



Long-term outcomes of Heller myotomy for achalasia: 5-year access comparison

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Abstract. Achalasia cardia (AC) is associated with marked impairment of oesophageal food transit and a substantial reduction in quality of life. Despite the widespread use of Heller myotomy, the effect of the type of surgical access on long-term treatment outcomes remains poorly understood. The purpose was to evaluate and compare the five-year results of the Heller myotomy performed by laparoscopic and open access with the analysis of clinical, functional, radiological, and endoscopic parameters. A combined retrospective and prospective multicentre study was conducted, which included 38 patients with confirmed AC. Surgical procedures were performed using open and laparoscopic approaches with antireflux correction. The assessment of efficacy was based on clinical symptoms, radiographic and endoscopic findings, and changes in the symptom severity score. The follow-up period was up to five years. After surgical treatment, there was a statistically significant improvement in all the parameters under study. The severity of symptoms decreased from 8.8 ± 1.5 to 1.7 ± 0.8 , the frequency of dysphagia decreased from 100% to 7.9%, and regurgitation decreased from 83.3% to 5.6%. X-ray examination revealed a decrease in the diameter of the oesophagus from 4.8 ± 0.7 to 3.2 ± 0.5 cm and an almost complete elimination of contrast delay. Endoscopic findings confirmed the restoration of cardia patency and a reduction in inflammatory changes of the mucosa. Laparoscopic access demonstrated a more pronounced recovery of evacuation function and a lower incidence of residual disorders compared with open interventions. The results obtained confirmed the high efficiency of Heller myotomy and substantiated the advantage of laparoscopic access in the treatment of AC.

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The data can be used to optimise surgical tactics and improve the quality of patient treatment, and serve as a basis for further research with sample expansion and standardisation of evaluation criteria

Keywords: achalasia cardia; laparoscopic access; dysphagia; quality of life; clinical outcomes

Introduction

Achalasia cardia (AC) is a chronic neuromuscular disease of the oesophagus characterised by impaired relaxation of the lower oesophageal sphincter (LOS) and loss of coordinated peristalsis, which leads to progressive dysphagia, regurgitation, and weight loss. These clinical manifestations have a significant impact on the daily activity of patients and are accompanied by a marked decrease in quality of life. Contemporary approaches to the treatment of AC are aimed at eliminating functional obstruction in the area of the gastroesophageal junction. The main method of surgical correction remains the Heller oesophagocardiomyotomy, which provides a stable reduction in pressure in the LOS area and restoration of food passage.

In turn, D.A. Patel *et al.* [1] emphasised that the choice of tactics should consider the clinical phenotype of the disease, since the severity of dysphagia and weight loss directly determine the severity of functional disorders. G. Zaninotto *et al.* [2] noted that this method is the preferred surgical treatment of AC due to its high efficiency and predictability of results. With the development of minimally invasive technologies, laparoscopic myotomy has become widespread and has become the preferred treatment method. According to G. Campos *et al.* [3], laparoscopic access provides comparable clinical efficacy compared to open interventions with less injury and faster recovery of patients. Similar conclusions were presented by A. Moonen *et al.* [4], who showed that minimally invasive technologies are characterised by sustainable results in the medium term.

Despite the proven benefits of laparoscopic access, the issue of its impact on long-term functional outcomes and quality of life remains controversial. G.E. Boeckxstaens *et al.* [5] concluded that the differences between treatment methods become less pronounced with prolonged follow-up, which requires further in-depth analysis. According to R. Salvador *et al.* [6], the preoperative functional characteristics of the oesophagus may influence treatment outcomes, which should also be considered when comparing different surgical approaches. Evaluation of the effectiveness of surgical treatment of AC goes beyond solely clinical indicators and includes an analysis of the quality of life of patients. The use of validated scales allows objectifying subjective feelings and assessing the impact of treatment on daily activity. In particular, the Eckardt Symptom Score is widely used to quantify disease symptoms and serves as a reliable tool for monitoring treatment effectiveness. According to V. Eckardt [7], a decrease in the total score after the intervention reflects the success of the surgical correction.

