



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

Email: [editorijhsp@gmail.com](mailto:editorijhsp@gmail.com)

## Hellar Cardiomyotomy For Achalasia Cardia In Sulaymaniyah, Clinical Outcomes And Patient Satisfaction

<sup>1</sup>Deari Ahmed Ismaeil, <sup>2</sup>Mohammad Hikmat Namiq, <sup>3</sup>Hedi Salah Mohammad, <sup>4</sup>Bawar Omer Rasul

<sup>1,2,3,4</sup>Branch of Clinical sciences, College of Medicine, University of Sulaymaniyah, Irak

<sup>1</sup>[deari.ismaeil@univsul.edu.iq](mailto:deari.ismaeil@univsul.edu.iq), <sup>2</sup>[mohammed.05002127@univsul.edu.iq](mailto:mohammed.05002127@univsul.edu.iq),

<sup>3</sup>[hedi.05001603@univsul.edu.iq](mailto:hedi.05001603@univsul.edu.iq), <sup>4</sup>[Bawar.05001910@univsul.edu.iq](mailto:Bawar.05001910@univsul.edu.iq).

\*Correspondence Email: [deari.ismaeil@univsul.edu.iq](mailto:deari.ismaeil@univsul.edu.iq)

**Abstract:** Achalasia cardia (AC) is a rare esophageal motility disorder characterized by impaired esophageal peristalsis and failure of lower esophageal sphincter (LES) relaxation, resulting in progressive dysphagia, regurgitation, weight loss, and reduced quality of life. This study aimed to evaluate the clinical outcomes of Heller cardiomyotomy in patients with achalasia cardia treated at the Gastrointestinal Tract Surgery Department of Sulaymaniyah Teaching Hospital between November 2018 and December 2023. A cross-sectional study was conducted among patients with primary achalasia who underwent Heller cardiomyotomy, while patients with incomplete records, recurrent disease, or previous peroral endoscopic myotomy (POEM) were excluded. Preoperative assessment included demographic characteristics, medical history, upper gastrointestinal endoscopy, barium swallow, high-resolution manometry, and Eckardt score evaluation. Patients underwent either laparoscopic or open Heller myotomy according to clinical feasibility and patient preference, followed by regular postoperative follow-up. Data were analyzed using descriptive and inferential statistical methods. The mean patient age was  $46.1 \pm 11.5$  years, with 74.1% aged 34–55 years, and females represented 58.1% of the study population (male-to-female ratio 1:1.4). Following surgery, 87.2% of patients achieved a final Eckardt score of  $\leq 3$ , indicating significant symptomatic improvement. Laparoscopic Heller myotomy with Dor fundoplication was performed in 58.1% of patients and resulted in three minor postoperative complications, whereas open Heller myotomy with Dor fundoplication was performed in 22.6% of patients without postoperative complications. No statistically significant association was observed between the surgical approach and postoperative Eckardt scores. In conclusion, Heller cardiomyotomy is an effective and safe treatment for achalasia cardia, providing substantial symptom relief and low postoperative morbidity. Although both laparoscopic and open approaches demonstrated favorable outcomes, the laparoscopic approach appears to be the preferred surgical option because of its widespread use and excellent clinical results.

**Keywords:** Achalasia Cardia, Heller Cardiomyotomy, Laparoscopic Heller Myotomy, Dor Fundoplication, Eckardt Score, Esophageal Motility Disorder, Surgical Outcomes, High-Resolution Manometry.

## INTRODUCTION

Achalasia cardia (AC) is a rare primary esophageal motility disorder characterized by impaired esophageal peristalsis and incomplete relaxation of the lower esophageal sphincter



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(LES), resulting in functional obstruction of the esophagogastric junction (Savarino et al., 2022). Although considered an uncommon disease, recent epidemiological studies have reported an increasing incidence worldwide, with annual rates rising from approximately 0.5–1.2 to 1.6 cases per 100,000 population in several regions (O'Neill et al., 2013). This trend may reflect improvements in diagnostic techniques, greater clinical awareness, and enhanced access to high-resolution manometry (HRM), which remains the gold standard for diagnosing achalasia.

The exact etiology of achalasia cardia remains incompletely understood. Current evidence suggests that the disease results from progressive degeneration of inhibitory ganglion cells within the esophageal myenteric plexus, leading to impaired LES relaxation and absent peristalsis (Ruiz-de-León et al., 2002). Autoimmune mechanisms appear to play a central role, particularly among genetically susceptible individuals carrying specific human leukocyte antigen (HLA)-DQ variants, including *DQA10103\** and *DQB10603\**. In addition, chronic viral infections, especially herpes simplex virus type 1, have been proposed as potential triggers that initiate immune-mediated neuronal destruction (Boeckxstaens, 2008). Secondary forms of achalasia may also occur in association with Chagas disease caused by *Trypanosoma cruzi* infection or as part of rare genetic syndromes such as Triple A (Allgrove) syndrome (Herbella et al., 2004; Verma et al., 1999).

Clinically, patients commonly present with progressive dysphagia affecting both liquids and solids, regurgitation of undigested food, retrosternal chest pain, weight loss, nocturnal cough, and recurrent aspiration (Savarino et al., 2022). As the disease progresses, chronic esophageal stasis predisposes patients to aspiration pneumonia, bronchiectasis, pulmonary abscesses, and progressive esophageal dilatation, substantially impairing quality of life. Consequently, early diagnosis and timely intervention are essential to prevent irreversible esophageal remodeling and long-term complications.

