

## Lecture No. 14

### Motility Disorders of the Esophagus - 2 - Esophageal Achalasia

Ever since the mechanisms governing the motility functions of the esophagus were first elucidated, the term “cardiospasm” - used to label a dysphagic symptom referred to the cardia - soon gave way to “achalasia”, which more precisely reflected the pathogenesis of the phenomenon: namely, the failed relaxation (from the Greek ἀχάλασις) of the lower esophageal sphincter (LES) following the primary wave.

The primum movens of the pathogenic process lies in the damage endured by Auerbach’s and Meissner’s intramural myenteric plexuses, which are markedly reduced in number and varyingly damaged. The relationship between the nerve damage and the esophageal motility disorder thus becomes clear. Similar functional alterations are seen in experimentally induced lesions to the vagus nerve and nucleus ambiguus. On the other hand, proof of this relationship between nerve damage and dysfunctional consequences is seen in Chagas’ disease (*Trypanosoma Cruzi*), a high number of cases of which show an association of megaesophagus with ganglion cells destruction.

The etiology of the nerve damage at the origin of the disease is unknown, even though a number of theories have been advocated. One of the most interesting of these holds that a possible ischemic factor lies at the origin of the ganglionic damage. Under conditions of diffuse esophageal spasm, for instance, endoluminal pressure may exceed arterial pressure; this possibility may in turn induce ischemic damage of the intramural ganglia, which are well known to be sensitive to ischemic noxae. The chief objection to this theory is that diffuse esophageal spasm does not as a rule precede the onset of achalasia.

From the pathophysiological standpoint, it must be stated from the outset that the single term achalasia does not exhaust the terms of the esophageal motility problem. Indeed, in many cases - rather than a failed opening of the LES after deglutition - an irregular and sporadic relaxation of the sphincter often occurs; as such, in these cases dyschalasia is a more appropriate term. In other instances the LES relaxes, but is delayed compared to what *should* be the primary wave (Fig. 1). I say *should*, since instead of on any sphincteral irregularity, the motility disorder is based on the absence of esophageal propulsive activity, inasmuch as the primary contractions along the entire organ are concomitant, that is synchronized and simultaneous (in esophageal manometry these are seen with all of their peaks aligned on the same vertical axis). As a result, the circular musculature contracts simultaneously throughout the various levels of the esophagus, thereby losing the primary wave’s propulsive property. In more advanced stages of the disease, the motility disorder becomes even more important, ultimately resulting in the complete absence of sphincteral relaxation and the substitution of the primary wave with anarchic and low-intensity tertiary waves (Fig. 2).