Additionally, the use of specialised and universal quality of life questionnaires allows assessing not only the physical, but also the psycho-emotional aspects of patients' condition. J.E. Ware & C.D. Sherbourne [8] noted that a comprehensive assessment of quality of life is a key component of the analysis of treatment outcomes for chronic oesophageal diseases. A number of studies have shown that after performing a Heller myotomy, there is a steady improvement in the functional parameters and quality of life of patients [9-11]. However, most of the research is limited to short- or medium-term monitoring, which does not allow fully assessing the stability of the results achieved. According to M.F. Vaezi *et al.* [12], the lack of long-term comparative studies remains one of the key problems of AC surgery. The purpose of this study was to conduct a comparative analysis of long-term clinical and functional results and quality of life indicators in patients with AC after various types of surgical intervention to determine the optimal treatment tactics.

Materials and Methods

The present study was performed in the format of a combined retrospective-prospective multicentre clinical analysis aimed at assessing the long-term results of surgical treatment of AC using various surgical approaches and associated antireflux protection techniques. The clinical component of the study was conducted at the surgical departments of Academician K.R. Ryskulova City Clinical Hospital No. 1, the Cortex Surgical Centre, the Medical Centre of the I.K. Akhunbaev Kyrgyz State Medical Academy, and Academic Clinic No. 7 (Research and Diagnostic Treatment Centre) of the Kyrgyz State Medical Academy. The observation period was from May 2015 to September 2025.

The study included 38 patients with verified AC who underwent Heller oesophagocardiomyotomy with laparotomy or laparoscopic access. The sample was formed according to strict criteria. Inclusion criteria: age ≥ 18 years; a clinical and instrumentally confirmed diagnosis of stage 1-3 achalasia cardia according to the B.V. Petrovsky classification; treatment by Heller myotomy; availability of both preoperative and postoperative follow-up data; and a follow-up period of at least 12 months for the prospective cohort and up to 5-10 years for the retrospective cohort. Exclusion criteria: the presence of malignant neoplasms of the oesophagus and cardia; secondary AC; previously performed surgeries on the oesophagus that are not associated with a recurrence of the disease; severe decompensated somatic diseases (class 4 and higher on the ASA scale);

refusal of the patient to participate. The diagnosis was established based on a comprehensive assessment of clinical data, the results of endoscopic and X-ray examination. Oesophagogastroduodenoscopy was performed to assess the dilation of the oesophagus, the presence of stagnant contents, and the phenomenon of “tightly closed cardia”. X-ray examination of the oesophagus with barium contrast revealed the characteristic “bird’s beak” symptom, the degree of expansion of the oesophagus and impaired contrast evacuation. Organic pathology was excluded in all cases.

The Eckardt Symptom Score was used to quantify clinical efficacy, including an analysis of the severity of dysphagia, regurgitation, pain, and weight loss (0-12 points). The assessment was performed before surgery, in the early postoperative period, after 12 months, and in the long term (up to 5 years or more). A decrease of ≤ 3 points was considered a successful result. The overall study cohort ($n = 38$) was divided into two groups according to the surgical approach and the accompanying fundoplication technique: Group 1 (open surgery, $n = 20$; 52.6%) comprised patients who underwent open Heller myotomy with anterior partial fundoplication according to E.P. Suvorova; Group 2 (laparoscopic, $n = 18$; 47.4%) comprised patients who underwent laparoscopic Heller myotomy with the authors’ original oesophagocardiogastroplasty technique. 20 cases were retrospectively analysed (52.6%, exclusively patients of the Group 1), 18 cases were prospectively analysed (47.4%, patients of the Group 2). The total gender composition was almost homogeneous: 20 women (52.6%) and 18 men (47.4%). The average age of the patients was 42.3 ± 12.1 years (from 18 to 67 years), while more than 60% of the patients were younger than 50 years old. The average body mass index (BMI) ranged from 24.5 ± 2.7 to 25.1 ± 2.9 kg/m². Comorbidities were rare and consisted mainly of mild anaemia and gallstone disease (GSD). One patient (5.5% of the laparoscopic group) underwent simultaneous intervention in the amount of oesophagocardiomyotomy and laparoscopic cholecystectomy. Surgical treatment included two intervention options: conventional Heller oesophagocardiomyotomy with laparotomy access and laparoscopic modified myotomy with antireflux protection elements. The choice of access was determined by the time period, the technical capabilities of the clinic, and the clinical characteristics of the patient.