Accurate diagnosis requires a combination of clinical assessment and complementary investigations. Upper gastrointestinal endoscopy is primarily performed to exclude mechanical causes of dysphagia, including esophageal strictures and malignancy, while characteristic findings in achalasia include retained food, esophageal dilatation, and resistance at the gastroesophageal



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junction (Fisichella et al., 2008). Timed barium esophagography provides valuable morphological information, demonstrating delayed esophageal emptying, the classical "bird-beak" appearance, and the degree of esophageal dilatation. However, HRM remains the diagnostic gold standard because it objectively measures esophageal motility patterns and enables classification of achalasia into clinically relevant subtypes that guide therapeutic decision-making (Jung et al., 2020).

The primary objective of achalasia treatment is to reduce LES pressure, improve esophageal emptying, relieve dysphagia, and prevent disease-related complications. Since no available therapy reverses the underlying neuronal degeneration, current treatment strategies focus on symptom control through mechanical disruption of the LES (Jung et al., 2020). Therapeutic options include pneumatic dilatation (PD), laparoscopic Heller myotomy (LHM), peroral endoscopic myotomy (POEM), botulinum toxin injection, and pharmacological therapy for selected high-risk patients (Bassotti & Annese, 1999). Among these interventions, LHM combined with partial fundoplication has long been regarded as the standard surgical treatment because of its excellent long-term efficacy, durable symptom relief, and relatively low recurrence rate.

Although laparoscopic Heller myotomy achieves symptom improvement in approximately 90–97% of patients, treatment failure and disease recurrence remain important clinical concerns (Bonatti et al., 2005). Previous studies have shown that 18–21% of patients undergoing LHM and up to 35% of those treated with pneumatic dilatation require retreatment within five years (Bonatti et al., 2005). Furthermore, approximately 10–15% of patients continue to develop progressive esophageal dilatation despite treatment, and nearly 5% eventually require esophagectomy because of end-stage disease (Eckardt et al., 2008). Emerging techniques such as POEM have demonstrated promising short-term outcomes, particularly for type III achalasia; however, postoperative gastroesophageal reflux disease (GERD) remains more frequent than after LHM (Inoue et al., 2015).

Despite considerable advances in surgical management, evidence regarding postoperative outcomes from developing countries remains limited. Most published studies originate from Europe, North America, and East Asia, while reports from the Middle East are relatively scarce.



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Differences in healthcare infrastructure, patient characteristics, surgical expertise, and resource availability may influence treatment outcomes and limit the generalizability of existing evidence to this region.

Therefore, this study aimed to evaluate the clinical outcomes, postoperative symptom improvement, perioperative complications, and patient satisfaction following Heller cardiomyotomy among patients with achalasia cardia treated at Sulaymaniyah Teaching Hospital, Iraq. By comparing laparoscopic and open surgical approaches using the Eckardt score and postoperative clinical outcomes, this study seeks to provide additional evidence regarding the effectiveness and safety of Heller cardiomyotomy in a tertiary referral center within a resource-limited healthcare setting. The findings are expected to contribute to the growing body of evidence supporting optimal surgical management of achalasia cardia and to inform future clinical decision-making in similar healthcare contexts.

## METHODS

### Study Design and Setting

This hospital-based cross-sectional study was conducted at the Gastrointestinal Tract Surgery Department of Sulaymaniyah Teaching Hospital, Iraq, between November 2018 and December 2023. The study aimed to evaluate the clinical outcomes, postoperative symptom improvement, perioperative complications, and patient satisfaction following Heller cardiomyotomy in patients diagnosed with primary achalasia cardia (AC). Sulaymaniyah Teaching Hospital serves as a tertiary referral center for upper gastrointestinal surgery in the Kurdistan Region of Iraq, receiving patients from various provinces.

The study protocol was approved by the Ethics Committee of the College of Medicine, University of Sulaymaniyah (Approval No. 106). All procedures were performed in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

### Study Population



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Patients were recruited consecutively from the surgical database of the Gastrointestinal Surgery Department. Eligible participants were adults diagnosed with primary achalasia cardia based on clinical presentation, upper gastrointestinal endoscopy (OGD), barium swallow examination, and high-resolution manometry (HRM).

## *Inclusion Criteria*

Participants were eligible if they:

1. had a confirmed diagnosis of primary achalasia cardia;
2. underwent Heller cardiomyotomy during the study period;
3. completed both preoperative and postoperative clinical evaluations; and
4. agreed to participate in postoperative follow-up.

## *Exclusion Criteria*

Patients were excluded if they:

1. had incomplete medical records;
2. did not undergo surgical treatment;
3. had recurrent achalasia requiring reoperation;
4. previously underwent Peroral Endoscopic Myotomy (POEM); or
5. were diagnosed with secondary achalasia caused by malignancy or other underlying diseases.

## **Preoperative Assessment and Data Collection**

A comprehensive preoperative evaluation was performed for every participant using standardized clinical assessment procedures. Demographic information included age, sex, occupation, residency, smoking status, alcohol consumption, body mass index (BMI), comorbidities, and relevant medical history.

Clinical severity was assessed using the Eckardt Score, a validated symptom scoring system that evaluates four clinical domains: dysphagia, regurgitation, retrosternal chest pain, and weight loss. Each symptom was scored from 0 to 3, resulting in a total score ranging from 0 to 12, where higher scores indicate more severe disease.