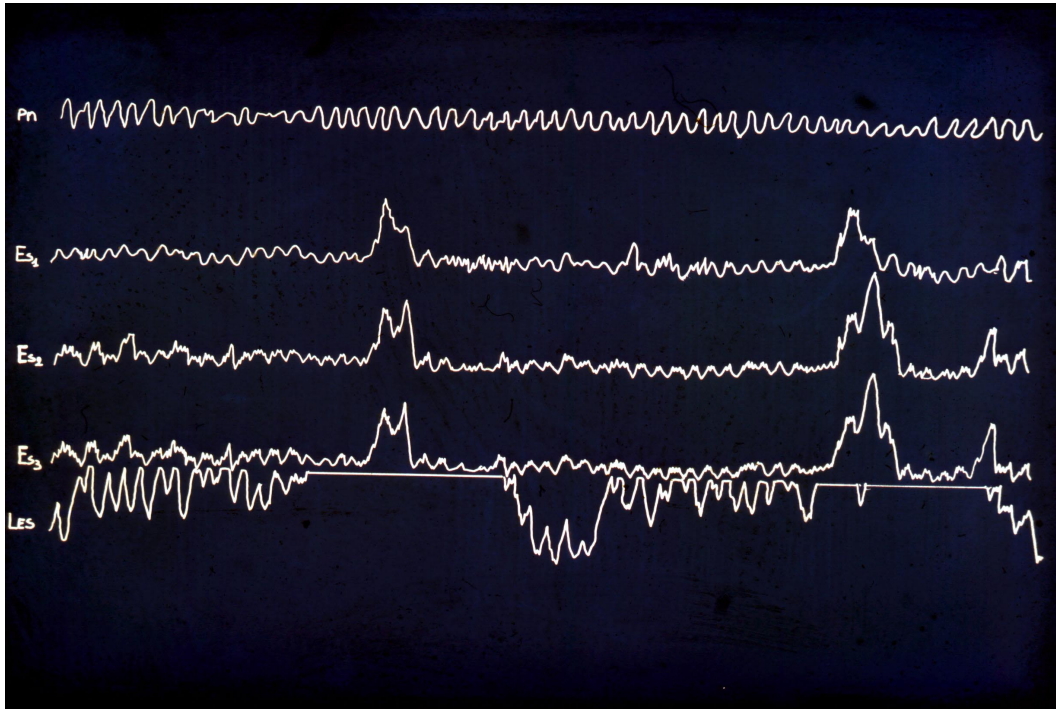


Fig. 1

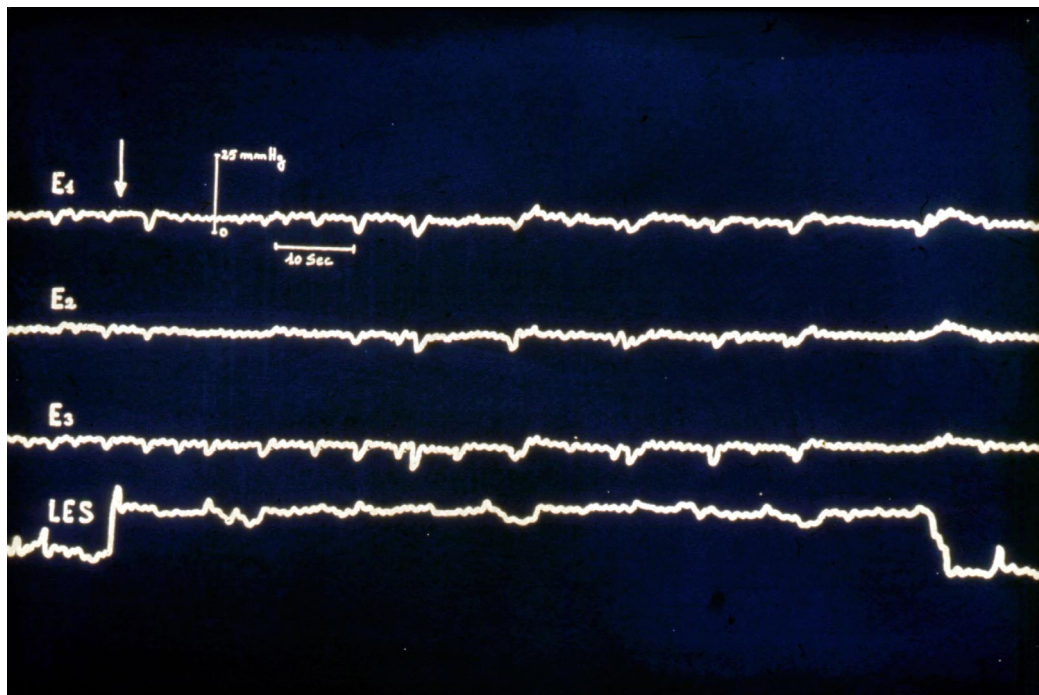


Fig. 2

These functional alterations induce organic consequences. While the esophagus maintains its normal shape during the initial stages of the disease, a thickening of the muscular wall, especially in its distal segments, occurs at later stages. A progressive dilatation of the esophageal lumen thus sets in, giving rise to a distally contracted and proximally dilated esophagus. The entire esophagus, except for the sphincteral tract, is ultimately overcome by the dilatation, creating the “mouse-tail” (or “bird beak”) radiological feature. Gradually, as the esophageal diameters increase, the thickness of the muscular walls decreases; simultaneously, the mucosa undergoes modifications, especially the tissue in the distal portions as a result of hypertrophic and inflammatory phenomena arising

from the retention of undigested food. By now the esophageal dilatation takes on relevance, aptly bearing out the term *megaesophagus*. Due to the persistence and worsening of the functional and organic pathogenic conditions, another event materializes that markedly modifies the shape of the esophagus, namely the elongation of the organ together with its dilatation. The esophagus takes on a shape defined as sigmoidal or “sock-like”: indeed, a right convex loop develops, whose fundus is often found to lie at the same level of the cardia. This deformity conditions an important modification in the esophagus’ structure: no longer aligned with the cardia, the esophageal column no longer weighs on it, but on the “sigmoidal” loop. As we will see below, this anatomic modification impacts heavily on the surgical approaches adopted to correct the disease.

This progression that the ailment undergoes triggers a series of stages representing characteristic clinical-diagnostic pictures:

1. initial tonic stage - vigorous stage
2. hypotonic stage - megaesophagus
3. failed atonic stage - dolichomegaesophagus

Here is a clinical case that clearly illustrates the initial stage of disease. A 16-year-old boy is often made fun of at home because it takes him so long to eat. Lately, he also accompanies his endless meals with disproportionate amounts of water. His parents begin to worry and, prompted especially for the countless number of glasses of water he downs while eating, they consult their general practitioner. Esophageal-stomach-duodenal radiography that is prescribed is negative. These eating habits are considered to be above all psychological, also in view of the fact that the boy is rather apprehensive, particularly for his schoolwork. On the advice of a neuropsychiatrist, the boy is placed on sedative/ansiolytic treatment for many months, but this leads to no noticeable improvement. At this point the boy was referred to the Center for Diagnosis and Therapy of Esophageal Disorders of the University of Genova Surgical Clinic. Here, an esophageal manometry test clearly evinces the diagnosis of esophageal achalasia. The unequivocal diagnostic effectiveness of manometry compared to traditional radiography in this stage of disease is to be emphasized. Surgical intervention quickly resolved the situation.