Statistical data processing was carried out using the packages SPSS Statistics 26.0 and Statistica 13.0. The normality of the distribution was checked using the Shapiro-Wilk criterion. To compare quantitative indicators, the Student’s t-test or the Mann-Whitney criterion were used, and for qualitative data, the Pearson χ^2 or the Fisher exact criterion were used. The dynamics of the indicators was assessed using paired criteria. The differences were considered statistically significant at $p < 0.05$. Clinical outcomes were assessed using the

Eckardt Symptom Score, the Gastroesophageal Reflux Disease Health-Related Quality of Life (GERD-HRQL) questionnaire, and the Clavien-Dindo classification of postoperative complications. The Eckardt Symptom Score was used to quantify the severity of dysphagia, regurgitation, pain, and weight loss. The GERD-HRQL questionnaire was used to analyse the symptoms of gastroesophageal reflux and their impact on the quality of life of patients before and after the intervention. Postoperative complications were recorded and classified according to the Clavien-Dindo system, which provided for the gradation of complications depending on the severity and the required amount of therapeutic measures. The obtained indicators were used to compare the effectiveness of treatment and analyse postoperative results. In addition, existing studies are characterised by heterogeneous design, differences in the assessment scales used, and the lack of a standardised approach to quality of life analysis. M.A. Khashab *et al.* [13] noted that these factors make it difficult to directly compare the results of laparoscopic and open interventions. The study by F. Schlottmann *et al.* [14] emphasised the need for long-term comparative studies with unified evaluation criteria. Thus, despite the accumulated experience of surgical treatment of AC, the issue of the effect of the type of surgical access on long-term quality of life remains insufficiently studied. This necessitates conducting studies aimed at a comprehensive assessment of long-term outcomes using standardised tools and comparable clinical groups.

The study was performed in accordance with the principles of the World Medical Association [15]. The protocol was approved by the local ethics committee of the I.K. Akhunbaev Kyrgyz State Medical Academy (Protocol No. 6 of 11 December 2017). All patients signed an informed voluntary consent to participate in the study and undergo surgical treatment. Surgical treatment of AC was performed using two different technological approaches, where surgical access was tightly coupled with a strictly defined type of antireflux component, which is due to the evolution of surgical techniques in clinics over a ten-year follow-up period. Surgical treatment was performed in two ways: laparotomy ($n = 20$; 52.6%) and laparoscopic ($n = 18$; 47.4%). One patient (5.5% of the laparoscopic group) underwent simultaneous intervention in the amount of oesophagocardiomyotomy and cholecystectomy. 20 cases (52.6%) were analysed retrospectively, 18 prospectively.

Open oesophagocardiomyotomy with fundoplication according to E.P. Suvorova (Group 1). The surgery was performed through an upper median laparotomy under general anaesthesia. After mobilisation of the abdominal oesophagus and cardia for at least 6-7 cm, an anterior extracellular oesophagocardiomyotomy according to Heller was performed. Dissection of the muscle layers was performed along the anterior surface of the oesophagus with a transition to the cardiac section

