

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,200

Open access books available

168,000

International authors and editors

185M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



## Chapter

# Update on Achalasia Treatment

*Gad Marom, Ronit Brodie and Yoav Mintz*

## Abstract

Achalasia is a primary motility disorder of the esophagus characterized by failure of relaxation of the lower esophageal sphincter (LES) and aperistalsis of the esophagus. There are 3 types of achalasia, diagnosed and differentiated according to the Chicago classification using high resolution manometry (HRM). The classic symptoms of achalasia as described by the Eckardt score are dysphagia, retrosternal pain, regurgitation and weight loss. This chapter will discuss the interesting evolution of achalasia in the modern era, the ways to diagnose achalasia, different sub-groups within achalasia patients population, treat it with either endoscopic or surgical manner, pre-operative and post-operative considerations and routine follow-up.

**Keywords:** achalasia, Eckardt score, per-Oral endoscopic Myotomy, high resolution manometry, Endo-FLIP

## 1. Introduction

Achalasia is a primary motility disorder of the esophagus characterized by failure of relaxation of the lower esophageal sphincter (LES) and aperistalsis of the esophagus. There are 3 types of achalasia, diagnosed and differentiated according to the Chicago classification 4.0 using high resolution manometry (HRM) [1]. These types are differentiated by the functionality of the esophageal motility and do not reflect a progression of the disease from one to the other. The classic symptoms of achalasia include progressive dysphagia, retrosternal pain, regurgitation or vomiting of undigested food and weight loss [2].

Over the last few years, the incidence of achalasia has increased. Once thought to be a rare disease with an incidence of 0.03–1.63 per 100,000 persons per year, a higher incidence of 2.3–2.93 cases per 100,000 persons per year was recently reported [3, 4]. The upsurge in incidence may be attributed to the increased use of high-resolution manometry (HRM). This test has become more sensitive and easier to interpret due to better sensors and intuitive visualization of results. Additionally, the emergence of Per-Oral Endoscopic Myotomy (POEM) has also largely contributed to the increased awareness of the disease.

The textbook presentation of patients with achalasia is outdated. Patients are no longer appearing as malnourished or cachectic as classically described [5, 6]. Counterintuitively, in recent years, due to the variety of calorie-rich, high fat soft and liquid foods, some achalasia patients have begun to present as overweight and even obese. These patients suffer from dysphagia and retrosternal pain but manage their symptoms via dietary changes and constant eating due to lack of satiety, which

may further contribute to increased weight gain despite dysphagia. Additionally, the complaints of chest pain are often mistakenly contributed to a reflux disease that is more common among obese patients than achalasia, thereby delaying their diagnoses. It is quite common to find achalasia patients treated with antacid medications such as proton pump inhibitors, unsuccessfully, as the pathophysiology of achalasia is not rooted in acid reflux but regurgitation of undigested food.

Young achalasia patients often are misdiagnosed as suffering from eating disorders, specifically among adolescents and female gender [7, 8]. It is not uncommon for patients to be admitted to inpatient care for eating disorder, further delaying time to correct diagnosis.

Delays in treatment either due to delay in diagnosis, or secondary to fear of treatment may significantly impact outcomes. Delaying treatment can aggravate symptoms, exacerbate dysphagia and cause severe weight loss and secondary pulmonary complications such as recurrent pneumonias secondary to micro-aspirations. Untreated long-standing achalasia may result in end-stage achalasia, expressed as sigmoid esophagus on barium swallow studies and endoscopy. This entity limits the treatment options that are available for other achalasia patients who are treated earlier in the disease process. Another sequela from untreated achalasia is the increased risk for esophageal cancer. This is thought to be caused by long-standing stasis of food, liquid and debris in the esophagus resulting in bacterial overgrowth and subsequently squamous cell cancer [9].

## **2. Diagnosis and work up**

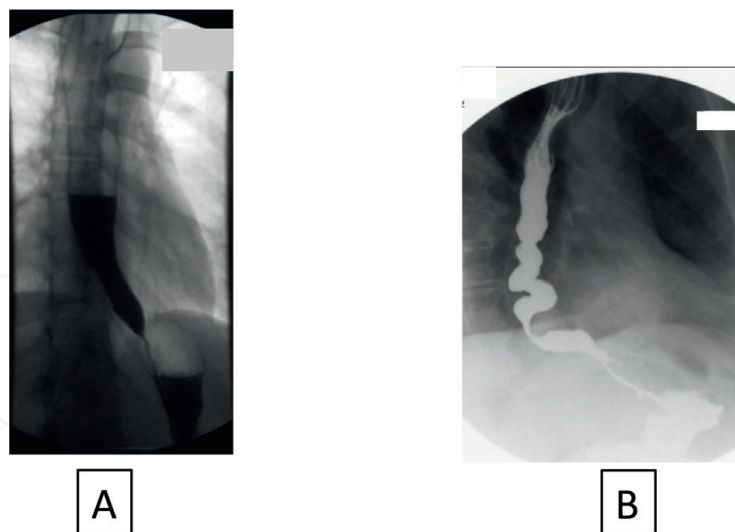
The diagnosis of achalasia is determined based on findings from three studies: high-resolution esophageal manometry, contrast enhanced swallow study (CESS), and esophagogastroduodenoscopy (EGD) [10]. The clinical severity is determined based on the Eckardt score scaling system.

