Research Article

Diagnostics and Minimally Invasive Surgery for Achalasia Cardia

Vadim Ratchik, Oleksandr Babii*, Natalia Prolom, Boris Shevchenko

Abstract

The objective of the research was to assess the effectiveness of balloon pneumatic dilation and laparoscopic Heller myotomy in treatment of patients with achalasia cardia.

Materials and methods. Twenty-one patients with achalasia cardia were examined and treated using pneumatic balloon dilation and laparoscopic Heller myotomy in the Department of Surgery from January 2016 to April 2018. There were 8 (38.1%) men and 13 (61.9%) women at the age of 28 to 75 years (the average age was (51.47 ± 3.63) years) and disease duration of 1 month to 8 years (the average disease duration was (3.05 ± 0.49) years).

Results and discussion. With the help of radiological methods of examination, all the patients were divided into 4 groups according to the esophageal diameter: Group I included 5 (23.8%) patients with the esophagus up to 4-5 cm in diameter; Group II comprised 6 (28.6%) patients with the esophagus up to 4-6 cm in diameter; Group III included 5 (23.8%) patients with the esophagus up to 6-8 cm in diameter; Group IV consisted of 5 (23.8%) patients with the esophagus of more than 8 cm in diameter and an S-shaped configuration. A significant decrease in the diameter of the esophagus according to fluoroscopy (p < 0.05) alongside with a decrease in the lower esophageal sphincter pressure according to manometry are indicative in assessing the effectiveness of achalasia cardia treatment after minimally invasive surgery. There were no complications when performing pneumatic balloon dilation and laparoscopic Heller myotomy.

Conclusions. In 7 (33.3%) patients, recurrences of achalasia cardia after balloon pneumatic dilation occurred within 2 - 10 months: in 4.7% of patients in Group I and 9.5% of patients in Group II, Group III, and Group IV. In recurrent achalasia cardia, repeated dilation was ineffective. There was performed laparoscopic Heller myotomy with Dor fundoplication, which was effective in 80.0% of cases.

Keywords

achalasia cardia; diagnostics; balloon pneumatic dilation; laparoscopic Heller myotomy, relapses

Institute of Gastroenterology of the National Academy of Medical Sciences of Ukraine, Dnipro, Ukraine

*Corresponding author: Aleksandr_babiy@ukr.net

Problem statement and analysis of the latest research

Achalasia cardia (AC) is a disorder characterized by impaired relaxation of the lower esophageal sphincter (LES) in response to swallowing, discoordination of peristaltic contractions and gradual development of functional intestinal obstruction [1].

This pathology is one of the most common causes of esophageal motor dysphagia. Its incidence rate is approximately 1 case per 100,000 people annually, while the prevalence rate is 10 cases per 100,000 people. AC affects men and women equally, while its incidence increases with age [2, 3].

According to the histological analysis, AC results from the degeneration of cellular ganglia in the intermuscular Auerbach plexus of the esophageal body and the LES which leads to the esophageal motility impairment and LES relaxation impairment [4, 5].

Among modern treatment options, laparoscopic Heller myotomy (LHM) with anterior Dor fundoplication, peroral endoscopic myotomy (POEM), balloon pneumatic dilation (PD) and endoscopic injection of botulinum toxin are considered [6].

The most commonly used techniques are balloon PD and LHM [7, 8, 9].

The tactics of AC treatment is currently widely discussed, since even surgical treatment not always provides the promising results. The use of conservative methods alongside with balloon PD is quite effective at the initial stages of AC. Circatrical changes in the gastroesophageal junction and persistent esophageal expansion are indications for surgical treatment with the use of modern laparoscopic and endoscopic techniques. The choice of surgical method depending on manometric subtypes determining the response to treatment is critical [9, 10, 11].

The objective of the research was to assess the effectiveness of balloon PD and LHM in treatment of patients with AC.
1. Materials and Methods

Twenty-one patients with AC were examined and treated in the Department of Digestive Organ Surgery from January 2016 to April 2018. There were 8 (38.1%) men and 13 (61.9%) women at the age of 28 to 75 years (the average age was $(51.47 \pm 3.63)$ years). According to the findings of radiological examination of the esophagus, all the patients were divided into 4 groups: Group I included 5 (23.8%) patients with the esophagus up to 4-5 cm in diameter; Group II comprised 6 (28.6%) patients with the esophagus up to 4-6 cm in diameter; Group III included 5 (23.8%) patients with the esophagus up to 6-8 cm in diameter; Group IV consisted of 5 (23.8%) patients with the esophagus of more than 8 cm in diameter. The study included patients with disease duration of 1 month to 8 years (the average disease duration was $(3.05 \pm 0.49)$ years).