of the stomach (6 cm along the oesophagus and 2-3 cm along the stomach) before visualisation of the mucous membrane without damage. In order to prevent gastro-oesophageal reflux, anterior partial fundoplication was formed in all 20 cases of this group: the bottom of the stomach was fixed to the edges of the myotomy with separate nodular sutures without tension. The surgery was completed by drainage and layered suturing of the wound. Laparoscopic oesophagocardiomyotomy with original oesophagocardiogastroplasty (Group 2). In all 18 patients of the Group 2, the intervention was performed using a four-port technique (as opposed to the standard 5-port) in the Semi-Fowler patient position. A pneumoperitoneum (10-12 mm Hg) was created, and two 10 mm trocars and two 5 mm trocars were inserted (Fig. 1). After mobilisation of the anterior surface of the distal oesophagus, an enlarged (with transition to the posterior mediastinum) anterior extracellular oesophagocardiomyotomy with a length of 9-11 cm (6-7 cm along the oesophagus and 2-3 cm along the stomach) was performed with mandatory monitoring of the integrity of the mucous membrane ("water test"). When a microperforation was detected, it was immediately sutured with an absorbable suture (Fig. 2).



Figure 1. Layout of minimally invasive trocar placement (2×10 mm and 2×5 mm) during surgery for AC
Source: developed by the authors

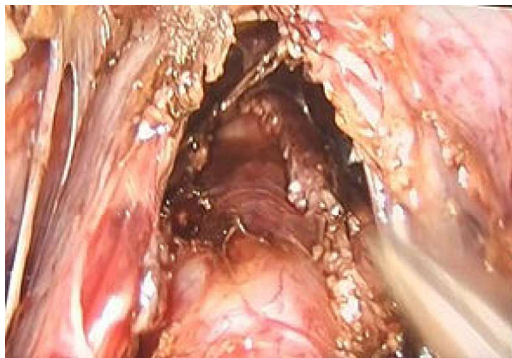


Figure 2. Intraoperative type of expanded anterior extracellular oesophagocardiomyotomy in the posterior mediastinum
Source: developed by the authors

To reliably cover the extensive defect in the mucous membrane and create a functional anti-reflux barrier, an original oesophagogastroplasty technique developed by the department was used in all 18 patients in the laparoscopic group: the defect in the muscular layer was covered by the anterior wall of the stomach, forming a triangular fold secured with a continuous suture. This technique ensured the creation of a functional anti-reflux barrier without excessive tension (Fig. 3-4). The surgery ended with the installation of drainage into the cardioesophageal zone and suturing of trocar wounds.

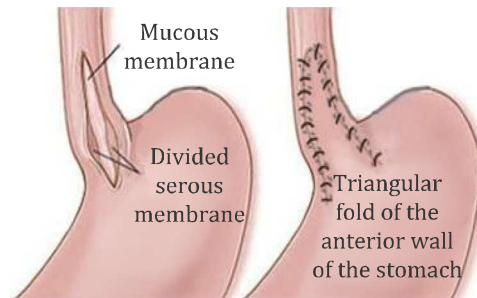


Figure 3. Diagram of oesophagocardiogastroplasty using the anterior gastric wall, as modified by the department
Source: developed by the authors

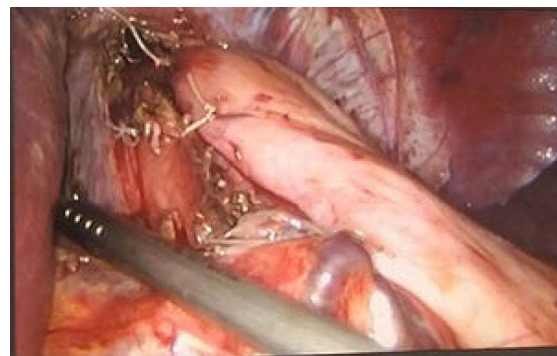


Figure 4. Oesophagocardiogastroplasty using the anterior gastric wall, as modified by the department
Source: developed by the authors

Perioperative management. For patients in Group 1 (open surgery), the standard management protocol was applied: mobilisation on days 2-3, prescription of opioid analgesics on demand, systemic infusion therapy at a rate of up to 2,000-2,500 ml/day, and initiation of enteral nutrition (liquid diet) from days 2-3 following X-ray assessment. Patients in the Group 2 (laparoscopic) were managed strictly in accordance with the Enhanced Recovery After Surgery (ERAS) protocol, which included multimodal analgesia without opioids, limited infusion therapy, early mobilisation (after 6-8 hours) and early initiation of enteral nutrition. Due to the risk of aspiration, preoperative carbohydrate loading was not used in patients with achalasia.