### **2.1 Contrast enhanced swallow study (CESS)**

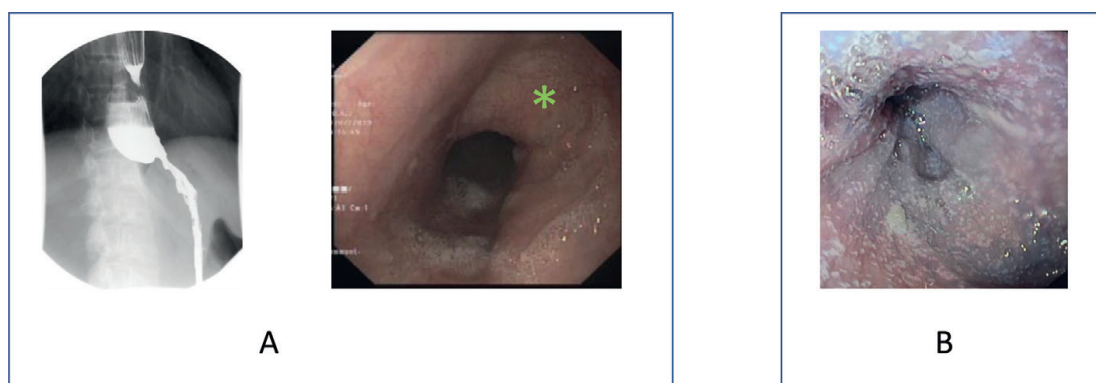
A key portion of diagnosis includes the evaluation of the anatomical image of the esophagus. Contrast enhanced swallow study, also known as barium swallow or upper GI swallow, allows for the visualization of the esophagus and elimination of alternative diagnosis such as carcinoma, strictures or diverticula [11]. CESS is non-invasive, widely available, and relatively inexpensive [12, 13]. As CESS has only 60% sensitivity for identifying achalasia [14], it cannot be solely relied upon for the diagnosis. The classic sign of tapering of the esophagus at the distal end giving a “bird’s beak” appearance at the esophagogastric junction is pathognomonic for a diagnosis of achalasia (**Figure 1A**). Additional findings include dilation of the esophagus, retention of barium in the esophagus and an air-fluid level. In long standing disease a sigmoid shape esophagus may be evident. The absence of gastric air bubble is also suggestive of achalasia. A torturous twisting appearance of the esophagus in a “corkscrew” fashion (**Figure 1B**) may also be suggestive of esophageal dysmotility [15].

### **2.2 Esophagogastroduodenoscopy (EGD)**

EGD is important in the diagnosis of achalasia as it is necessary to rule out other possible causes of dysphagia including gastroesophageal reflux, strictures due to erosive esophagitis, esophageal diverticula (**Figure 2A**), tumors and obtaining biopsies



**Figure 1.**  
*Contrast enhanced swallow study images that correlate with achalasia. A: Pathognomonic appearance of bird's beak on CESS. B: Corkscrew esophagus from esophageal dysmotility.*



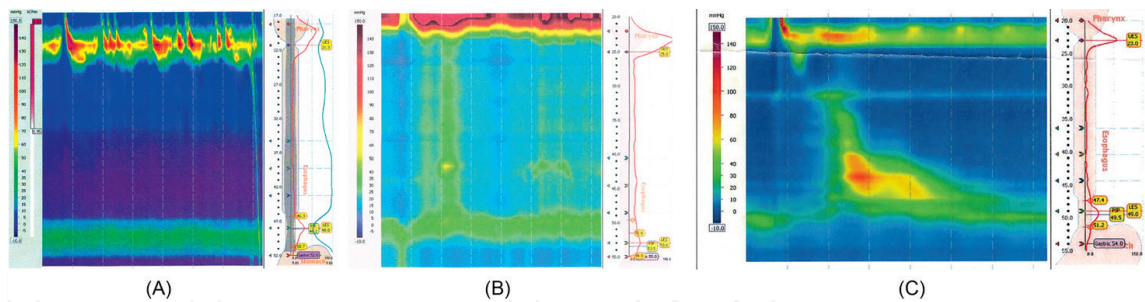
**Figure 2.**  
*Endoscopic images of different endoscopic pathologies that can mimic achalasia symptoms. A: Esophageal diverticula- on the left fluoroscopic image, on the right endoscopic image (green asterisk marks the diverticula). B: Esophageal candidiasis.*

to rule out eosinophilic esophagitis. Careful attention should be made to the ease of passage through the esophago-gastric junction (EGJ) into the stomach, any signs of esophagitis or strictures, as well as a detailed retroflexion view to rule out any tumor. Additional findings may include candidiasis infection (**Figure 2B**) as demonstrated by white plaques on the esophageal walls, not uncommon in patients with achalasia, most likely secondary to the change in pH due to food stasis [16].