The symptomatology of initial stage esophageal achalasia can in fact be deceiving. Beyond the signs seen in the case described above, these patients may assume rather strange positions in order to ease the act of swallowing: twisting the thorax, stretching and turning the neck, lifting the chin, standing up and walking around after each bite. Often, patients also claim to experience a feeling of heaviness and rarely of pain in the retrosternal area or at the xiphoid process. This is more than enough to formulate a diagnosis far removed from that of achalasia. And we are a long way off from the classic symptoms that are normally evoked when labeling esophageal achalasia, i.e., dysphagia, regurgitation and weight loss.

To be sure, the postures described above are an expression of dysphagia, which constitutes the symptom that is most important and most directly associated with the disorder’s pathogenesis. It is not always present, but is unpredictably induced triggered, by very cold foods or beverages, for instance, or by emotions or stressful events. Especially during the disease’s early stages, and in any event sporadically, the patient finds it more difficult to swallow liquids than solid food. This is defined as the *paradoxical dysphagia*, a term used to describe the incongruity of the phenomenon: the solid bolus would, in fact, seemingly imply greater difficulty in swallowing. This peculiarity is quite telling and distinguishes an esophageal obstacle that is organic (scar tissue, neoplasm, etc.), from one that is functional, which is precisely what achalasia is: in the first case the dysphagia is total (liquids and solids) or greater for solid foods.

The classic symptomtological picture is more clearly evident in the next stage of the disease. The diameter of the esophagus increases, thereby leading to megaesophagus. Dysphagia persists; the patient realizes that the undigested bolus, be it liquid or solid, causes retrosternal pressure, and notices (and is relieved by) the moment in which - thanks to the force of gravity - the weight of the contents stagnating in the esophagus ultimately overcomes the resistance of the sphincter and the esophagus is emptied. With worsening of the conditions the esophageal dilatation increases, and the undigested content is retained at length in the organ. This leads to the decomposition of the static bolus and the easy backflow of the contents by means of (foul smelling) regurgitation, and the possibility of dangerous aspiration pneumonia (aspiration in a reclined position); the prolonged contact of the retained content leads to alterations of the esophageal mucosa, especially in the distal segment, with accompanying inflammatory phenomena, hypertrophy, dysplasia, metaplasia and possible neoplastic transformation (as many as 10% of long-term patients).

Some patients in whom symptoms are not excessively serious may tolerate this situation at length. Adjustment to the symptomatic picture described above brings with it a gradual but progressive worsening of functional and, most of all, organic conditions. Weight loss due to a nutritional deficit ensues, all of the consequences cited above increase in intensity, and slowly the third stage of the disease, dolichomegaesophagus, sets in. The esophagus has now taken on dimensions that not infrequently can be described as monstrous, and disturbances stemming from compression of mediastinal structures, chiefly on the bronchial branches and on the pulmonary hilus.

Instrumental diagnosis includes radiology, esophageal manometry and endoscopy.

As already pointed out, radiology during early stage disease serves little purpose. With the affliction's development the progressive dilatation of the esophagus becomes increasingly evident, ultimately taking on the morphological characteristics of megaesophagus with the classic "bird beak" deformity of the distal esophagus; at the same time esophageal contractility diminishes and is ultimately lost. When the dilatation increases, evidence of residual undigested food may be seen in its middle and lower thirds, at times with air-fluid levels. In subsequent stages the esophagus is, in addition to dilated and inert, elongated and with the already described sigmoid shape.