Results

Early results and complications of surgical treatment of AC. Comparative analysis showed significant advantages of laparoscopic access in combination with the ERAS protocol (main group, $n = 18$) over open surgery (comparison group, $n = 20$). Intraoperative parameters and safety of interventions. The use of minimally invasive technologies reduced the surgery time by 26.2% (107.6 ± 2.1 min versus 145.8 ± 3.4 min; $p < 0.01$) and reduced blood loss by more than 6 times (20 ml versus 120 ml; $p < 0.001$). When performing surgical interventions, key attention was paid to the prevention of specific complications and the control of the integrity of the mucous membrane of the oesophagus. The frequency of intraoperative perforation of the oesophageal mucosa was comparable in both groups (11.1% vs. 5.0%; $p = 0.59$) and did not depend on the type of access. These microperforations occurred in 2 patients (11.1%) of the main group and in 1 patient (5.0%) in the comparison group. All cases of perforation were promptly verified intraoperatively by means of an air and dye test, after which they were sutured using an atraumatic suture. Due to the timely intraoperative elimination of defects and the absence of long-term negative consequences, these cases were fully considered in the final analysis of long-term clinical and radiological results along with the rest of the patients in the sample.

Postoperative complications (Clavien-Dindo). The overall rate of early complications in the study group was almost twice as low as in the comparison group: 16.7% ($n = 3$) versus 30.0% ($n = 6$), respectively ($p = 0.04$). In the group of open surgeries, grade 2

complications prevailed (30.0%, $n = 6$): infectious and respiratory complications, namely pneumonia (15.0%, $n = 3$) and wound infection (10.0%, $n = 2$), requiring the appointment of antibacterial therapy. In the laparoscopic group, all complications (16.7%, $n = 3$) corresponded to grade 1 (transient gastrointestinal paresis in 2 patients and subfebrility in 1 patient), without requiring drug correction. There were no specific infectious complications. The implementation of the ERAS protocol provided: Reduction of hospitalisation time: by more than 2 times (3.4 ± 1.1 versus 7.2 ± 1.5 days; $p < 0.01$); Acceleration of mobilisation: by 3 times (0.9 ± 0.3 versus 2.8 ± 0.7 days; $p < 0.001$); Optimisation of analgesia: complete rejection of opioid analgesics in the main group (0% versus 45.0% in the comparison group; $p < 0.01$), which contributed to early recovery of gastrointestinal motility and prevention of pulmonary complications.

Intraoperative parameters and technical aspects. When performing surgical interventions, key attention was paid to the prevention of specific complications. Analysis of intraoperative data showed that microperforations of the oesophageal mucosa during oesophagocardiomyomy occurred in 2 patients (11.1%) of the main group and in 1 patient (5.0%) in the comparison group ($p = 0.59$). All cases of perforation were promptly verified intraoperatively by means of an air and dye test, after which they were sutured using an atraumatic suture, with no long-term adverse effects for the patients. There were no recorded conversions in the main group. The comparative characteristics of the key intraoperative parameters are presented in Table 1.

Table 1. Comparative characteristics of intraoperative parameters depending on the type of access

Indicator	Laparoscopy ($n = 18$)	Open surgery ($n = 20$)	p-value
Surgery time, min	107.6 ± 2.1	145.8 ± 3.4	< 0.01
Volume of blood loss, ml	20 [10; 40]	120 [80; 200]	< 0.001
Intraoperative perforation, n (%)	2 (11.1%)	1 (5.0%)	0.59

Source: developed by the authors

The analysis confirms that laparoscopic access combined with ultrasound dissection can significantly reduce blood loss by more than 6 times and reduce exposure time by 26.2%. The structure of complications according to the Clavien-Dindo classification. The overall complication rate in the study group was 16.7% ($n = 3$) versus 30.0% ($n = 6$) in the comparison group ($p = 0.04$). According to the Clavien-Dindo classification, the distribution was as follows: in the laparoscopic group, all complications corresponded to grade 1 (transient gastrointestinal paresis, subfebrility), without requiring drug correction. In the group of open interventions, grade 2 complications were recorded (pneumonia – 15.0%, $n = 3$; wound infection – 10.0%, $n = 2$), requiring antibacterial therapy. A significant reduction

in the incidence of infectious complications is associated with minimising surgical trauma and the introduction of the ERAS protocol.