### 2.3 High resolution manometry (HRM)

In order to understand the motility and function of the esophagus, the high-resolution manometry in conjunction with the new Chicago Classification 4.0 has allowed for better understanding, earlier diagnosis and improved classification of esophageal motility disorders [1, 17]. The HRM is able to provide images detailing the information regarding vigor of each swallow, peristalsis, relaxation and pressure of the upper and lower esophageal sphincters, thereby improving diagnostic accuracy [18]. Furthermore, the ability of testing to differentiate between the pressures of the lower esophageal sphincter and the diaphragmatic pressure, which with previous standard





**Figure 3.** High resolution manometry demonstrating different types of achalasia (left to right)- all 3 types have mean IRP pressure higher than the upper limit of normal. Type 1 with 100% failed peristalsis, type 2 with panesophageal pressurization and type 3 with distal spastic contractions.

manometry was not as clearly differentiated, has been beneficial. The identification of hiatal hernia versus increased esophageal pressure is one of the keys to proper diagnosis and treatment.

HRM in which a catheter containing pressure sensors approximately 1 to 2 cm apart is positioned from the hypopharynx to the stomach (via nasal introduction) with the patient being asked to swallow mouthfuls of water at several intervals. The sensors combined with computer analytic software can build an image of higher and lower pressures, peristalsis and relaxation of the esophageal sphincters. The inclusion of impedance which allows for the visualization of bolus clearance, also aides in the differentiation of esophageal from oro-pharyngeal motility dysfunctions [19].

In achalasia findings on HRM will be dependent on what type of achalasia is present, with all types demonstrating both aperistalsis and elevated Lower esophageal sphincter residual pressures (>15). Determination of which type of achalasia will be dependent on the remaining findings on HRM (**Figure 3**).

Hallmark findings according to the Chicago classification 4.0 for Type 1 achalasia will demonstrate 100% failed peristalsis, while type 2 will demonstrate panesophageal pressurization in 20% or more swallows, and type 3 will present with 20% or more premature spastic appearing contractions.

## 2.4 Eckardt score

Eckardt score (**Table 1**) is a scoring panel used to assess the severity of achalasia symptoms and is based on four major symptoms: dysphagia, regurgitation, chest pain, and weight loss [10]. Symptoms of dysphagia in patients with achalasia are usually described as progressing from solids and to liquids. Regurgitation, bringing up undigested food following meals – even hours later, is also common. Retrosternal chest pain is usually described as burning pressure often radiating to the upper back and neck. Weight loss varies, according to the dietary changes made by each patient to accommodate their symptoms.

To score, each symptom is given a value between 0 and 3 depending on its frequency (**Table 1**). It is important to note that while the Eckardt score is utilized for the determination of severity and for determining success of treatment, it holds limitations, and the severity may not correlate with manometric or CESS findings. The occurrence of concomitant obesity and achalasia has been previously reported, and as the obesity endemic grows, the possibility of achalasia in obese patients presenting with dysphagia should not be discounted [20]. As such, determination of severity based on the Eckardt scale may not accurately reflect certain populations with achalasia.

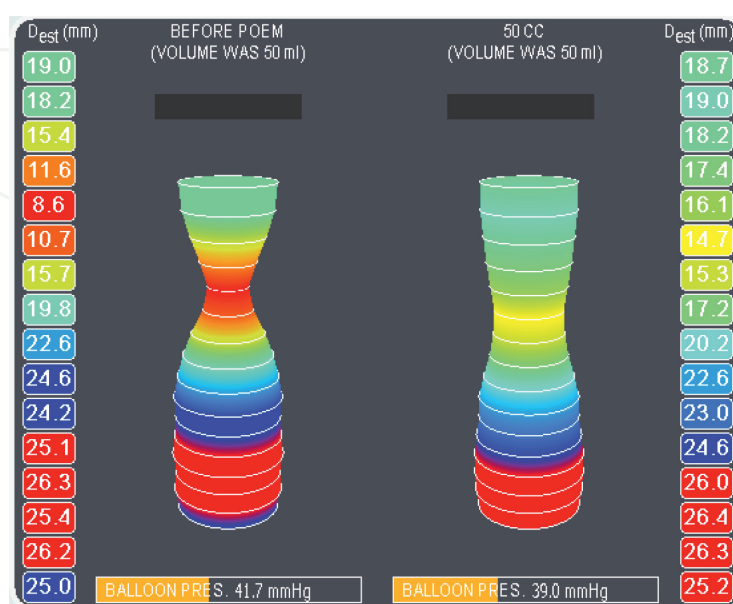
	Weight loss (kg)	Dysphagia	Retrosternal pain	Regurgitation
0	None	None	None	None
1	<5	Occasional	Occasional	Occasional
2	5 to 10	Daily	Daily	Daily
3	>10	Each Meal	Each Meal	Each Meal

**Table 1.**  
 Eckardt score: Each symptom is given a value between 0 and 3 depending on frequency while weight loss is scored based on how many kilogram in weight have been lost. A summary of this score is done and a total between 0 and 12 is given.