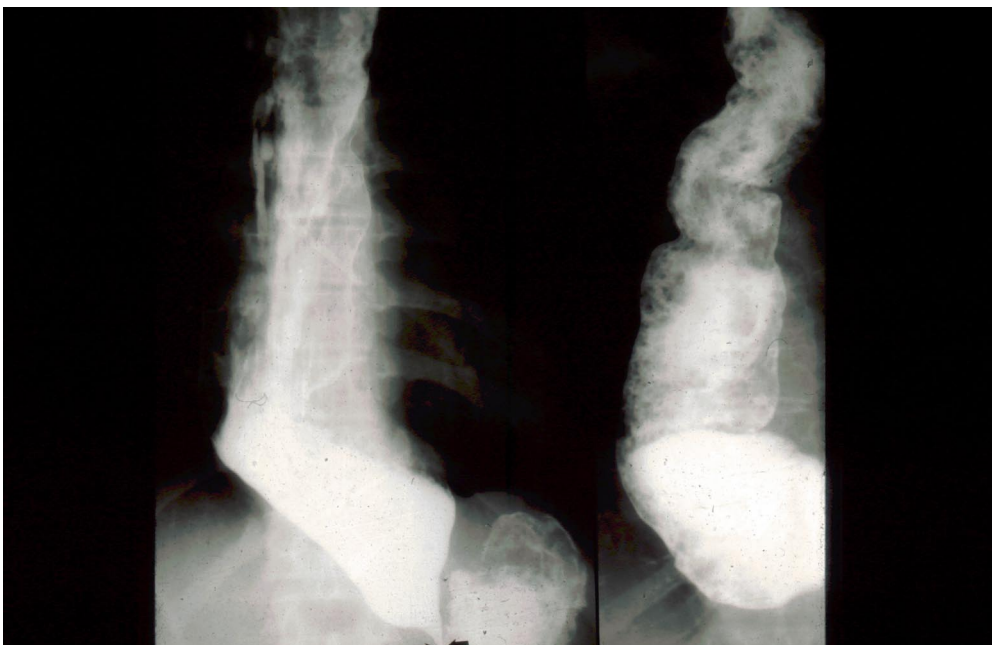


Fig. 3 - a  
Radiological features of achalasic megaesophagus



Fig. 3 - b  
Radiological features of achalasic megaesophagus  
dolichomegaesophagus

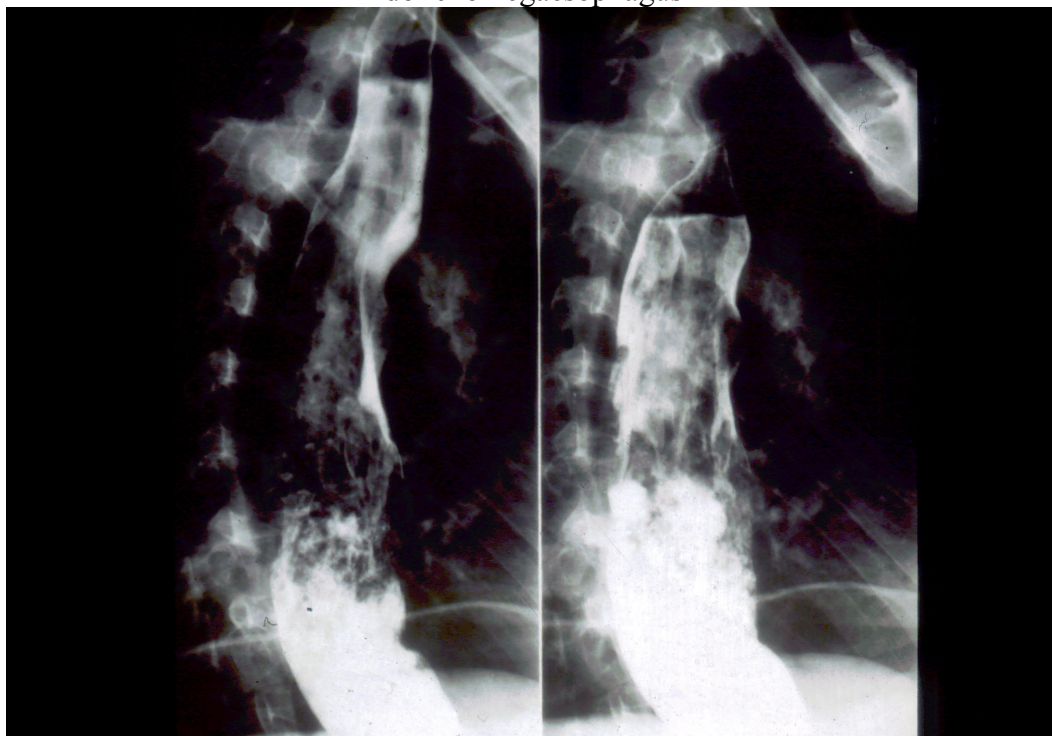


Fig. 3 - c  
Radiological features of achalasic megaesophagus  
evident residue of foodstuffs

While, as we have said, radiology contributes little during initial stage disease, manometric investigation of esophageal motility is immediately and clearly definitive. Noticeable first and foremost are the primary waves, which are still valid for their amplitudes, but which, because they are synchronous, are aligned along the same vertical axis. Relaxation of the LES may be limited, delayed or altogether absent. As the stage progress, these motility alterations increasingly worsen:

the primary waves diminish in size, becoming irregular to the point that they are substituted by a disorganized series of movements resembling tertiary waves. Behavior of the LES progressively deteriorates, ultimately showing long periods of high pressure without relaxation.

Even if achalasic, the LES is still easily penetrable by endoscopy. This is the first and often most important finding afforded by this examination, above all when the nature of cardia defect/constriction is unclear. In cases of organic stenoses, passage of the probe is difficult or even impossible. Endoscopic examination of unequivocal megaesophagus - which can be performed only after a thorough washing of the organ and clearing of retained undigested food - clearly reveals the conditions of the esophageal wall: atony, distension and alterations of the mucosa.