Radiological examination with contrast agent administration was carried out using the innovatory R/F remote-controlled table OperaT-90; the peristalsis, the size, the rate of contrast evacuation, the location of the esophagus and the state of the gastroesophageal junction were studied. The diameter of the esophagus was measured in pixels; 65 pixels were equal to 1 cm. In the control group, the esophagus was 1.5-2.0 cm in diameter.

Endoscopic diagnostics was carried out using the Olympus HQ-190 HD (Japan) and the Olympus XQ-40 (Japan) endoscopes.

Esophageal manometry was performed using the digital pressure gauge MHX-01 (Ukraine). The method involved the measurement of the LES pressure (mm Hg) using the air-filled balloon with a diameter of 2.0 cm. The normal LES pressure was 10-25 mm Hg.

A 35-mm and a 40-mm Rigiflex II Boston Scientific balloon (USA) were used to perform PD. There were performed 3-6 sessions of balloon PD under endoscopic or/and radiological control; each session lasted 3-5 minutes; the interval between sessions was 1-3 days; the pressure was created to complete the expansion of the balloon in the area of narrowing. On the background of PD, pharmacological therapy (proton pump inhibitors (pantoprazole), M-cholinolytics, calcium channel blockers, nitrates, tranquilizers) was performed (Fig. 1).

LHM with Dor fundoplication was performed using the equipment manufactured by Karl Storz (Germany) and an ultrasonic scalpel SonoSurg (Japan) in 5 (23.8%) patients.

2. Results and Discussion

In Group I, esophagoscopy revealed no esophagitis; the characteristic endoscopic sign was change in the width of the esophageal lumen; its peristalsis, the state of the mucosa, the location of the cardia and the degree of its opening did not undergo any changes. The cardiac sphincter was centered, closed and opened in case of a low level of air insufflation. The retrograde examination revealed that the LES was tightly wrapped around the endoscope; the mucous membrane was elastic. The passage of the endoscope through the LES and the cardia was easy and there were no obstacles (Fig. 2a).

Characteristic radiological signs were normal esophageal peristalsis, increase in the esophageal diameter up to 4 cm, slight narrowing of the distal esophagus which easily let barium suspension flow in (Fig. 2b).

In Group II, esophagoscopy revealed esophagitis; the characteristic endoscopic sign was a significant expansion of the esophageal lumen; a characteristic funnel-shaped and wedge-shaped form of its terminal portion without any contents (the accumulation of the mucus or fluid, food debris) was observed. The mucous membrane was smooth, even and shiny; its folds were longitudinal in direction. The cardiac sphincter was centered, slit-shaped and closed; however, it easily opened in case of a moderate level of air insufflation. The passage of the endoscope through the LES and the cardia was easy and there were no obstacles (Fig. 3a).

Radiological examination revealed spasm of the cardia that was more persistent as compared to Group I, while the esophageal diameter increased from 4 to 6 cm. Peristaltic waves were diminished as they moved to the distal esophagus. The opening of the narrowed portion did not occur immediately; it opened in case of tighter filling of the esophagus. The cardia was closed until the process of emptying contrast...
Diagnostics and Minimally Invasive Surgery for Achalasia Cardia — 3/6

media from the esophagus was completed (Fig. 3b).

![Figure 3](image)

**Figure 3.** AC in Group II: a) endoscopic assessment of the esophageal mucosa; b) X-ray assessment of the passage of the contrast agent through the esophagus

In Group III, during esophagoscopy, the characteristic endoscopic sign was the expansion of the esophagus and the presence of abundant mucus and food debris in its lumen. The cardiac sphincter was eccentrically located, tightly closed, dot-shaped; it did not open even in case of a high level of air insufflation. The esophageal mucosa was slightly thickened due to constant backup of food within the esophagus; in the distal portion, the mucous membrane was hyperemic and slightly swollen (Fig. 4a). A significant resistance was felt when the endoscope passed through the cardial part to the stomach.

Characteristic radiological signs were the increase in the esophageal diameter from 6 to 8 cm, the absence of normal peristalsis and irregular contractions of its walls. The cardia opened only in case of a significant filling of the esophageal lumen. There was observed the reduction in the size of the gastric air bubble, or it was absent (Fig. 4b).

![Figure 4](image)

**Figure 4.** AC in Group III: a) endoscopic assessment of the esophageal mucosa; b) X-ray assessment of the passage of the contrast agent through the esophagus

In Group IV, esophagoscopy revealed an ectatic esophagus with the formation of transverse folding. On an empty stomach, the esophageal lumen contained the accumulation of fluid, mucus, and food debris in such quantities that there was a need for an esophageal lavage to carry out more adequate reexamination. The cardia was eccentrically located. The mucous membrane was thickened, hyperemic and slightly swollen; in 2 cases, there were observed cicatrical changes in the lower third of the esophagus (Fig. 5a). More significant resistance was felt when the endoscope passed through the cardia.