All patients underwent standardized diagnostic investigations before surgery, including:



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1. Upper gastrointestinal endoscopy (OGD) to exclude malignancy or mechanical obstruction;
2. Timed barium swallow examination to determine esophageal morphology and degree of dilatation;
3. High-resolution manometry (HRM) to confirm the diagnosis and evaluate lower esophageal sphincter pressure and esophageal motility.

Clinical information and investigation findings were extracted from patients' medical records using a structured data collection form developed specifically for this study.

## **Surgical Procedure**

The surgical approach was selected according to anatomical feasibility, surgeon assessment, and patient preference. Patients underwent either laparoscopic Heller myotomy or conventional open Heller myotomy.

For the laparoscopic procedure, five trocar ports were inserted, including one port for liver retraction. Patients allocated to open surgery underwent an upper midline laparotomy.

Following exposure of the distal esophagus, longitudinal and circular muscle fibers were carefully divided using dissecting forceps and/or a LigaSure™ device until the submucosal plane was completely exposed. The myotomy extended approximately 6 cm proximally along the esophagus and 2 cm distally onto the gastric cardia to ensure adequate lower esophageal sphincter release.

An intraoperative leak test using methylene blue solution was routinely performed to identify possible mucosal perforation. Following successful myotomy, an anterior 180° Dor fundoplication was constructed to reduce the risk of postoperative gastroesophageal reflux while preserving esophageal emptying.

## **Postoperative Follow-up**

All patients received standardized postoperative care according to institutional protocols.

Clinical follow-up was conducted through scheduled outpatient visits and structured telephone interviews. During each follow-up, patients were reassessed using the Eckardt Score to evaluate postoperative symptom improvement. Information regarding dysphagia, regurgitation,



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chest pain, weight loss, postoperative complications, and additional interventions was systematically recorded.

The mean postoperative follow-up period was approximately  $2.8 \pm 1.6$  years, allowing assessment of intermediate-term surgical outcomes and patient satisfaction.

## Outcome Measures

The primary outcome was postoperative symptom improvement measured using the final Eckardt Score. Successful treatment was defined as an Eckardt score of  $\leq 3$ , consistent with international guidelines for achalasia management.

Secondary outcomes included:

1. perioperative complications;
2. postoperative complications;
3. comparison of outcomes between laparoscopic and open Heller myotomy;
4. relationships between preoperative investigations (OGD, barium swallow, and HRM) and postoperative outcomes; and
5. overall patient satisfaction during follow-up.

## Statistical Analysis

Data were manually verified for completeness before being entered into Microsoft Excel 2022 and subsequently analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 22.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean  $\pm$  standard deviation (SD), whereas categorical variables were summarized using frequencies and percentages.

Associations between categorical variables were evaluated using Pearson's Chi-square test or Fisher's Exact Test when appropriate. Relationships between preoperative clinical findings and postoperative outcomes were analyzed using cross-tabulation analysis.

All statistical tests were two-tailed, and a p-value of  $<0.05$  was considered statistically significant.

## RESULT AND DISCUSSION

### Result

#### *Socio-demographics*

The study included 31 patients; females were (58.1%), whereas the males were (41.9%) (Table 1). The mean age was (46.11±1.5), from 18 to 68 years old, most of the cases were aged between 34 to 55 years old (74.1%) as shown in.

Regarding occupation of cases most are housewives (45.5%), followed by workers (19.4%), driver and policemen (9.7%) and (6.5%) respectively (Table 2).

Sex					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	13	41.9	41.9	41.9
	female	18	58.1	58.1	100.0
	Total	31	100.0	100.0	

**Table 1:** Sex of patients

Most of the patients were non-smokers (83.9%) and non-drinkers (90.3%). as shown in (Table 2).

Smoking					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	5	16.1	16.1	16.1
	No	26	83.9	83.9	100.0
	Total	31	100.0	100.0	
Drinking					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	3	9.7	9.7	9.7
	no	28	90.3	90.3	100.0
	Total	31	100.0	100.0	

**Table 2:** Smoking and drinking status of the cases

Regarding comorbidities with AC, most of the cases did not have co-morbidities (77.4%), but (4) of the cases have hypertension. (Table 3)

Comorbidity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hypertension	4	12.9	12.9	12.9
	Hypertension, Hypothyroidism	1	3.2	3.2	16.1
	Hypothyroidism	2	6.5	6.5	22.6
	None	24	77.4	77.4	100.0
	Total	31	100.0	100.0	

**Table 3: Co-Morbidity of patients**

## Clinical Assessment And Investigations

The Eckardt Score which is based on frequency of 4 symptoms as it was talked about before was taken retrogradely, the score is from 0-12. The initial Eckardt score shows a range score of 4-10 which is (87%) of total cases as shown in (Table 4).