The analysis of long-term results of surgical treatment of AC was carried out based on X-ray, endoscopic, and clinical and functional data. In the long-term follow-up, changes in indicators characterising the patency of the oesophageal-gastric junction and the evacuation function of the oesophagus were noted (Table 2). Comparative analysis showed a statistically significant decrease in the frequency of contrast agent delay of more than 1 minute after surgical treatment, while differences between access groups also reached statistical significance ($p < 0.05$). The elimination of the “bird’s beak” symptom has been registered in most patients.

Table 2. Radiological parameters in patients with AC in the long term

Indicator	Before surgery	After surgery	p-value
Diameter of the oesophagus, cm	4.8 ± 0.7	3.2 ± 0.5	<0.001
Barium retention >5 min, %	100.0	5.3	<0.001
«Bird's beak» symptom, %	100.0	7.9	<0.001

Source: developed by the authors

The analysis of radiological trends showed that the average diameter of the oesophagus decreased from 4.8 ± 0.7 cm to 3.2 ± 0.5 cm ($p < 0.001$). It is important to note that the “bird's beak” symptom in the laparoscopic group was completely eliminated in 94.4% of patients compared to 85.0% in the open group. Residual barium retention of more than 5 minutes one year after surgery in the main group was observed only in 5.5% of cases, which indicates a high evacuation capacity of the

formed transition. Endoscopic changes in the mucous membrane of the oesophagus and cardia are shown in Table 3. After surgical treatment, there was a statistically significant decrease in the frequency of oesophageal dilation, stagnation of contents, and erosive changes ($p < 0.01-0.001$). Complete elimination of the sign of “tightly closed cardia” was recorded in all patients ($p < 0.001$). Free passage of the endoscope through the cardia was noted in all observations.

Table 3. Endoscopic parameters in patients with AC before and after surgery

Indicator	Before surgery, %	After surgery, %	p-value
Dilation of the oesophagus	83.3	11.1	<0.001
Content stagnation	66.7	5.6	<0.001
Erosive changes	44.4	11.1	<0.01
“Tightly closed cardia”	88.9	0	<0.001

Source: developed by the authors

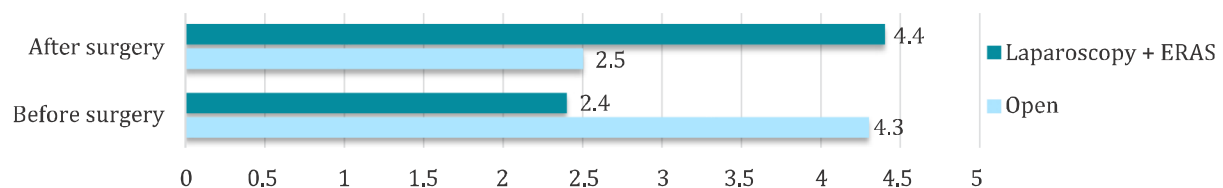
At endoscopic control after 12 months, the sign of a “tightly closed cardia” was absent in all patients. Special attention was paid to the detection of signs of reflux oesophagitis. Erosive mucosal changes in the long-term period amounted to only 11.1% (and all cases were recorded in people with signs of congestive oesophagitis before surgery), while no cases of severe oesophagitis (grade C-D according to the Los Angeles classification) were recorded. This confirms the anti-reflux effectiveness of the plastic surgery technique. Clinical and functional results. The

change in clinical symptoms on the Eckardt score is shown in Table 4. After surgical treatment, a statistically significant decrease in the total score ($p < 0.001$) was revealed. The frequency of the main symptoms (dysphagia, regurgitation, chest pain) also decreased, which was confirmed by the results of statistical analysis ($p < 0.001$). In the dynamics of assessing the clinical condition of patients, changes in GERD-HRQL indicators were analysed, reflecting the severity of symptoms of gastroesophageal reflux disease before and after treatment (Fig. 5).