Radiological examination revealed esophageal atony, a sharp increase in the esophageal diameter of more than 8 cm, the reduction in the esophageal length (Fig. 5b).

![Figure 5](image)

**Figure 5.** AC in Group IV: a) endoscopic assessment of the esophageal mucosa; b) X-ray assessment of the passage of the contrast agent through the esophagus

All the patients underwent balloon PD, while endoscopic balloon PD was performed in 5 patients of Group IV.

Fig. 6 presents a fragment of performing endoscopic balloon PD.

![Figure 6](image)

**Figure 6.** Endoscopic balloon PD: a) the balloon is positioned within the LES; b) the LES after balloon PD with characteristic linear mucosal tears without active bleeding

The data of LES manometry in groups of patients before and after balloon PD course are presented in Table 1.

After balloon PD course, there was observed a significant difference in the reduction in the LES pressure in all the groups (p<0.05). The control of treatment effectiveness was carried out using the radiological data obtained (Table 2).

According to Table 2, a statistically significant (p<0.05) dynamics was observed in all the patients. There were no complications when performing balloon PD. During balloon PD, the effect of the gradual disappearance of the balloon
Table 1. LES manometry in groups of patients before and after balloon PD course

| LES manometry          | Group I (n=5) | Group II (n=6) | Group III (n=5) | Group IV (n=5) |
|------------------------|--------------|---------------|----------------|---------------|
| before treatment, mm Hg| 62.9±17.8    | 63.2±7.7      | 66.3±11.7      | 86.10±15.5    |
| after treatment, mm Hg | 10.5±3.0*    | 14.8±2.2**    | 15.3±3.5**     | 16.4±3.7**    |

Notes:
* - (p<0.05);
** - (p<0.01) – the reliability of the difference in the manometric indicators before and after balloon PD course.

Table 2. Radiological examination of the esophagus in groups of patients before and after balloon PD course

| Esophageal diameter | Group I (n=5) | Group II (n=6) | Group III (n=5) | Group IV (n=5) |
|---------------------|--------------|---------------|----------------|---------------|
| before treatment, cm| 3.24±0.24    | 5.13±0.26     | 7.28±0.16      | 8.54±0.26     |
| after treatment, cm | 1.60±0.15*   | 3.21±0.26*    | 3.86±0.69**    | 5.72±0.27*    |

Notes:
* - (p<0.05);
** - (p<0.01) – the reliability of the difference in the manometric indicators before and after balloon PD course.

waist was achieved in all the patients. As recurrences of AC after balloon PD occurred within 2 - 10 months, repeated courses of balloon PD were carried out. They were effective in 50.0% of cases in Group I and Group II, and 20.0% of cases in Group III and Group IV. In 23.8% of patients, repeated course of balloon PD was ineffective.

Such patients underwent LHM with Dor fundoplication. An ultrasonic scalpel was used to make a 5-cm incision of the muscular fibers in the distal esophagus followed by a 3-cm incision in the cardia. After gastric fundus mobilization, there was performed anterior fundoplication using a continuous suture technique, anatraumatic needle and non-absorbable Ti-Cron 2/0 surgical sutures.

Fig. 7 presents the stages of performing LHM.

After LHM and Dor fundoplication, the positive results were observed in 4 (80.0%) cases. There were no intraoperative and postoperative complications when performing LHM.

Fig. 8 presents an example of LHM instrumental screening with a positive dynamics.

Balloon PD is an effective primary treatment of AC, especially in the short term. However, the use of PD is characterized by relapses and the need for retreatment. Although LHM demonstrates better long-term effectiveness, there are patients who suffer from constant or recurrent symptoms of AC after LHM. Thus, according to the results of one of the prospective multcenter randomized trials, 2 years after LHM, 10% of patients developed significant recurrent symptoms of AC [12]. According to the data of the meta-analysis conducted by Illés A et al. (2017), the effectiveness of LHM exceeded that of PD by the duration of remission and the reduction in the frequency of relapses in AC [9]; whereas according to the results of Cheng JW et al. (2017), there were no significant differences between LHM and PD in 2-year and 5-year remission periods. This study showed that any type of treatment may be offered as initial treatment of AC [13].

Thus, when assessing the methods of minimally invasive surgery for AC we used, it should be noted that balloon PD provided good results immediately after procedure; however, in one-third of cases, it was characterized by rather short-term effectiveness, especially in later stages of the disease. Therefore, the use of LHM with Dor fundoplication complements the program of comprehensive treatment and improves the anti-reflux function of the LES.