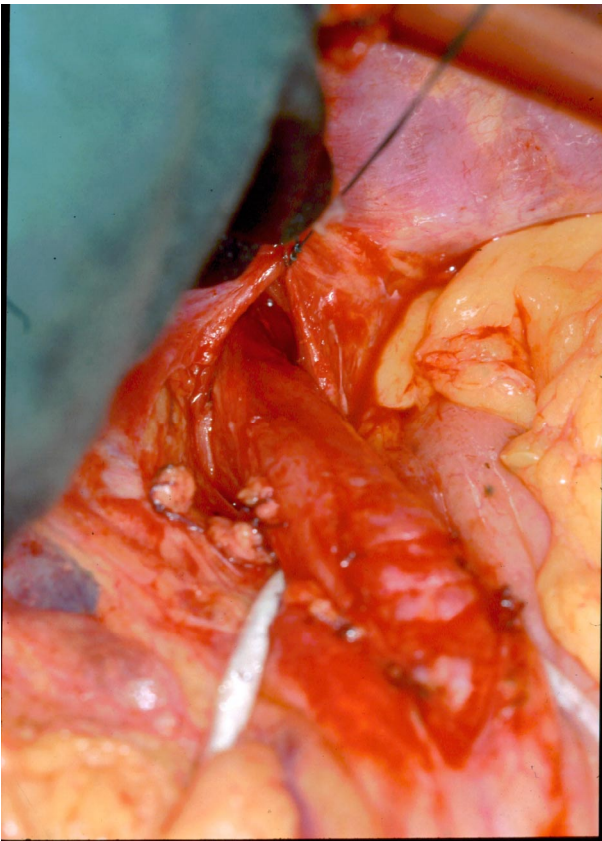
E. Heller first published his results on extramucosa cardiomyotomy in 1914 (Extramucöse cardioplastik beim chronischen cardiospasmus mit dilatation des oesophagus. Mitt Granzbeg Med Chir 27: 141-149; 1914).

In years when techniques to ascertain the pathogenesis of the disorder were unknown, Heller's was undoubtedly serendipitous insight, the outcome nonetheless of a shrewd and intelligent physician. The operation entails the removal of the most pathogenic of the causes of esophageal achalasia, that is, annulling LES function. This is achieved through the above-mentioned *extramucosa cardiomyotomy*, whereby the circular musculature corresponding to the segment having a sphincteral function is interrupted.

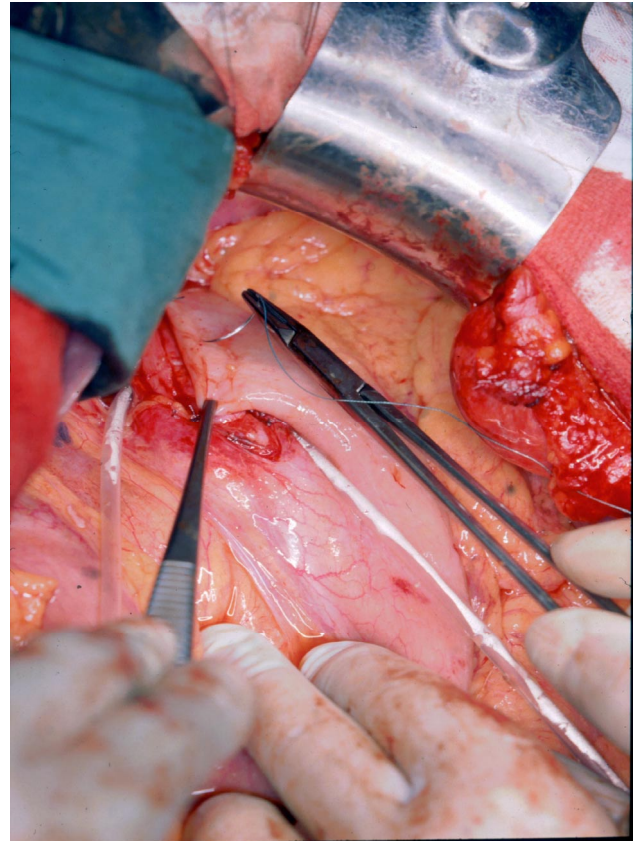
This procedure was the subject of much debate in the years that followed.

The first issue of dispute was the length of the myotomy. Today, it is apparently clear that this must be at least 8 cm above and 2-3 cm below (on the gastric wall) the anatomic cardia. The school I directed for years conducted extensive research on this matter, and we found that perioperative esophageal manometry bears out the need for this length in order to sufficiently weaken the LES. Subsequent long-term monitoring and outcomes confirmed the positive results of this approach.