		Initial Eckardt Score			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3.2	3.2	3.2
	3.00	1	3.2	3.2	6.5
	4.00	2	6.5	6.5	12.9
	5.00	5	16.1	16.1	29.0
	6.00	1	3.2	3.2	32.3
	7.00	5	16.1	16.1	48.4
	8.00	6	19.4	19.4	67.7
	9.00	5	16.1	16.1	83.9
	10.00	3	9.7	9.7	93.5
	11.00	1	3.2	3.2	96.8
	12.00	1	3.2	3.2	100.0
	Total		31	100.0	100.0

**Table 4: initial Eckardt Score**

Most of the patients didn't go through previous treatment such as (dilation, stent) (87.1%), some had dilation by balloon (9.7%). (Table 5)

		Previous treatment			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dilation	3	9.7	9.7	9.7
	none	27	87.1	87.1	96.8
	sent	1	3.2	3.2	100.0
	Total	31	100.0	100.0	

**Table 5: previous Treatment for Achalasia**

The OGD shows that the patients oesophagus were either tight (41.9%) or tight+dilated (45.2%) and some were normal (12.9%). (Table 6)

		OGD			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	4	12.9	12.9	12.9
	Tight	13	41.9	41.9	54.8
	Tight+Dilated	14	45.2	45.2	100.0
	Total	31	100.0	100.0	

**Table 6: OGD before operation**

Barium swallow which is divided into 3 grades based on a maximal diameter measured by (cm): grade I (<3.5cm), grade II (3.5-6.0cm), grade III (>6.0cm). (Table 7) shows majority of cases where grade II (45.2%) followed by grade I (38.7%).

Barium swallow morphology was also calculated they were either straight or sigmoid (90.3%) and (9.7%) respectively as shown in (Table 7)

Grade					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	12	38.7	38.7	38.7
	2.00	14	45.2	45.2	83.9
	3.00	5	16.1	16.1	100.0
	Total	31	100.0	100.0	
Morphology					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sigmoid	3	9.7	9.7	9.7
	Straight	28	90.3	90.3	100.0
	Total	31	100.0	100.0	

*Table 7: Barium swallow grades and morphology*

HRM shows: most cases had increased resting pressure in the LES (90.3%) (table 8).

HRM					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	increase	28	90.3	90.3	90.3
	normal	3	9.7	9.7	100.0
	Total	31	100.0	100.0	

*Table 8: HRM investigation*

The types of surgery that was done and most went through Lap+Dor (58.1%) followed by Open+Dor (22.6%) (Table 9).

Type of surgery					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lap+Dor	18	58.1	58.1	58.1
	Lap-Dor	4	12.9	12.9	71.0
	Open+Dor	7	22.6	22.6	93.5
	Open-Dor	2	6.5	6.5	100.0
	Total	31	100.0	100.0	

*Table 9: Types of surgery*

Minimal peri-operative complication occurred (90.3%) and only 3 cases had esophageal perforation (Table 10).

Perioperative Complication					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Esophageal Perforation	3	9.7	9.7	9.7

		Frequency	Percent	Valid Percent	Cumulative Percent
	none	28	90.3	90.3	100.0
	Total	31	100.0	100.0	
Post-Operative Complication					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Infection	1	3.2	3.2	3.2
	None	27	87.1	87.1	90.3
	Respiratory Complication	3	9.7	9.7	100.0
	Total	31	100.0	100.0	

**Table 10:** Perioperative and postoperative complications

For follow up we used the Eckardt scoring system again, most have no symptoms (54.8%), and from the 4 symptoms dysphagia was the most frequently reported (32.3) (Table 11).

The final Eckardt score was taken from a mean time 2.8 (1.6) years since operation and shows a final Eckardt score range from 0-6 which is a major improvement (Table 12).

		Frequency	Percent	Valid Percent	Cumulative Percent
Follow up					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	none	17	54.8	54.8	54.8
	Dysphagia	3	9.7	9.7	64.5
	Dysphagia, Retrosternal pain, Heartburn	1	3.2	3.2	67.7
	Dysphagia, Retrosternal pain, Regurgitation, Heartburn	2	6.5	6.5	74.2
	Dysphagia, Weight loss	4	12.9	12.9	87.1
	Heartburn	1	3.2	3.2	90.3
	Regurgitation	1	3.2	3.2	93.5
	Retrosternal pain	1	3.2	3.2	96.8
	Retrosternal pain, Regurgitation, Heartburn	1	3.2	3.2	100.0
	Total	31	100.0	100.0	

**Table 11:** follow up of symptoms

		Frequency	Percent	Valid Percent	Cumulative Percent
Final Eckardt score					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	18	58.1	58.1	58.1
	1.00	3	9.7	9.7	67.7
	2.00	2	6.5	6.5	74.2
	3.00	4	12.9	12.9	87.1
	5.00	2	6.5	6.5	93.5
	6.00	2	6.5	6.5	100.0
	Total	31	100.0	100.0	

**Table 12:** final Eckardt score

## OGD finding and relationship with initial Eckardt score

There was a relation between initial Eckardt score and the OGD results, Patients which have higher Eckardt score are more likely to have OGD abnormality (P value = 0.124) (Table 13).