Table 4. Dynamics of Eckardt Score indicators

Indicator	Before surgery	After surgery	p-value
Total score	8.8 ± 1.5	1.7 ± 0.8	<0.001
Dysphagia, %	100.0	7.9	<0.001
Regurgitation, %	83.3	5.6	<0.001
Chest pain, %	72.2	10.5	<0.001

Source: developed by the authors

**Figure 5.** Dynamics of GERD-HRQL indicators

Source: developed by the authors

Figure 5 shows the concomitant dynamics of quality of life according to the GERD-HRQL questionnaire, demonstrating a significant decrease in the intensity of reflux symptoms after surgery. Clinical efficacy and dynamics of Eckardt score at different time points (before

surgery, after 6 and 12 months). The Eckardt score is an integral indicator, but it is a detailed analysis of its components (dysphagia, regurgitation, pain) which allows assessing the quality of life after various types of interventions (Table 5).

Table 5. Measured resistance and voltage values for TiO₂ and ZrO₂ films

Symptom / Term	Before surgery	6 months (basic)	6 months (comparison)	12 months (basic)	12 months (comparison)
Dysphagia	2.7 ± 0.4	0.4 ± 0.1*	0.7 ± 0.2*	0.3 ± 0.1*	0.6 ± 0.2*
Regurgitation	2.4 ± 0.5	0.2 ± 0.1*	0.4 ± 0.1*	0.2 ± 0.1*	0.5 ± 0.2*
Chest pain	1.8 ± 0.6	0.1 ± 0.05*	0.3 ± 0.1*	0.1 ± 0.05*	0.3 ± 0.1*

Note: *p < 0.05 when compared with the preoperative level

Source: developed by the authors

By the 6th month of follow-up, both groups showed a sharp decrease in the intensity of dysphagia, which indicates the adequacy of the performed myotomy. However, in the laparoscopic group, the level of regurgitation and pain behind the sternum was consistently lower (p < 0.05). This can be interpreted as the result of a modified oesophagogastroplasty (research proposal No. 1/19-20), which restores the anatomy of the cardio-oesophageal junction in a more physiological manner than the conventional Suvorov fundoplication. Rehabilitation indicators and the ERAS protocol. The length of hospitalisation has become one of the key differentiating factors between the subgroups. In the laparoscopic group (ERAS), the mean length of stay was 3.4 ± 1.1 days, whereas for open surgery it was 7.2 ± 1.5 days (p < 0.01). This significant difference is due not only to the type of access, but also to opioid withdrawal (0% in the main group versus 45.0% in the control group), which made it possible to start enteral nutrition within 12-18 hours after the intervention. Early mobilisation (during the first day) in the main group contributed to a decrease in the systemic inflammatory response and rapid recovery of working capacity. Comparative analysis demonstrated that laparoscopic oesophagocardiomyotomy under the ERAS protocol is not only safer in the short term (reducing Clavien-Dindo complications), but also more effective in the long term on the Eckardt Score, providing more stable relief of regurgitation and pain.

Discussion

The results obtained in this study indicate the high effectiveness of Heller oesophagocardiomyotomy in the treatment of AC with a marked and statistically significant decrease in clinical symptoms, improvement in radiological and endoscopic parameters, and restoration of the functional state of the oesophagus. The advantages of laparoscopic access in comparison with open interventions were revealed. The decrease in the average Eckardt score from 8.8 ± 1.5 to 1.7 ± 0.8 (p < 0.001) meets the criteria for clinical success and reflects a marked regression of disease symptoms. Similar

results were presented by S. Rohof *et al.* (2020), where after laparoscopic myotomy, a decrease in the Eckardt score to <3 points was noted in 85-90% of patients. L.L. Swanström [16] also showed that long-term clinical success after Heller myotomy reaches 88%, which is comparable with the data obtained in the present study.