## 2.5 EndoFLIP™

Functional luminal imaging probe (FLIP) quantifies the relationship between luminal geometry and pressure when assessing the esophageal wall and area around the lower esophageal sphincter (LES) at the esophago-gastric junction (EGJ). EndoFLIP™ (Medtronic Inc., Minneapolis, Minn, USA) provides information on both distensibility and lumen diameter of the esophagus. The technology consists of a multielectrode probe and proprietary software that measures the dynamic geometrical changes of the EGJ and esophageal body. It uses high-resolution impedance planimetry during volume-controlled distension of the probe once it passes the EGJ. Specifically, EndoFLIP analyzes the relationship between luminal cross-sectional area (CSA) and pressure, providing a measurement of the luminal distensibility (CSA/pressure) [21, 22]. The EndoFLIP can be used intraoperatively to assess treatment results following completion of myotomy (**Figure 4**). As opposed to HRM which requires patient cooperation and swallowing, the EndoFLIP can be performed on anesthetized patients and determine the post-op distensibility and lumen diameter.

In addition, there are several reports in the literature that use FLIP to evaluate contractility in the esophageal body of patients to complement HRM results. However, in



**Figure 4.**  
 EndoFLIP- on the left is the pre-myotomy image showing low distensibility at the EGJ with narrow passage. On the right is the post-myotomy image showing improvement in the distensibility and a wider passage at the EGJ.

order to do so, the probe is placed more proximal along the esophagus and a special software is used to assess peristalsis [23, 24].

### **3. Treatment options**

The mainstay of treatment for achalasia is directed toward lowering the LES pressure to allow food passage to the stomach. The non-surgical treatment options include pneumatic balloon dilatation and Botulinum toxin injection while surgical treatments include Heller myotomy and per-oral endoscopic myotomy (POEM) [25, 26]. Offering the appropriate treatment option to a specific patient is done when taking into consideration all the pre-operative work up, comorbidities, and nutritional status of each individual patient.

#### **3.1 Non-surgical treatment**

Generally, the non-surgical treatment options are preferred for patients who are considered high risk for surgical intervention secondary to their comorbidities.

##### *3.1.1 Botilium toxin injection*

Botilium toxin A (Allergan Inc., Irvine, California, USA), a muscle paralytic which acts via inhibiting the release of acetylcholine locally at the neuromuscular junction thereby reducing the tone of the lower esophageal sphincter resulting in its relaxation [27]. Endoscopically guided injections of 25 units are placed in each of four quadrants circumferentially around the lower esophageal sphincter just above the Z line using a sclerotherapy needle, for a total of 100 units. However, its rather limited short acting results with 78.7% patients having relief of symptoms at one month post injection and declining to 40.6% at 12 months post injection [28], and approximately 50% of patients requiring repeated injections [29]. Botilium toxin injection may be used as a bridging procedure in severely malnourished patients until surgery to allow some relief of symptoms and weight gain [30]. Botilium toxin injection may be a good option for elderly high-risk surgical patients, even if repeated injections are necessary.

##### *3.1.2 Pneumatic dilation*

Under endoscopic and radiological guidance an achalasia balloon commonly the Rigiflex Balloon system (Boston Scientific Corp, Boston, Massachusetts, USA) is used to tear the musculature of the lower esophageal sphincter thereby reducing the outflow obstruction and alleviating symptoms. The balloon should be approximately 150% of the diameter of normal EG junction. It is placed under endoscopic and fluoroscopic guidance and slowly inflated to 30 to 35 or 40 mm using 7–15 psi of air. The balloon is held inflated for 15–60 seconds effectively tearing the lower esophageal sphincter muscles thereby leaving the area open [31]. A risk of pneumatic dilation (PD) is the possibility of esophageal perforation, carrying a risk of 1.9% when done by experienced clinicians (range 0–16), and if occurs requires emergent surgical intervention. With 62% of patients reporting alleviation of symptoms at 6 months post dilation, this is a good option for poor surgical candidates [32].

It should be noted that a PD post-surgical intervention either lap heller or POEM may be useful tool for treating recurrence of symptoms (see below recurrent symptoms) [33]. Typically, a one-time treatment to 30 mm is sufficient.

### **3.2 Surgical intervention**

Laparoscopic Heller myotomy (LHM) with fundoplication is the surgical gold standard treatment of achalasia. Since 2007 with the introduction of Per-Oral Endoscopic Myotomy (POEM), has become more widely used. LHM has excellent efficacy, with an improvement in symptom scores and high satisfaction in more than 90% of patients for up to 5 years after the procedure [34]. Due to the high rate of malnutrition in patients with achalasia, it is imperative to evaluate the patient's metabolic status and consider pre-operative enteral nutrition. By providing enteral or parenteral nutrition for a short time prior to surgical intervention, the catabolic status may be reversed, thereby reducing chances of complications.

#### *3.2.1 Laparoscopic or robotic Heller myotomy*

Laparoscopic Heller Myotomy (LHM) includes the division of the circular and longitudinal muscles 2 cm distal and 5–7 cm proximal to the EGJ in achalasia types 1 and 2. For achalasia type 3 a longer, esophageal myotomy is done, and can be tailored to each patient according to the HRM. In order to avoid gastro- esophageal reflux, a fundoplication, either posterior (Toupet) or anterior (Dor) is added to the procedure.