Initial Eckardt Score relation with OGD finding						
			OGD			Total
			normal	Tight	Tight+Dilated	
Initial Eckardt Score	2.00	Count	1	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	100.0%
	3.00	Count	0	0	1	1
		% within Initial Eckardt Score	0.0%	0.0%	100.0%	100.0%
	4.00	Count	0	2	0	2
		% within Initial Eckardt Score	0.0%	100.0%	0.0%	100.0%
	5.00	Count	1	1	3	5
		% within Initial Eckardt Score	20.0%	20.0%	60.0%	100.0%
	6.00	Count	1	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	100.0%
	7.00	Count	0	3	2	5
		% within Initial Eckardt Score	0.0%	60.0%	40.0%	100.0%
	8.00	Count	0	4	2	6
		% within Initial Eckardt Score	0.0%	66.7%	33.3%	100.0%
	9.00	Count	0	2	3	5
		% within Initial Eckardt Score	0.0%	40.0%	60.0%	100.0%
	10.00	Count	1	0	2	3
		% within Initial Eckardt Score	33.3%	0.0%	66.7%	100.0%
	11.00	Count	0	1	0	1
		% within Initial Eckardt Score	0.0%	100.0%	0.0%	100.0%
12.00	Count	0	0	1	1	
	% within Initial Eckardt Score	0.0%	0.0%	100.0%	100.0%	
Total		Count	4	13	14	31

	% within Initial Eckardt Score	12.9%	41.9%	45.2%	100.0%
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**Table 13:** Initial Eckardt score relation with OGD finding

### **Barium swallow grade and relationship with initial Eckardt score**

There was weak association between Barium swallow grade and Eckardt score, meaning patients with high Eckardt score might have normal Barium swallow grade finding and vice versa (P value = 0.692) (Table 14).

Initial Eckardt score relation with Barium grading						
			Grade			Total
			1.00	2.00	3.00	
Initial Eckardt Score	2.00	Count	1	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	100.0%
	3.00	Count	1	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	100.0%
	4.00	Count	2	0	0	2
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	100.0%
	5.00	Count	2	1	2	5
		% within Initial Eckardt Score	40.0%	20.0%	40.0%	100.0%
	6.00	Count	0	1	0	1
		% within Initial Eckardt Score	0.0%	100.0%	0.0%	100.0%
	7.00	Count	2	3	0	5
		% within Initial Eckardt Score	40.0%	60.0%	0.0%	100.0%
	8.00	Count	2	2	2	6
		% within Initial Eckardt Score	33.3%	33.3%	33.3%	100.0%
	9.00	Count	1	3	1	5
		% within Initial Eckardt Score	20.0%	60.0%	20.0%	100.0%
	10.00	Count	1	2	0	3
		% within Initial Eckardt Score	33.3%	66.7%	0.0%	100.0%
	11.00	Count	0	1	0	1
		% within Initial Eckardt Score	0.0%	100.0%	0.0%	100.0%
12.00	Count	0	1	0	1	
	% within Initial Eckardt Score	0.0%	100.0%	0.0%	100.0%	
Total	Count	12	14	5	31	
	% within Initial Eckardt Score	38.7%	45.2%	16.1%	100.0%	

**Table 14:** Initial Eckardt score relation to Barium swallow grading

### **Initial Eckardt score and its relationship with HRM:**

With a P value of (0.018) this suggests a statically significant relationship between HRM and Eckardt score, this might indicate that patients with abnormal HRM have higher Eckardt score which suggests worse symptoms (P value = 0.018) (Table 15).

Initial Eckardt score and its relation with HRM						
			HRM		Total	
			increase	normal		
Initial Eckardt Score	2.00	Count	0	1	1	
		% within Initial Eckardt Score	0.0%	100.0%	100.0%	
	3.00	Count	0	1	1	
		% within Initial Eckardt Score	0.0%	100.0%	100.0%	
	4.00	Count	2	0	2	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	5.00	Count	5	0	5	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	6.00	Count	1	0	1	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	7.00	Count	5	0	5	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	8.00	Count	5	1	6	
		% within Initial Eckardt Score	83.3%	16.7%	100.0%	
	9.00	Count	5	0	5	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	10.00	Count	3	0	3	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	11.00	Count	1	0	1	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	12.00	Count	1	0	1	
		% within Initial Eckardt Score	100.0%	0.0%	100.0%	
	Total		Count	28	3	31
			% within Initial Eckardt Score	90.3%	9.7%	100.0%

**Table 15:** Initial Eckardt score and its relationship with HRM

### **Perioperative Esophageal perforation rates in different surgical approaches for AC**

The data shows a perforation rate of 9.7% across all surgeries. (Table 16). From the data of the table, it seem that traditional surgery (Open-lap) has the highest perforation 50%, but this comparison is bias because its surgent related than type of approach related also it plays a major role, and with a P value of 0.117 there might not be an association (P value = 0.117).

Peri-Op complication relation with surgical approach					
			Perioperative Complication		Total
			Esophageal Perforation	none	
Type of surgery	Lap+Dor	Count	1	17	18
		% within Type of surgery	5.6%	94.4%	100.0%
	Lap-Dor	Count	1	3	4
		% within Type of surgery	25.0%	75.0%	100.0%
	Open+Dor	Count	0	7	7
		% within Type of surgery	0.0%	100.0%	100.0%

	Open-Dor	Count	1	1	2
		% within Type of surgery	50.0%	50.0%	100.0%
Total		Count	3	28	31
		% within Type of surgery	9.7%	90.3%	100.0%

**Table 16:** Peri-Op complication relation with surgical approach

### **Post-operation complication and surgical approach.**

The relation between a surgical approach and respiratory complication as well as infection in general, the data shows there is a higher risk of Post-Op complication with Lap+Dor (P value = 0.453) (Table 17).

