Achalasia & POEM
(Peroral endoscopic myotomy)

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SAMSUNG 삼성서울병원

Contents

- Definition
- Epidemiology
- Etiology
- Pathophysiology
- Clinical manifestations
- Diagnosis
- Treatment
- Peroral Endoscopic Myotomy (POEM)

Definition

- Mamometrically characterized by insufficient relaxation of LES and loss of peristalsis. Radiographically characterized by aperistalsis, esophageal dilatation, with minimal LES opening, "bird-beak" appearance, poor emptying of barium. Endoscopically characterized by dilated esophagus with retained saliva, liquid, undigested food particles in the absence of mucosal stricturing or tumor.

Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49; quiz 50.

Table 4 The Chicago Classification of esophageal motility v3.0

Achalasia and EGJ outflow obstruction	Criteria
Type I achalasia (classic achalasia)	Elevated median IRP (>15 mmHg*), 100% failed peristalsis (DCI <100 mmHg·s·cm) *Premature contractions with DCI values less than* 450 mmHg·s·cm *satisfy criteria for failed peristalsis*
Type II achalasia (with esophageal compression)	Elevated median IRP (>15 mmHg*), 100% failed peristalsis, panesophageal pressurization with ≥20% of swallows *Contractions may be masked by esophageal pressurization and DCI should not be calculated*
Type III achalasia (spastic achalasia)	Elevated median IRP (>15 mmHg*), no normal peristalsis, premature (spastic) contractions with DCI >450 mmHg·s·cm with ≥20% of swallows *May be mixed with panesophageal pressurization*
EGJ outflow obstruction	Elevated median IRP (>15 mmHg*), sufficient evidence of peristalsis such that criteria for types I-III achalasia are not met†

Epidemiology

- M:F = 1:1

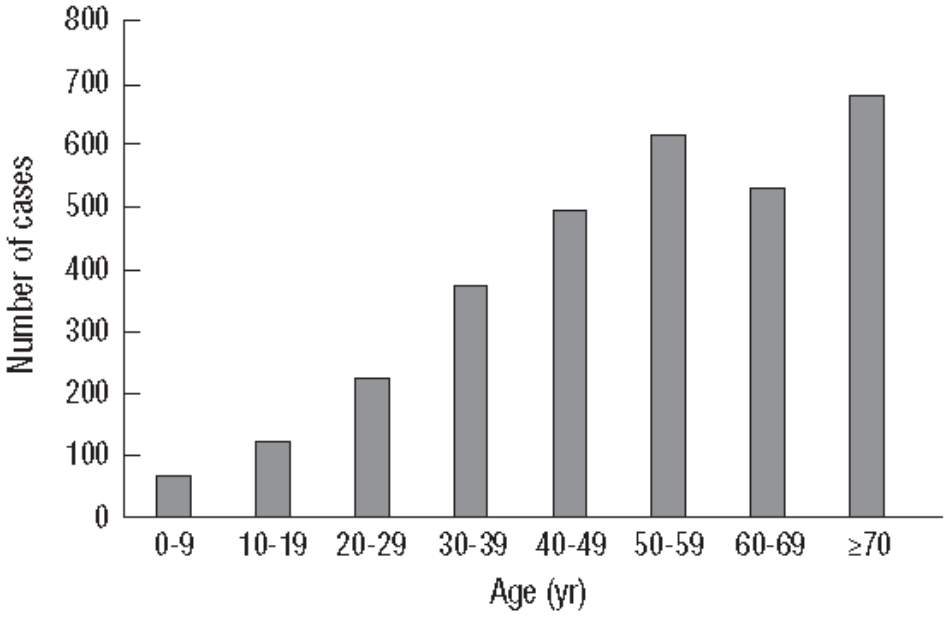

Fig. 1. Age distribution of patients with achalasia identified between 2007 and 2011 (n = 3,105).

Table 3. Published studies addressing the incidence and prevalence of achalasia

Study population	No. of cases	Study period	Incidence (cases/100,000/yr)	Prevalence (cases/100,000)
USA				
Rochester (28)	11		0.6	
Virginia (8)	30		0.6	
UK				
Scotland (17)	699		1.1/1.2*	11.2
Oxford (17)	216		0.9/0.9*	9.99
Cardiff (29)	48	1926-1977	0.4	
Nottingham (30)	53	1966-1983	0.5	8
Edinburgh (7)	25	1986-1991	0.8	
Leicester (31)	14	1986-2005	0.89	
Israel (32)	162	1973-1978	0.8	7.9-12.6
New Zealand (6)	152	1980-1984	1.0	
Zimbabwe (33)	25	1974-1983	0.03	
Singapore (4)	49	1989-1996	0.3	1.8
Iceland (9)	62	1952-2002	0.55	8.7
Canada (3)	463	1995-2008	1.63	10.82
Korea	3,105	2007–2011	0.39	7.8

Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49; quiz 50.
Francis DL, Katzka DA. Achalasia: update on the disease and its treatment. Gastroenterology 2010;139:369-74.
Kim E, Lee H, Jung HK et al. Achalasia in Korea: an epidemiologic study using a national healthcare database. J Korean Med Sci 2014;29:576-80.