This procedure can be done robotically with enhanced visualization of the circular muscles and better control of their delicate division and several studies and meta-analysis have demonstrated a lower of esophageal perforation rate and reduction of technical complications [35, 36].

Several studies have shown excellent results with LHM, demonstrating improvement of symptoms and patient satisfaction of >90% in the 6 months post-operative period. These results were maintained in most studies for up to 5 years. However, there were some studies demonstrating a decrease with time in symptoms improvement of up to 57% in some reports [32, 34, 37]. Although LHM is done with fundoplication, some patients still suffer from GERD symptoms and have esophagitis on endoscopy.

#### *3.2.2 Per-Oral endoscopic myotomy (POEM)*

Once considered innovative novel procedure, POEM is becoming more and more accepted as a viable alternative to LHM. POEM is performed under general anesthesia using a standard gastroscope inserted into the esophagus per orally.

A small longitudinal incision is made on the esophageal mucosa approximately 10 cm proximal to the EGJ to allow the gastroscope to slide into the submucosal plane. A sub-mucosal dissection is then performed and carried all the way until 2 cm distal to the EGJ. Then the myotomy is performed including the circular muscle layer only, leaving the longitudinal layer intact. The length of the myotomy is tailored to each patient according to the HRM but usually begins from 2 cm distal to the EGJ to 5–7 cm proximal to it. This can be done in an antegrade fashion or retrograde. It can be done on the anterior or the posterior aspects of the esophagus [38]. POEM is especially recommended for patients with type 3 achalasia as a long thoracic myotomy is indicated for these patients [39], which is more difficult to perform in LHM.



POEM has excellent results as demonstrated by a reduction in Eckardt score to  $<3$ , achieving clinical success and improvement of dysphagia in 83–98% of the patients [40, 41]. However, GERD is a concern among post-operative achalasia patients. Several studies have compared LHM to POEM regarding post-operative GERD symptoms. Werner et al. [41] randomly assigned 221 patients to undergo either POEM (112 patients) or LHM plus Dor's fundoplication (109 patients). They showed that after POEM 44% of the patients had esophagitis after 24 months vs. 29% in the LHM group. However, high-grade esophagitis (Los Angeles Classification grade C or D) was similar between POEM and LHM at 24 months, suggesting 5% in the POEM group and 6% in the LHM group. They also found that 24 h pH monitoring was similar among patients who underwent POEM and LHM.

In order to reduce reflux symptoms that could potentially lead to GERD, esophagitis, strictures, Barrett's esophagus and even cancer Inoue et al. [42] described adding an endoscopic fundoplication to POEM (F-POEM), but this technique is still novel and needs to be further explored.

### *3.2.3 Esophagectomy*

End-stage achalasia is characterized by severe dysphagia and a sigmoid, torturous esophagus seen on endoscopy and on barium swallow study. Although patients with end-stage achalasia might suffer from complications such as pulmonary complications, esophagitis and risk for cancer, they do not have many treatment options [43]. Although most studies suggest that POEM, LHM or PD might be the first step in trying to treat patients with end-stage achalasia [44, 45], others suggest that esophagectomy alone is the treatment that these patients should be offered [46].

Reconstruction after esophagectomy can be done preferably using gastric pull-up or colonic interposition. This is a high morbidity procedure that should be reserved to specific patients as it comes with the potential for significant post-operative complications, morbidity and although rare, mortality [47, 48].

## **4. Special considerations**

### **4.1 Pediatric population**

In recent years, the incidence of achalasia has risen rather significantly including an increase in pediatric population and may in part be due to the increased sensitivity of testing and increased awareness of the diagnosis. Children who were otherwise misdiagnosed, with anorexia, chronic pulmonary manifestations such as recurrent pneumonia and failure to thrive are now being diagnosed with achalasia. Diagnosis is made as in the adult population, via HRM, EGD and CESS. Special attention should be made to biopsies for evaluation of eosinophilic esophagitis which may mimic achalasia symptoms but requires treatment with oral steroid gel rather than surgical intervention. In general, the treatment options for the pediatric population need to take into consideration growth and long-term risk for reflux. The gold standard of treatment in pediatric patients is laparoscopic Heller myotomy Botilium toxin injection is not recommended as there is no clear dose known for pediatric population [49]. Pneumatic dilation is not a good option for children as first line therapy, due to need for recurrent dilations [50]. In recent years, POEM has gained popularity and is

often preferred over traditional surgery. With results similar to their adult counterparts, POEM is a good option for pediatric population in the hands of experienced surgeons [51, 52].

## **4.2 Pregnancy**

Maternal nutrition has long been a subject in the medical world and similar to malnutrition from other causes, achalasia is known to cause intrauterine growth restriction, preterm labor and small for gestational age [53]. Additional considerations include the socioeconomic effects of absent mothers due to extended hospitalizations, missed work, and increased healthcare costs. The early diagnosis and treatment of achalasia prior to pregnancy is imperative to ensure healthy outcomes for both mother and fetus. As such ideally, diagnosis and treatment are made prior to pregnancy. However, in cases where the diagnosis is only made during pregnancy the clinician must take into consideration both patients, mother and fetus. Treatment options during pregnancy may include enteral nutrition supplements via feeding tube placement and delaying definitive treatment until delivery with close monitoring of fetus for IUGR and SGA.