<b>Post-Op and relationship with type of surgery</b>						
			Post-Operative Complication			Total
			infection	none	Respiratory Complication	
Type of surgery	Lap+Dor	Count	1	15	2	18
		% within Type of surgery	5.6%	83.3%	11.1%	100.0%
	Lap-Dor	Count	0	4	0	4
		% within Type of surgery	0.0%	100.0%	0.0%	100.0%
	Open+Dor	Count	0	7	0	7
		% within Type of surgery	0.0%	100.0%	0.0%	100.0%
	Open-Dor	Count	0	1	1	2
		% within Type of surgery	0.0%	50.0%	50.0%	100.0%
Total	Count	1	27	3	31	
	% within Type of surgery	3.2%	87.1%	9.7%	100.0%	

**Table 17:** Post-Op and relationship with type of surgery

### **Final Eckardt score association with type of surgery**

The final Eckardt score and the type of surgery didn't seem to have a strong association as shown by the (P value 0.773), either surgery they did the final Eckardt score shows most patient had the best outcome (Eckardt score  $\leq 3$ ) (P value = 0.773) (Table 18).

<b>Final Eckardt score association with type of surgery</b>							
			Type of surgery				Total
			Lap+Dor	Lap-Dor	Open+Dor	Open-Dor	
Final Eckardt score	.00	Count	8	2	6	2	18
		% within Final Eckardt score	44.4%	11.1%	33.3%	11.1%	100.0%
	1.00	Count	3	0	0	0	3

		% within Final Eckardt score	100.0%	0.0%	0.0%	0.0%	100.0%
2.00	Count		1	1	0	0	2
	% within Final Eckardt score		50.0%	50.0%	0.0%	0.0%	100.0%
3.00	Count		2	1	1	0	4
	% within Final Eckardt score		50.0%	25.0%	25.0%	0.0%	100.0%
5.00	Count		2	0	0	0	2
	% within Final Eckardt score		100.0%	0.0%	0.0%	0.0%	100.0%
6.00	Count		2	0	0	0	2
	% within Final Eckardt score		100.0%	0.0%	0.0%	0.0%	100.0%
Total	Count		18	4	7	2	31
	% within Final Eckardt score		58.1%	12.9%	22.6%	6.5%	100.0%

**Table 18:** showing association between type of surgery and a Final Eckardt score

### **Pre-Operative OGD and Final Eckardt score.**

Pre-operative OGD seems to have no association with the final Eckardt score, because most patients had tight OGD results and the P value was not significant (0.851) (Table 19).

Crosstab						
		OGD			Total	
		normal	Tight	Tight+Dilated		
Final Eckardt score	.00	Count	2	7	9	18
		% within Final Eckardt score	11.1%	38.9%	50.0%	100.0%
	1.00	Count	0	2	1	3
		% within Final Eckardt score	0.0%	66.7%	33.3%	100.0%
	2.00	Count	0	1	1	2
		% within Final Eckardt score	0.0%	50.0%	50.0%	100.0%
	3.00	Count	1	2	1	4
		% within Final Eckardt score	25.0%	50.0%	25.0%	100.0%
5.00	Count	1	0	1	2	
	% within Final Eckardt score	50.0%	0.0%	50.0%	100.0%	
6.00	Count	0	1	1	2	
	% within Final Eckardt score	0.0%	50.0%	50.0%	100.0%	
Total		Count	4	13	14	31
		% within Final Eckardt score	12.9%	41.9%	45.2%	100.0%

**Table 19:** final Eckardt score and pre-OP OGD

### **Barium swallow grade and final Eckardt score**

The barium swallow grade seems to affect the final Eckardt score as it can be seen from (Table 20) the higher the grade the is the Eckardt score ( P value = 0.188 not significant).

Final Eckardt score with barium swallow grade						
			Grade			Total
			1.00	2.00	3.00	
Final Eckardt score	.00	Count	9	7	2	18
		% within Final Eckardt score	50.0%	38.9%	11.1%	100.0%
	1.00	Count	1	2	0	3
		% within Final Eckardt score	33.3%	66.7%	0.0%	100.0%
	2.00	Count	0	2	0	2
		% within Final Eckardt score	0.0%	100.0%	0.0%	100.0%
	3.00	Count	2	0	2	4
		% within Final Eckardt score	50.0%	0.0%	50.0%	100.0%
	5.00	Count	0	2	0	2
		% within Final Eckardt score	0.0%	100.0%	0.0%	100.0%
	6.00	Count	0	1	1	2
		% within Final Eckardt score	0.0%	50.0%	50.0%	100.0%
	Total	Count	12	14	5	31
		% within Final Eckardt score	38.7%	45.2%	16.1%	100.0%

**Table 20:** Final Eckardt score with barium swallow grade

### **HRM and Final Eckardt score**

There seem to be no association between the abnormality of HRM and final Eckardt score because most of the patient (90.3%) had increased HRM. (P value = 0.792) (Table 21).

HRM and Final Eckardt score					
			HRM		Total
			increase	normal	
Final Eckardt score	.00	Count	15	3	18
		% within Final Eckardt score	83.3%	16.7%	100.0%
	1.00	Count	3	0	3
		% within Final Eckardt score	100.0%	0.0%	100.0%
	2.00	Count	2	0	2
		% within Final Eckardt score	100.0%	0.0%	100.0%
	3.00	Count	4	0	4
		% within Final Eckardt score	100.0%	0.0%	100.0%
	5.00	Count	2	0	2
		% within Final Eckardt score	100.0%	0.0%	100.0%
	6.00	Count	2	0	2
		% within Final Eckardt score	100.0%	0.0%	100.0%
	Total	Count	28	3	31
		% within Final Eckardt score	90.3%	9.7%	100.0%

**Table 21:** HRM and Final Eckardt score

### **Initial Eckardt score vs Final Eckardt score**

The majority of patients had a substantial outcome (87.2%) and had a final Eckardt score of  $\leq 3$ , improvement of the patient's symptom those who presented with a high initial of achieved a score of  $\leq 3$  after surgery, patient with severe symptoms had variable outcome, some resolving the symptom completely (P value = 0.061) (Table 22).