The second issue regarded antireflux protection. For a number of years this problem seemingly didn't even exist: many, even renown, surgeons performed cardiomyotomies without worrying the least bit about provisions against gastroesophageal reflux. A first point to highlight is that the esophagus - because it has no propulsive action and thus no clearing activity even after the cardiomyotomy - the reflux is able to exert serious harm to the esophageal mucosa precisely because it remains and stagnates in the esophagus. It's quite possible that this lack of concern by surgeons in the past was linked to the exiguity of the myotomy, perhaps not entirely sufficient to correct the achalasia, but still able to maintain antireflux protection. By the same token, a number of the re-operations performed by us were due to cases of achalasia that had been inadequately treated with excessively short myotomies. What is evident in any case is that when the sphincteral activity is neutralized by means of a sufficiently long (8 + 2-3) myotomy, the antireflux action of the LES is also nullified, thereby requiring protective measures. This could be a simple Dor anterior fundoplication (our preferred technique and one that is easily performed video-laparoscopically), or a Toupet posterior fundoplication. Some surgeons opt for a 360° Nissen-Rossetti fundoplication: we and others do not share this choice, because, since the esophagus lacks propulsive activity, the greater containment of the Nissen-Rossetti procedure, even if floppy ("Floppy Nissen"), would potentially counteract the purpose of the myotomy.

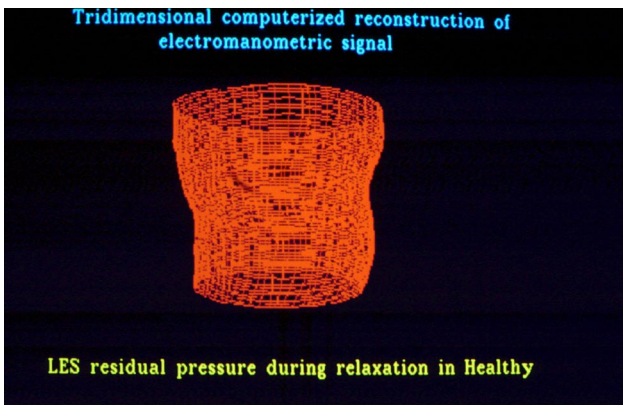


a

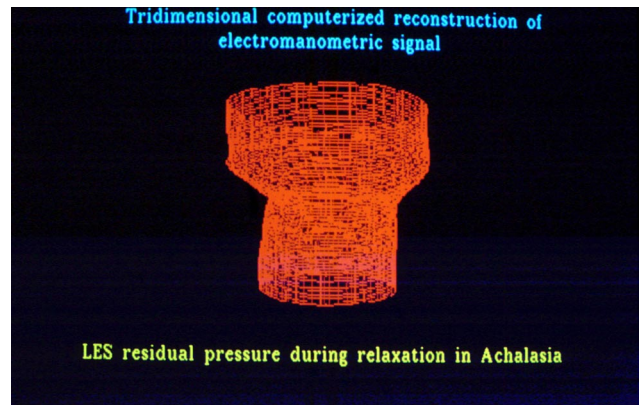


b

Fig. 4 - a) A Heller extramucosal cardiomyotomy - the suture at the top keeps the diaphragmatic hiatus divaricated - the white loop, bridging the cardia, distends the esophagus. b) anterior Dor fundoplication



a



b

Fig. 5 - Digital reconstruction of esophageal manometry signals. Clearly evident in b) is the defective relaxation of the LES during deglutition compared to normal function a).