Non-surgical treatments such as Botox injection have been reported in the literature [54, 55] however, Botox is labeled as a pregnancy category C, based on studies using significantly lower doses for cosmetic use. As such the use Botox in pregnancy and its safety is not clear [56].

Following delivery, standard surgical intervention can be scheduled either laparoscopic Heller myotomy or POEM.

## **4.3 Follow up**

Post POEM follow up should include surveillance with Eckardt score, with a score less than three regarded as treatment success, barium swallow study, 24 hours pH-metry, manometry and EGD as needed based on patient symptomatology [57]. While follow up diagnostics and treatments vary from center to center, studies have found that surveillance EGD at 1 year post POEM may help to identify those patients with reflux [58]. The recommendation for yearly EGD examination has also been suggested by Milito et al. [59].

## **4.4 Salvage therapy for recurrence or failed treatment**

Recurrence of symptoms can occur in some patients. These symptoms need to be investigated to understand if the symptoms are related to outflow obstruction, GERD or dysmotility of the esophagus. A barium swallow study should be performed for an accurate imaging of the esophagus with dynamic evaluation, an upper endoscopy to assess the LES, presence of esophagitis, candidiasis or other pathology and a manometry to evaluate the esophagus and the LES function. If available, EndoFLIP is a reasonable complementary test for evaluation.

After these assessments, if a diagnosis of recurrence or failed treatment is established, a salvage therapy may be offered. The salvage therapy depends on the type of initial treatment. Studies trying to evaluate what kind of salvage therapy is more appropriate, failed to demonstrated superiority of one over the other [60–63]. After failed LHM or POEM either posterior POEM or PD can be offered. If a patient suffers from GERD after POEM a treatment with either medical management or laparoscopic

fundoplication are viable options. In patients with candida which can mimic recurrence of symptoms, the recommended treatment is oral antifungals.

## 5. Summary

While achalasia was once thought to be a rare disorder, recent years has seen a significant increase in the incidence, perhaps attributable to the increased use of HRM and general recognition of the disease. Contrary to classic textbook descriptions, achalasia patients may present in normal weight or even obese due to the availability of high calorie and protein soft and liquid food. Diagnosis should be made based on three exams, HRM, CESS and EGD. The Eckardt score can aid in understanding the severity of symptoms, but may not adequately reflect actual disease status, and may not be correlated with exam findings. Early treatment is key especially in younger populations, in order to prevent disease progression and complications. Treatment options should be tailored to each patient based on age, nutrition status and comorbidities. The gold standard of treatment is Laparoscopic Heller Myotomy with fundoplication; however, POEM has been accepted as a comparable surgical treatment if performed in experienced centers. Follow-up is mandatory to assist patients with coping with this chronic disease and screen for early or late complications as well as offering salvage treatment when needed.

Achalasia is a chronic and irreversible condition. Early treatment may slow down the progression of the disease. Opening the LES may facilitate passage of food into the stomach and alleviate symptoms, however aperistalsis of the esophagus persists.

### Author details


Gad Marom<sup>1,2\*</sup>, Ronit Brodie<sup>1</sup> and Yoav Mintz<sup>1,2</sup>

1 Department of General Surgery, Hadassah Hebrew University Medical Center, Jerusalem, Israel

2 Faculty of Medicine, Hebrew University of Jerusalem, Jerusalem, Israel

\*Address all correspondence to: gadimarom@gmail.com

### IntechOpen

© 2022 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Yadlapati R et al. Esophageal motility disorders on high-resolution manometry: Chicago classification version 4.0(©). *Neurogastroenterology and Motility*. 2021;**33**(1):e14058
- [2] Eckardt VF, Aignherr C, Bernhard G. Predictors of outcome in patients with achalasia treated by pneumatic dilation. *Gastroenterology*. 1992;**103**(6):1732-1738
- [3] Samo S et al. Incidence and prevalence of achalasia in Central Chicago, 2004-2014, since the widespread use of high-resolution manometry. *Clinical Gastroenterology and Hepatology*. 2017;**15**(3):366-373
- [4] Duffield JA et al. Incidence of achalasia in South Australia based on esophageal manometry findings. *Clinical Gastroenterology and Hepatology*. 2017;**15**(3):360-365
- [5] Annese V, Bassotti G. Non-surgical treatment of esophageal achalasia. *World Journal of Gastroenterology*. 2006;**12**(36):5763-5766
- [6] Howard PJ et al. Five year prospective study of the incidence, clinical features, and diagnosis of achalasia in Edinburgh. *Gut*. 1992;**33**(8):1011-1015
- [7] Goldacre M, Benians R, Goldacre R. Esophageal achalasia diagnosed in people previously diagnosed with an eating disorder: Epidemiological study using record-linkage. *The International Journal of Eating Disorders*. 2021;**54**(11):2015-2018
- [8] Letranchant A et al. Eating disorder or oesophageal achalasia during adolescence: Diagnostic difficulties. *Eating and Weight Disorders*. 2020;**25**(1):87-90
- [9] Chino O et al. Clinicopathological studies of esophageal carcinoma in achalasia: Analyses of carcinogenesis using histological and immunohistochemical procedures. *Anticancer Research*. 2000;**20**(5c):3717-3722
- [10] Eckardt AJ, Eckardt VF. Current clinical approach to achalasia. *World Journal of Gastroenterology*. 2009;**15**(32):3969-3975
- [11] Schlottmann F, Patti MG. Esophageal achalasia: Current diagnosis and treatment. *Expert Review of Gastroenterology & Hepatology*. 2018;**12**(7):711-721
- [12] Aviv JE et al. Cost-effectiveness of two types of dysphagia care in head and neck cancer: A preliminary report. *Ear, Nose, & Throat Journal*. 2001;**80**(8):553-556 558
- [13] Administration HCF. Enrollment Package, Medicare Part B, Area 01, Manhattan. Washington DC: H.C.F. Administration; 2000
- [14] El-Takli I, O'Brien P, Paterson WG. Clinical diagnosis of achalasia: How reliable is the barium x-ray? *Canadian Journal of Gastroenterology*. 2006;**20**(5):335-337
- [15] Debi U et al. Barium esophagogram in various esophageal diseases: A pictorial essay. *Indian Journal of Radiology and Imaging*. 2019;**29**(2):141-154
- [16] Pandolfino JE, Gawron AJ. Achalasia: A systematic review. *JAMA*. 2015;**313**(18):1841-1852
- [17] Lafraia FM et al. A pictorial presentation of esophageal high