The X-ray changes revealed in this study demonstrate the restoration of patency of the oesophageal-gastric junction and regression of oesophageal dilatation. A decrease in the diameter of the oesophagus and a significant decrease in the frequency of contrast delay confirm the restoration of motor evacuation function. Similar data were presented in the study by P. Familiari *et al.* [17], where there was a significant decrease in the diameter of the oesophagus and an improvement in the evacuation of barium suspension after surgical treatment. The endoscopic results of this study indicate the restoration of anatomical patency of the cardia and the absence of pronounced inflammatory changes in the mucous membrane. The absence of severe reflux oesophagitis in the long-term period indicates the effectiveness of antireflux correction performed simultaneously with myotomy. F. Abir *et al.* [18] showed that the addition of fundoplication reduces the frequency of postoperative gastroesophageal reflux by up to 10-15%, whereas without an antireflux procedure, this indicator can exceed 40%.

A comparative analysis of surgical approaches in the present study showed that laparoscopic myotomy is accompanied by a lower incidence of residual functional disorders and a more pronounced restoration of oesophageal motility. The study by H. Jung *et al.* [19] also noted that minimally invasive technologies can reduce surgical trauma and improve functional outcomes. The impact of minimally invasive technologies on postoperative recovery deserves special attention [20]. S.H. Kim *et al.* [21] showed that laparoscopic myotomy is associated with shorter hospital stays and faster recovery of peristalsis. The limitation of the study is the relatively small sample size, which is conditioned by the low prevalence of the disease. However, the results obtained are comparable with international research

data and demonstrate the statistical significance of the main indicators. Thus, the results of this study confirm that laparoscopic Heller oesophagocardiomyomy with antireflux correction and the use of the ERAS protocol provides a pronounced and sustained improvement in clinical and functional parameters, surpassing open interventions in a number of parameters. The data obtained are consistent with contemporary international research and complement existing ideas about the surgical treatment of achalasia cardia.

Conclusions

The study showed that Heller oesophagocardiomyotomy is a highly effective method of surgical treatment of AC, providing a lasting improvement in clinical, functional, radiological, and endoscopic parameters in the long term of follow-up. A significant decrease in the total score on the Eckardt score, and a significant decrease in the frequency of dysphagia, regurgitation, and pain syndrome indicate a marked regression of clinical symptoms and the achievement of a stable clinical effect. It has been established that surgical intervention helps to restore the motor evacuation function of the oesophagus, which is confirmed by a decrease in its diameter, the almost complete elimination of contrast agent retention, and the elimination of characteristic radiological signs of the disease. Endoscopic data also demonstrate the restoration of patency of the cardia and a significant reduction in inflammatory changes of the mucous membrane, which indicates the effectiveness of an integrated surgical approach with antireflux correction.

A comparative analysis of various surgical approaches has shown the advantages of Heller laparoscopic myotomy. The minimally invasive approach is characterised by a more pronounced restoration of

oesophageal function and a lower incidence of residual functional disorders in the long term compared with open interventions. The results obtained confirm the expediency of widespread use of laparoscopic technologies in the treatment of acne. An additional factor contributing to the improvement of treatment outcomes is the use of the ERAS protocol, which optimises the perioperative management of patients and accelerates functional recovery. Despite the convincing results obtained, the study has limitations in terms of relatively small sample size and the multi-centre nature of the study. In this regard, promising areas for further research include expanding the patient sample, conducting randomised comparative studies with standardised assessment criteria, and a more detailed analysis of quality of life using standardised questionnaires. Special attention should be paid to investigating the effect of the initial stages of the disease and the morphofunctional characteristics of the oesophagus on the long-term results of surgical treatment.

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Conflict of Interest

None.

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