3. Conclusions

1. AC recurrences after balloon PD occurred within 2 - 10 months in 33.3% of cases; therefore, repeated courses of balloon PD were carried out. They were effective in 9.5% of cases. In 23.8% of patients, repeated course of balloon PD was ineffective.

2. After LHM with Dor fundoplication, the positive results were observed in 80.0% of cases.

References

[1] Clark SB, Rice TW, Tubbs RR et al. The nature of the myenteric infiltrate in achalasia: an immunohistochemical analysis. Am J Surg Pathol. 2000;24(8):1153-1158. DOI: https://doi.org/10.1097/00000478-200008000-00014 [PMid:10935657]

[2] Enestvedt BK, Williams JL, Sonnenberg A. Epidemiology and practice patterns of achalasia in a large multi-centre database. Aliment Pharmacol Ther. 2011;33(11):1209-1214. DOI: https://doi.org/10.1111/j.1365-2036.2011.04655.x

[3] Francis DL, Katzka DA. Achalasia update on the disease and its treatment. Gastroenterology. 2010;139(2):369-374. DOI: https://doi.org/10.1053/j.gastro.2010.06.024
Figure 7. Stages of performing LHM with Dor fundoplication: a) the dissection of the muscular layer of the esophagus to its mucosal layer; b) the stage of esophagectomy; c) the stage of cardiomyotomy; d) the stage of the endoscopic control of the gastroesophageal junction permeability; e) the stage of continuous suturing when performing Dor fundoplication; f) the final stage of performing Dor fundoplication.

[4] Salis GB, Mazzadi SA, García AO, Chiocca JC. Pneumatic dilatation in achalasia of the esophagus: a report from Argentina. Dis Esophagus. 2004;17(2):124-8. DOI: https://doi.org/10.1111/j.1442-2050.2004.00388.x

[5] Ghoshal UC, Daschakraborty SB, Singh R. Pathogenesis of achalasia cardia. World J Gastroenterol. 2012;18(24):3050-3057. DOI: https://doi.org/10.3748/wjg.v18.i24.3050

[6] Katada N, Sakuramoto S, Yamashita K et al. Recent trends in the management of achalasia. Ann Thorac Cardiovasc Surg. 2012;18(5):420-428. DOI: https://doi.org/10.5761/atcs.ra.12.01949 [PMid:23099422]

[7] Amani M, Fazlollahi N, Shirani S et al. Assessment of pneumatic balloon dilation in patients with symptomatic relapse after failed Heller myotomy: a single center experience. Middle East J Dig Dis. 2016;8(1):57-62. DOI: https://doi.org/10.15171/mejdd.2016.08

[8] Chrystoja CC, Darling GE, Diamant NE et al. Achalasia-specific quality of life after pneumatic dilation or laparoscopic Heller myotomy with partial fundoplication: a multicenter, randomized clinical trial. Am J Gastroenterol. 2016;111(11):1536-1545. DOI: https://doi.org/10.1038/ajg.2016.402

[9] Illés A, Farkas N, Hegyi P et al. Is Heller myotomy better than balloon dilation? A meta-analysis. J Gastrointestin Liver Dis. 2017;26(2):121-127. DOI: https://doi.org/10.15403/jgld.2014.1121.262.myo

[10] Esposito D, Maione F, D’Alessandro A et al. Endoscopic treatment of esophageal achalasia. World J Gastrointest Endosc. 2016;8(2):30-39. doi: [10.4253/wjge.v8.i2.30] DOI: https://doi.org/10.4253/wjge.v8.i2.30

[11] Rohof WO, Salvador R, Annese V et al. Outcomes of treatment for achalasia depend on manometric subtype. Gastroenterology. 2013;144(4):718-725. DOI: https://doi.org/10.1053/j.gastro.2012.12.027

[12] Boeckxstaens GE, Annese V, des Varannes SB et al. Pneumatic dilation versus laparoscopic Heller’s myotomy for idiopathic achalasia. N Engl J Med. 2011;364(19):1807-1816. DOI: https://doi.org/10.1056/NEJMoa1010502

[13] Cheng JW, Li Y, Xing WQ et al. Laparoscopic Heller myotomy is not superior to pneumatic dilation in the management of primary achalasia: Conclusions of a systematic
review and meta-analysis of randomized controlled trials. Medicine (Baltimore). 2017;96(7):e5525. DOI: https://doi.org/10.1097/MD.0000000000005525

Received: 2017-12-15
Revised: 2017-12-25
Accepted: 2017-12-29