resolution manometry current parameters. *Arquivos Brasileiros de Cirurgia Digestiva*. 2017;**30**(1):69-71

[18] Pandolfino JE et al. High-resolution manometry in clinical practice: Utilizing pressure topography to classify oesophageal motility abnormalities. *Neurogastroenterology and Motility*. 2009;**21**(8):796-806

[19] Carlson DA, Pandolfino JE. High-resolution manometry in clinical practice. *Gastroenterology & Hepatology (N Y)*. 2015;**11**(6):374-384

[20] Almogly G, Anthone GJ, Crookes PF. Achalasia in the context of morbid obesity: A rare but important association. *Obesity Surgery*. 2003;**13**(6):896-900

[21] Savarino E et al. Use of the functional lumen imaging probe in clinical Esophagology. *The American Journal of Gastroenterology*. 2020;**115**(11):1786-1796

[22] Pannala R et al. Devices for esophageal function testing. *VideoGIE*. 2022;**7**(1):1-20

[23] Carlson DA et al. Classifying esophageal motility by FLIP Panometry: A study of 722 subjects with manometry. *The American Journal of Gastroenterology*. 2021;**116**(12):2357-2366

[24] Carlson DA et al. The functional lumen imaging probe detects esophageal contractility not observed with manometry in patients with achalasia. *Gastroenterology*. 2015;**149**(7):1742-1751

[25] Khashab MA et al. ASGE guideline on the management of achalasia. *Gastrointestinal Endoscopy*. 2020;**91**(2):213-227.e6

[26] Tolone S et al. Recent trends in endoscopic management of achalasia.

*World Journal of Gastrointestinal Endoscopy*. 2014;**6**(9):407-414

[27] Brisinda G et al. Treatment of gastrointestinal sphincters spasms with botulinum toxin a. *Toxins (Basel)*. 2015;**7**(6):1882-1916

[28] Campos GM et al. Endoscopic and surgical treatments for achalasia: A systematic review and meta-analysis. *Annals of Surgery*. 2009;**249**(1):45-57

[29] Pasricha PJ et al. Intrasphincteric botulinum toxin for the treatment of achalasia. *The New England Journal of Medicine*. 1995;**332**(12):774-778

[30] DeMeester SR. Per-oral endoscopic myotomy for achalasia. *Journal of Thoracic Disease*. 2017;**9**(Suppl. 2):S130-s134

[31] Richter JE. Esophageal motility disorder achalasia. *Current Opinion in Otolaryngology & Head and Neck Surgery*. 2013;**21**(6):535-542

[32] Vela MF et al. The long-term efficacy of pneumatic dilatation and Heller myotomy for the treatment of achalasia. *Clinical Gastroenterology and Hepatology*. 2006;**4**(5):580-587

[33] Patti MG, Schlottmann F, Herbella FAM. Esophageal achalasia: Evaluation and treatment of recurrent symptoms. *World Journal of Surgery*. 2022;**46**(7):1561-1566

[34] Ortiz A et al. Very long-term objective evaluation of heller myotomy plus posterior partial fundoplication in patients with achalasia of the cardia. *Annals of Surgery*. 2008;**247**(2):258-264

[35] Milone M et al. Robotic versus laparoscopic approach to treat symptomatic achalasia: Systematic

review with meta-analysis. *Diseases of the Esophagus*. 2019;**32**(10):1-8

[36] Ali AB et al. Robotic and per-oral endoscopic myotomy have fewer technical complications compared to laparoscopic Heller myotomy. *Surgical Endoscopy*. 2020;**34**(7):3191-3196