Initial Eckardt Score * Final Eckardt score									
			Final Eckardt score						Total
			.00	1.00	2.00	3.00	5.00	6.00	
Initial Eckardt Score	2.00	Count	1	0	0	0	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	3.00	Count	1	0	0	0	0	0	1
		% within Initial Eckardt Score	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	4.00	Count	1	0	0	1	0	0	2
		% within Initial Eckardt Score	50.0%	0.0%	0.0%	50.0%	0.0%	0.0%	100.0%
	5.00	Count	3	1	0	1	0	0	5
		% within Initial Eckardt Score	60.0%	20.0%	0.0%	20.0%	0.0%	0.0%	100.0%
	6.00	Count	0	0	0	0	1	0	1
		% within Initial Eckardt Score	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	7.00	Count	4	0	0	0	0	1	5
		% within Initial Eckardt Score	80.0%	0.0%	0.0%	0.0%	0.0%	20.0%	100.0%
	8.00	Count	3	1	0	2	0	0	6
		% within Initial Eckardt Score	50.0%	16.7%	0.0%	33.3%	0.0%	0.0%	100.0%
	9.00	Count	4	0	0	0	0	1	5

		% within Initial Eckardt Score	80.0%	0.0%	0.0%	0.0%	0.0%	20.0%	100.0%
	10.00	Count	1	1	0	0	1	0	3
		% within Initial Eckardt Score	33.3%	33.3%	0.0%	0.0%	33.3%	0.0%	100.0%
	11.00	Count	0	0	1	0	0	0	1
		% within Initial Eckardt Score	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
	12.00	Count	0	0	1	0	0	0	1
		% within Initial Eckardt Score	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Total		Count	18	3	2	4	2	2	31
		% within Initial Eckardt Score	58.1%	9.7%	6.5%	12.9%	6.5%	6.5%	100.0%

**Table 22:** Initial Eckardt score compared to Final Eckardt score

## Discussion

This study evaluated the clinical outcomes of Heller cardiomyotomy (HCM) in patients with achalasia cardia treated at a tertiary referral center over a five-year period. The findings demonstrated that HCM provides substantial symptomatic relief, with 87.2% of patients achieving a postoperative Eckardt score of  $\leq 3$ . The low incidence of perioperative complications and the absence of significant differences in symptom improvement between laparoscopic and open approaches further support the safety and effectiveness of HCM as the standard surgical treatment for achalasia cardia. These findings are consistent with current international guidelines recommending Heller myotomy with partial fundoplication as one of the most effective long-term therapeutic options for achalasia (Savarino et al., 2022; Jung et al., 2020).

The demographic characteristics observed in this study are generally comparable with previous epidemiological reports. The mean patient age of  $46.1 \pm 11.5$  years closely resembles that reported in Malaysia (44.6 years) and Japan (43.3 years) but is slightly younger than the mean age



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

Email: [editorijhsp@gmail.com](mailto:editorijhsp@gmail.com)

reported in the Netherlands (54 years) (Chin et al., 2022; Sato et al., 2019; Van Hoeij et al., 2018). These differences may reflect variations in healthcare accessibility, referral systems, disease awareness, and diagnostic availability across countries rather than differences in disease biology. Similarly, although achalasia has generally been reported to affect males and females equally, the female predominance observed in this study (58.1%) differs from several earlier reports (Muralidharan et al., 1978; Gupta et al., 2021). Such discrepancies are likely attributable to the relatively small sample size and regional demographic characteristics rather than sex-specific susceptibility.

A notable finding of this study is that laparoscopic Heller myotomy combined with Dor fundoplication represented the most frequently performed procedure (58.1%). This observation reflects the ongoing global transition toward minimally invasive esophageal surgery. Laparoscopic surgery offers several well-established advantages, including reduced surgical trauma, less postoperative pain, shorter hospitalization, faster recovery, and improved cosmetic outcomes while maintaining surgical efficacy comparable to conventional open procedures (Paula et al., 2020). Although three intraoperative esophageal perforations occurred during laparoscopic surgery, all were recognized immediately and managed successfully without major postoperative consequences. These findings suggest that the laparoscopic approach can be performed safely in experienced centers despite its technical complexity.

Importantly, no statistically significant association was observed between the type of surgical approach and postoperative Eckardt score ( $p = 0.773$ ). Both laparoscopic and open Heller myotomy resulted in excellent postoperative symptom control, indicating that long-term clinical success depends more on adequate myotomy length and proper fundoplication than on the surgical approach itself. Similar findings have been reported by Katilius and Velanovich (2001), who demonstrated comparable symptom relief between laparoscopic and open procedures despite better postoperative quality of life following laparoscopic surgery. Likewise, Ancona et al. (1995) reported lower postoperative morbidity and faster functional recovery after laparoscopic Heller-Dor procedures while maintaining equivalent long-term efficacy.