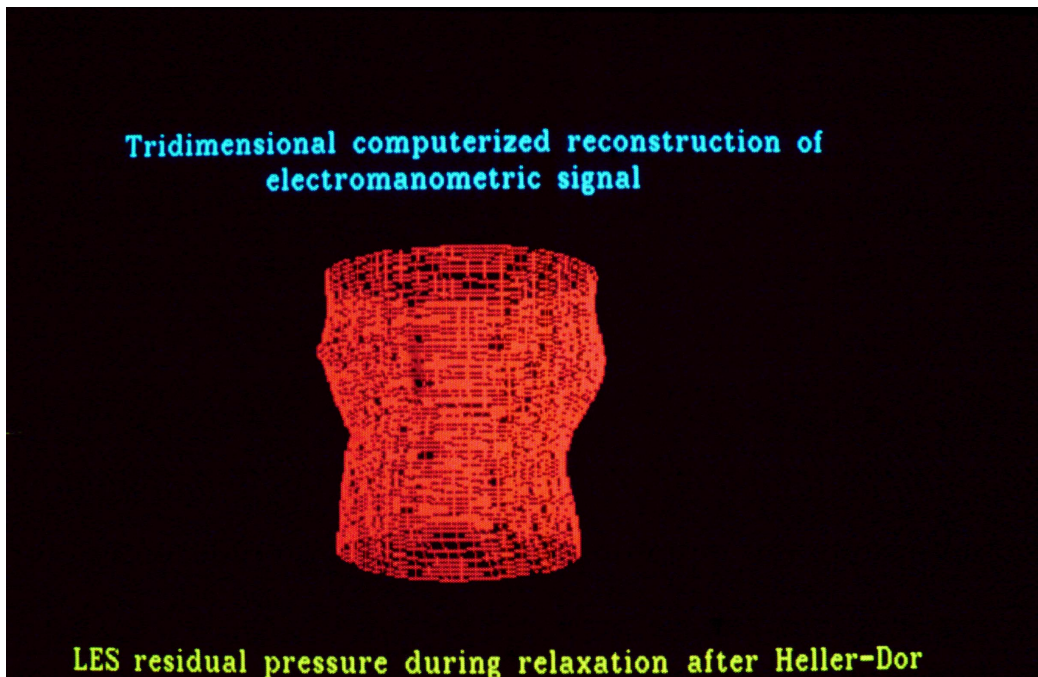


Fig. 6 - The new high-pressure zone following a Heller-Dor myotomy.

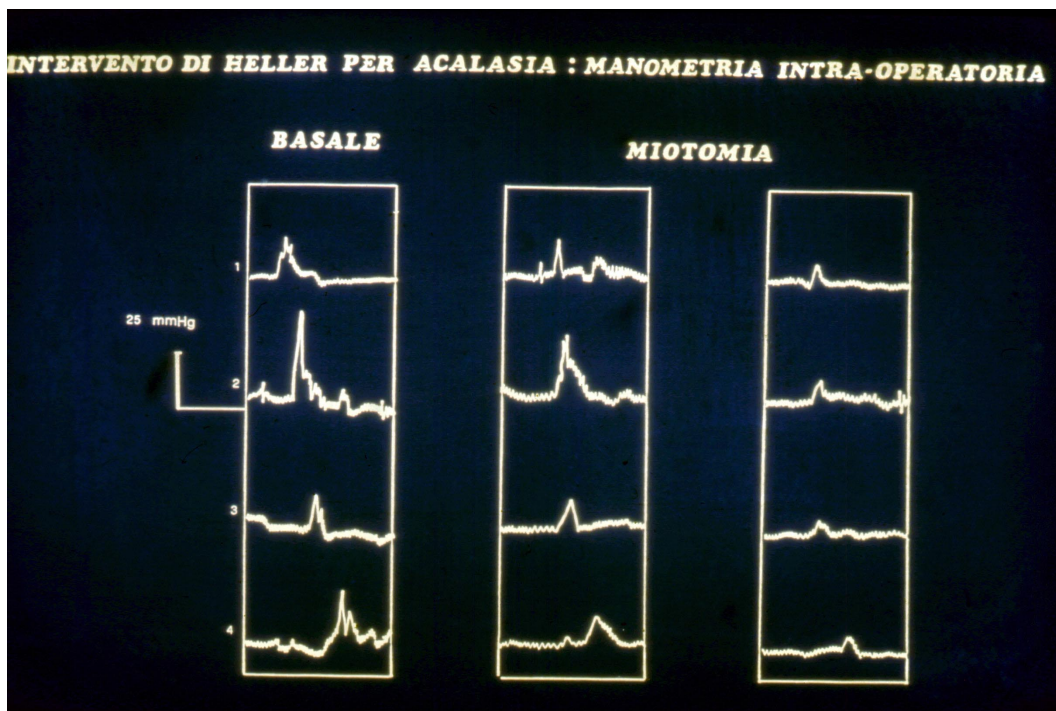


Fig. 7 - recordings of the pressure decrease of the LES following a Heller myotomy.

The third issue of dispute regards the access route. In the past, American surgeons in particular were accustomed to performing transthoracic procedures (left thoracotomy in the 6th - 7th intercostal space), also in view of the fact that esophageal surgery was the claim of thoracic surgeons. While some continue to prefer this approach, most surgeons, including us, opt now for the abdominal route (laparotomic or video-laparoscopic) because it expedites access to the terminal



esophagus and to the adjoining cardial tract of the stomach, with a consequent simplified handling of the gastric fundus for antireflux procedures.

Although the Heller myotomy ensures excellent results, it resolves only the functional problem of the LES, while the defect affecting the esophagus - which still lacks any propulsive activity - remains uncorrected. This means that the progression of the bolus relies exclusively on the pharyngeal action and gravity. It follows that, if the esophageal-cardia-stomach axis is not correctly aligned - as occurs in the atonic stage of dolichomegaesophagus - the cardiomyotomy has no curative effect. In these cases treatment entails the resection of the distal esophagus with the interposition between the esophagus and the stomach of a jejunal loop (Merendino's technique), or of a colonic segment (Belsey procedure). In cases where the esophagus is seriously compromised a total (or subtotal) esophagectomy may be considered.