[37] Patti MG, Tamburini A, Pellegrini CA. Cardiomyotomy. *Seminars in Laparoscopic Surgery*. 1999;**6**(4):186-193

[38] Marom G et al. The POEM bottom-up technique for achalasia. *Surgical Endoscopy*. 2021;**35**(11):6117-6122

[39] Vaezi MF et al. ACG clinical guidelines: Diagnosis and Management of Achalasia. *The American Journal of Gastroenterology*. 2020;**115**(9):1393-1411

[40] Delliturri A et al. A narrative review of update in per oral endoscopic myotomy (POEM) and endoscopic esophageal surgery. *Annals of Translational Medicine*. 2021;**9**(10):909

[41] Werner YB et al. Endoscopic or surgical Myotomy in patients with idiopathic achalasia. *The New England Journal of Medicine*. 2019;**381**(23):2219-2229

[42] Inoue H et al. Peroral endoscopic myotomy and fundoplication: A novel NOTES procedure. *Endoscopy*. 2019;**51**(2):161-164

[43] Eckardt VF, Hoischen T, Bernhard G. Life expectancy, complications, and causes of death in patients with achalasia: Results of a 33-year follow-up investigation. *European Journal of Gastroenterology & Hepatology*. 2008;**20**(10):956-960

[44] Qiu S et al. Advanced achalasia: Good candidate for peroral endoscopic

myotomy. *Diseases of the Esophagus*. 2021;**34**(3):1-7

[45] Waters J, Martin LW, Molena D. Esophagectomy for end-stage achalasia. *World Journal of Surgery*. 2022;**46**(7):1567-1574

[46] Devaney EJ et al. Esophagectomy for achalasia: Patient selection and clinical experience. *The Annals of Thoracic Surgery*. 2001;**72**(3):854-858

[47] Glatz SM, Richardson JD. Esophagectomy for end stage achalasia. *Journal of Gastrointestinal Surgery*. 2007;**11**(9):1134-1137

[48] Palanivelu C et al. Laparoscopic transhiatal esophagectomy for 'sigmoid' megaesophagus following failed cardiomyotomy: Experience of 11 patients. *Digestive Diseases and Sciences*. 2008;**53**(6):1513-1518

[49] Franklin AL, Petrosyan M, Kane TD. Childhood achalasia: A comprehensive review of disease, diagnosis and therapeutic management. *World Journal of Gastrointestinal Endoscopy*. 2014;**6**(4):105-111

[50] Tashiro J, Petrosyan M, Kane TD. Current management of pediatric achalasia. *Translational Gastroenterology and Hepatology*. 2021;**6**:33

[51] Goneidy A et al. Surgical Management of Esophageal Achalasia in pediatrics: A systematic review. *European Journal of Pediatric Surgery*. 2020;**30**(1):13-20

[52] Choné A et al. Multicenter evaluation of clinical efficacy and safety of per-oral endoscopic Myotomy in children. *Journal of Pediatric Gastroenterology and Nutrition*. 2019;**69**(5):523-527

[53] Khudyak V, Lysy J, Mankuta D. Achalasia in pregnancy. *Obstetrical &*

Gynecological Survey. 2006;**61**(3):  
207-211

[54] Hooft N, Schmidt ES, Bremner RM. Achalasia in pregnancy: Botulinum toxin a injection of lower esophageal sphincter. *Case Reports Surgery*. 2015;**2015**:328970

[55] Wataganara T et al. Treatment of severe achalasia during pregnancy with esophagoscopy injection of botulinum toxin a: A case report. *Journal of Perinatology*. 2009;**29**(9):637-639

[56] Lowe NJ et al. Dosing, efficacy and safety plus the use of computerized photography for botulinum toxins type a for upper facial lines. *Journal of Cosmetic and Laser Therapy*. 2010;**12**(2):106-111

[57] Oude Nijhuis RAB et al. European guidelines on achalasia: United European gastroenterology and European Society of Neurogastroenterology and Motility recommendations. *United European Gastroenterologisches Journal*. 2020;**8**(1):13-33

[58] Ponds FA et al. Effect of Peroral endoscopic Myotomy vs pneumatic dilation on symptom severity and treatment outcomes among treatment-naive patients with achalasia: A randomized clinical trial. *JAMA*. 2019;**322**(2):134-144

[59] Milito P et al. Revisional therapy for recurrent symptoms after Heller Myotomy for achalasia. *Journal of Gastrointestinal Surgery*. 2022;**26**(1):64-69

[60] Felix VN et al. Achalasia: What to do in the face of failures of Heller myotomy. *Annals of the New York Academy of Sciences*. 2020;**1481**(1):236-246

[61] Legros L et al. Long-term results of pneumatic dilatation for relapsing symptoms of achalasia after Heller

myotomy. *Neurogastroenterology and Motility*. 2014;**26**(9):1248-1255

[62] Tang X et al. Feasibility and safety of peroral endoscopic myotomy for achalasia after failed endoscopic interventions. *Diseases of the Esophagus*. 2017;**30**(3):1-6

[63] van Hoeij FB et al. Management of recurrent symptoms after per-oral endoscopic myotomy in achalasia. *Gastrointestinal Endoscopy*. 2018;**87**(1):95-101