of the esophagus extirpation.
LES, low esophageal sphincter.

Mean pH of the distal esophagus 5.55

G 24-h pH-metry

Residual LES/wrap pressure 17.2

Esophageal diameter 4.3

G Barium swallow

Maximal LES/wrap resting pressure 24.3

Manometry

24-h pH-metry.

Mean pH of the distal esophagus 5.55 ± 0.3

LES, low esophageal sphincter.

4. Discussion

As the etiology of esophageal achalasia is not known, the treatment is focused on decreasing the outflow resistance caused by a hypertensive and non-relaxing LES. Pneumatic dilatation has always been traditionally the first choice in the treatment of esophageal achalasia [6,7]. This choice is mostly based on the fear of the operation, the postoperative pain, the long recovery time and existence of postoperative complications; however, the only prospective randomized trial of pneumatic dilatation and myotomy for the treatment of achalasia, as well, as many retrospective studies, have clearly shown that the results obtained by open surgery were better than those obtained by dilatation [22,23].

The results in our series are in concordance with the available results from patients undergoing open surgery for achalasia. We attribute the low rate of postoperative dysphagia in our patients with complete wraps to our technique of precise antireflux cardia creation and its anchoring to the crura with a help of reconstructed ligament apparatus of the esophagus. No patients had gastroesophageal reflux after operation in our series. A slow steady nocturnal drift to a pH just below pH 4 on a 24-h pH-monitoring in patients after segmental esophagoplasty from group III may be a consequence of food stagnation and bacterial overgrowth in the dilated esophagus. However, these patients were asymptomatic. It is known from other studies that fermentation of retained food is responsible for the low pH score [24,25], or that ingested acidic foodstuff was not cleared by the aperistaltic esophagus. Taking into account that the main values of functional state assessment results in group III of patients were beyond physiological ranges, we support the concept that the early diagnostics and operative treatment before occurrence of significant dilatation and morpho-functional changes of the esophagus, can ensure favorable postoperative results in patient with esophageal achalasia. Even though we used a complete wrap in our patients, the rate of postoperative dysphagia was at the bottom of the published range and there were no gastro-esophageal reflux or herniation of the wrap into the chest in these patients. We suggest that antireflux cardia provides adequate bolus passage and properly realizes antireflux barrier function, maintaining the esophageal distal pH within the physiological ranges even without esophageal peristalsis restoration. Our study showed that myotomy with antireflux cardia creation, resection of the cardia with the following segmental esophagocardioplasty and extirpation of the esophageal mucousubmucosal layer and its subsequent replacement with the left colon placed in saved muscular esophagus sheath are effective methods for the treatment of various stages of achalasia.

References


Table 1

Pre- and postoperative results of functional state of the esophagus assessment

<table>
<thead>
<tr>
<th>Methods and parameters</th>
<th>Before surgical treatment</th>
<th>1 year after surgery</th>
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<tbody>
<tr>
<td></td>
<td>I (n=22)</td>
<td>II (n=35)</td>
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<tr>
<td>Barium swallow</td>
<td></td>
<td></td>
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<tr>
<td>Esophageal diameter</td>
<td>4.3±1.8</td>
<td>7.4±1.4</td>
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<tr>
<td>Manometry</td>
<td></td>
<td></td>
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<tr>
<td>Maximal LES/wrap resting pressure</td>
<td>24.3±3.8</td>
<td>29.6±2.6</td>
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<tr>
<td>Residual LES/wrap pressure</td>
<td>17.2±2.4</td>
<td>21.7±3.1</td>
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<tr>
<td>24-h pH-metry</td>
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<tr>
<td>Mean pH of the distal esophagus</td>
<td>5.55±0.3</td>
<td>5.45±0.9</td>
</tr>
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Appendix A. Conference discussion

Dr W. Walker (Edinburgh, United Kingdom): There were quite a lot of different surgeries here. Was the time interval for follow-up testing similar, or how did you gauge that?

Dr Ryabchun: Can you repeat the question, please?

Dr Walker: When you did the postoperative studies, were they all done at the same time, or how long after the operation?

Dr Ryabchun: The postoperative study was scheduled at 10 days, 1 month, 3 months, 6 months, 1 year, 3 years, 6 years, 9 years after all surgeries and also at 12 and 15 years after esophagocardiomyotomy with the creation of dilating antireflux cardia by Onopriev, as long-term follow-up in these patients was more than 10 years.