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Therapy of this disorder is also pharmacologic, with agents being used at times during early-stage disease when esophageal dilatation has not yet set in. Calcium channel blockers have been used with mixed results; more effective, but with non-negligible adverse effects, are nitrate derivatives. More recently, the repeated endoscopic injection of botulinum

toxin into the LES has given rise to some therapeutic results; long-term outcomes, however, are not overly encouraging, and the true benefit of the approach has yet to be established.

Mechanical dilatation, hydrostatic or pneumatic, of the sphinctral segment constitutes yet another therapeutic option, performed above all by a qualified gastroenterologist. This approach achieves an efficacious disruption of the circular muscular fibers, with positive results obtainable especially in early-stage disease. As a rule of thumb, numerous endoscopic sittings are needed to maintain dilatation over time. The method is not without its drawbacks: the foremost is the risk of serious esophagitis due to reflux resulting from the annulment of sphinctral high pressure; the second is the possibility (far from seldom for some Authors) of a feared laceration of the esophageal wall and the resulting need for emergency surgical repair.

The surgeon is generally wary of this method for two reasons. First, because emergency surgery for a lacerated esophagus is a high-risk operation given the frequency of complications, which can also be severe. Second, because it is not uncommon that a patient, who has already undergone mechanical dilatation without achieving a positive and stable outcome, subsequently requires a cardiomyotomy. Since mechanical dilatation exerts a traumatic effect on the esophageal wall, also because of the possible lacerations of muscle fibers, the cleavage plane between the mucosa and the muscular wall becomes poorly penetrable; separation of the two layers thus becomes difficult, and the risk of perforating the mucosal wall even greater. In our experience with conditions of this kind, detachment of the two structures, the circular muscular and the mucosal plane, was often achievable by means of hydrodissection (see **video no. 2**). This approach seemingly reduced the risk of perforating the mucosal layer.

Video-laparoscopic Heller myotomy is now considered by most surgeons and a fair number of gastroenterologists the therapy of choice for esophageal achalasia.

The salient steps of the procedure (see videos no. 1 and no. 2) can be summarized as follows:

- visualization of a sufficient esophageal segment above the cardia (with the esophagus under traction);
- identification and preservation of the vagus nerves;
- longitudinal section and separation of the longitudinal fibers;
- identification of the circular muscle layer;
- longitudinal myotomy of the circular layer (8 cm above and 2-3 cm below the cardia);
- the mucosa must herniate between the margins of the myotomy (proof of a completed procedure)
- anterior Dor fundoplication

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Two brief summaries of clinical cases are reported below in which re-operations became necessary because of negative results following previous extramucosa cardiomyotomy (EMC).

Case no. 1

- R.L. - a 49-year-old male presenting dysphagia for solids and liquids, regurgitation of undigested food and weight loss of 20 Kg.;
- Five years after onset, a diagnosis of achalasia was made and the patient underwent EMC in another center;
- Symptoms present before the operation (e.g., dysphagia, etc.) soon reappeared;
- Seven months later the patient came under our observation: an insufficient relaxation of the LES most likely due to incomplete myotomy was detected, upon which remyotomy was performed along with an anterior Dor fundoplication;
- Long-term follow-up confirmed the good outcome of the surgery, and indeed, the patient at present is asymptomatic.

Case no. 2

- M.A., a 51-year-old female presented with dysphagia for solids and liquids, regurgitation of undigested food and sialorrhea
- One year after onset, a diagnosis of achalasia was made and the patient underwent EMC in another center;
- The patient complains about the same symptoms soon thereafter;
- Nine years following the first operation remyotomy was performed in still another center and led to similar results;
- Twelve years later the patient came under our observation, presenting with extremely deficient nutritional status, anemia, and very poor general and neuropsychological conditions;
- Following intensive antianemic and nutritional (parenteral) treatment, instrumental diagnosis revealed advanced stage dolichomegaesophagus, as well as the absence of esophageal motility and LES pressure (presumably as a result of the previous remyotomy);

- Given these findings we opted for a esophageal-gastric resection and recanalization for the interposition of a jejunal loop between the esophagus and the stomach (Merendino technique);
- Postoperative course was normal;
- At follow-up (also long-term) the patient's conditions are excellent, the esophageal-gastric recanalization functional, and no gastroesophageal reflux phenomena have been observed.

These two cases fittingly exemplify the two most frequent errors that may be made when treating esophageal achalasia: the insufficient length of the myotomy and Heller myotomy performed on dolichomegaesophagus. Still another error in our view is the failure to provide for antireflux protection following a Heller myotomy: the severe esophagitis that may result was in our series of patients another cause for reoperation.

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Video no. 1: Extramucosa cardiomyotomy - traditional laparotomic approach

Video no. 2: Extramucosa cardiomyotomy - minimally invasive video-laparoscopic approach