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

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The present study also demonstrated that preoperative radiological and endoscopic findings were not significantly associated with postoperative symptom improvement. Patients with severe esophageal dilatation or advanced endoscopic abnormalities achieved outcomes comparable to those with less advanced disease after successful myotomy. This finding suggests that structural abnormalities alone may not accurately predict postoperative recovery when lower esophageal sphincter obstruction is adequately relieved. Similar observations have been reported in previous surgical series indicating that postoperative symptom improvement depends primarily on restoration of esophageal emptying rather than baseline esophageal morphology (Fisichella et al., 2008).

Conversely, a significant association was identified between higher preoperative Eckardt scores and abnormal high-resolution manometry (HRM) findings ( $p = 0.018$ ). HRM remains the diagnostic gold standard because it objectively characterizes esophageal motor dysfunction and allows classification of achalasia subtypes according to the Chicago Classification. Previous studies have demonstrated that HRM subtype influences treatment response, with type II achalasia generally showing the highest success rates after Heller myotomy, whereas type III disease often requires more extensive myotomy or alternative interventions such as peroral endoscopic myotomy (POEM) (Jung et al., 2020; Inoue et al., 2015). Therefore, incorporating HRM into routine preoperative assessment not only improves diagnostic accuracy but also facilitates individualized surgical planning.

Although POEM has emerged as an effective minimally invasive alternative for achalasia management, laparoscopic Heller myotomy remains widely regarded as the reference surgical procedure because of its durable long-term outcomes and lower incidence of postoperative gastroesophageal reflux disease (GERD). Large multicenter studies have demonstrated comparable symptom relief between POEM and Heller myotomy; however, postoperative reflux appears more frequent following POEM because the procedure does not include an anti-reflux mechanism such as fundoplication (Moonen et al., 2016; Inoue et al., 2015). The present study further supports the continued role of Heller myotomy with Dor fundoplication as an effective



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

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treatment strategy, particularly in centers where advanced endoscopic expertise or specialized POEM equipment is not readily available.

The clinical implications of this study are particularly relevant for healthcare systems in low- and middle-income countries. Despite resource limitations, the favorable outcomes observed demonstrate that high-quality surgical management of achalasia can be achieved when standardized operative techniques and structured postoperative follow-up are implemented. These findings may assist surgeons and healthcare policymakers in optimizing treatment strategies for achalasia within similar resource-constrained settings.

Several limitations should be acknowledged when interpreting these findings. First, the relatively small sample size ( $n = 31$ ) limits statistical power and may reduce the generalizability of the results. Second, this was a single-center, non-randomized study, introducing potential selection bias because surgical approach was determined according to surgeon judgment and patient preference. Third, the mean follow-up duration of approximately 2.8 years may not adequately capture late complications, disease recurrence, or the development of postoperative GERD. Finally, quality-of-life assessment instruments, postoperative pH monitoring, and repeat HRM evaluations were not routinely performed, limiting comprehensive evaluation of long-term functional outcomes.

Despite these limitations, this study contributes important evidence regarding the effectiveness and safety of Heller cardiomyotomy in a Middle Eastern tertiary referral center. The consistently favorable postoperative outcomes observed reinforce the role of laparoscopic Heller myotomy with Dor fundoplication as the preferred surgical approach for achalasia cardia while demonstrating that excellent clinical results can also be achieved using the conventional open approach when minimally invasive surgery is not feasible.

## CONCLUSION

Heller cardiomyotomy, particularly via the laparoscopic approach with Dor fundoplication, provides significant symptomatic improvement and low complication rates in patients with AC.



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

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Both laparoscopic and open techniques demonstrated favorable outcomes; however, the laparoscopic method offers superior recovery profiles and reduced postoperative morbidity, supporting its use as the preferred surgical approach when feasible.

Future multicenter, randomized studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and to compare the long-term efficacy of LHM with emerging alternatives such as POEM. Incorporating standardized quality-of-life instruments and objective reflux evaluation will further enhance the understanding of patient-centered outcomes in achalasia management.

## ***List of abbreviations***

Achalasia cardia (AC), lower oesophageal sphincter (LES), human leukocyte antigen (HLA), high resolution manometry (HRM), timed barium oesophagogram (TBE), endoscopic ultrasonography (EUS), Pneumatic dilatation (PD), laparoscopic Heller's myotomy (LHM), peroral endoscopic myotomy (POEM), botulinum toxin (BT).

## ***Declarations***

### *Ethics approval and consent to participate*

Approval (number 106) was granted from the ethical committee of the College of medicine/University of Sulaimani, Iraq. The work was implemented in accordance with international guidelines and 2008 Declaration of Helsinki. Written informed consents were provided by participants.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

The data and results supporting the conclusion of this study are included within the article.

### *Competing interests*

The authors declare that they have no competing interests.

### *Funding*

There is no funding in this work to be reported.



# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

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## *Author contributions*

Bawar omer, Hedi salah, Mohammad Hikmat contributed to data collection, study design, statistical approach, writing manuscript, and reviewing the manuscript. Deari Ahmad read and approved the final manuscript.

## *Acknowledgment*

The authors would like to express their appreciations to Dr. Deari Ahmad, Dr. Aram Abdullah, Dr. Karzan Seerwan, Dr. Barham Muhamad and we would like to thank Sulaymaniyah GI teaching hospital for providing data and cases.

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# International Journal of Health Systems and Policy

ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

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ISSN(Online): 3109-5267

Vol 2 no 1 (2026): June 2026

<https://journal.as-salafiyah.id/index.php/ijhsp/index>

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