Etiology

- Ganglion cell degeneration due to unclear etiology
  - Autoimmune processes
    (e.g., Myenteric antiplexus antibodies, Anti-Hu Ab)
  - Genetic abnormalities
    (e.g., Abnomal VIP receptor 1 gene, All-grove's Synd.)
  - Viral infection
    (e.g., HSV-1)
  - Neurodegenerative process

- Secondary process
  (e.g., Malignancy, Amyloidosis, T.cruzi)

Francis DL, Katzka DA. Achalasia: update on the disease and its treatment. Gastroenterology 2010;139:369-74.
Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49; quiz 50.

Pathophysiology

- Loss of ganglion cell in esophageal myenteric plexus
- Loss of inhibitory neurotransmitter (e.g., NO, VIP)
- Imbalance between excitatory and inhibitory neuron
  - Incomplete LES relaxation
  - Aperistalsis

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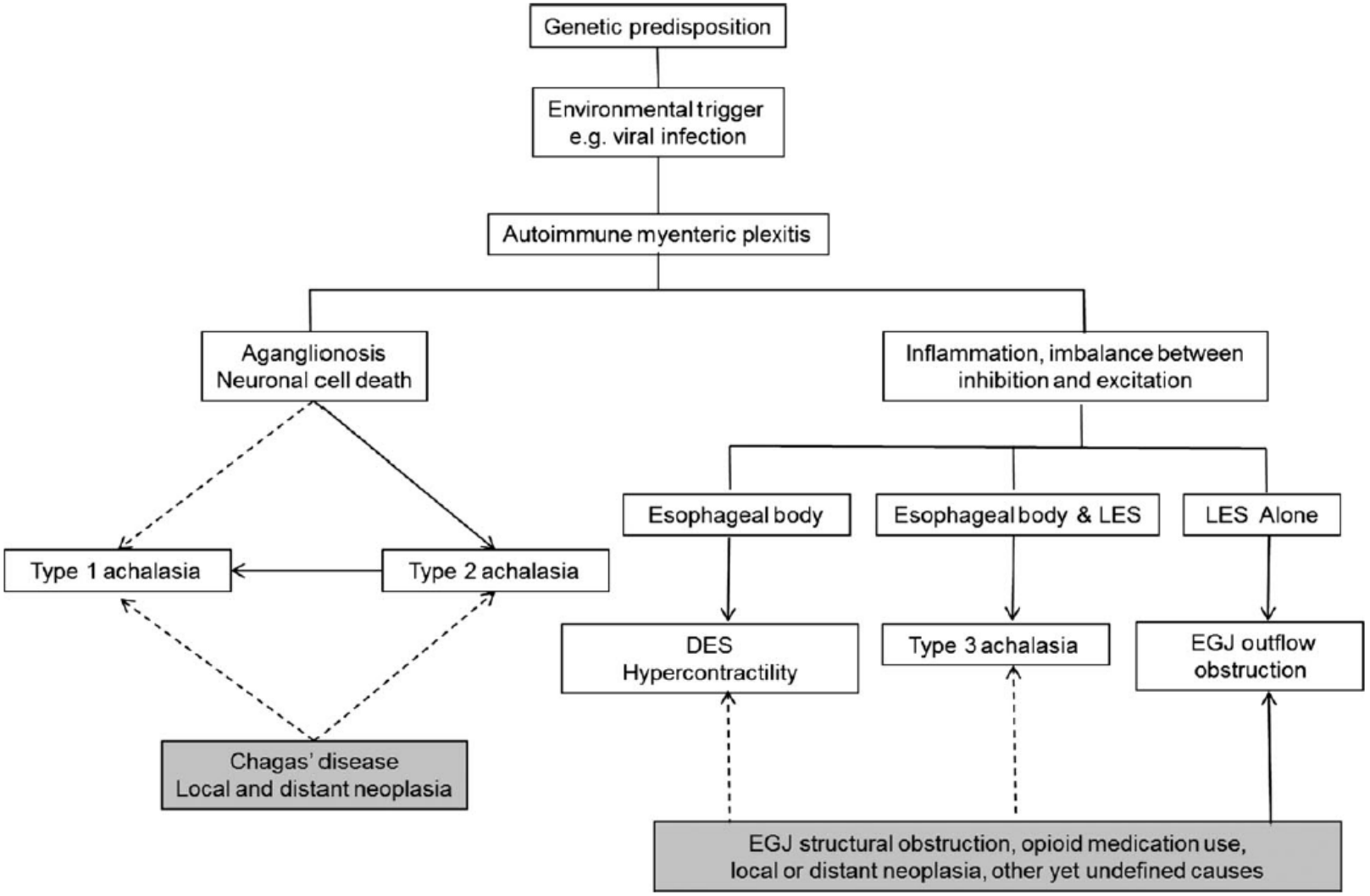
Pathophysiology



Gyawali CP. Achalasia: new perspectives on an old disease. Neurogastroenterology and motility : the official journal of the European Gastrointestinal Motility Society. 2016;28(1):4-11.

Clinical manifestations

- Dysphagia
  - Often for both solids and liquids
- Chest pain
  - Substernal pain
  - Unresponsive to reflux therapy
- Heartburn
- Regurgitation
- Weight loss

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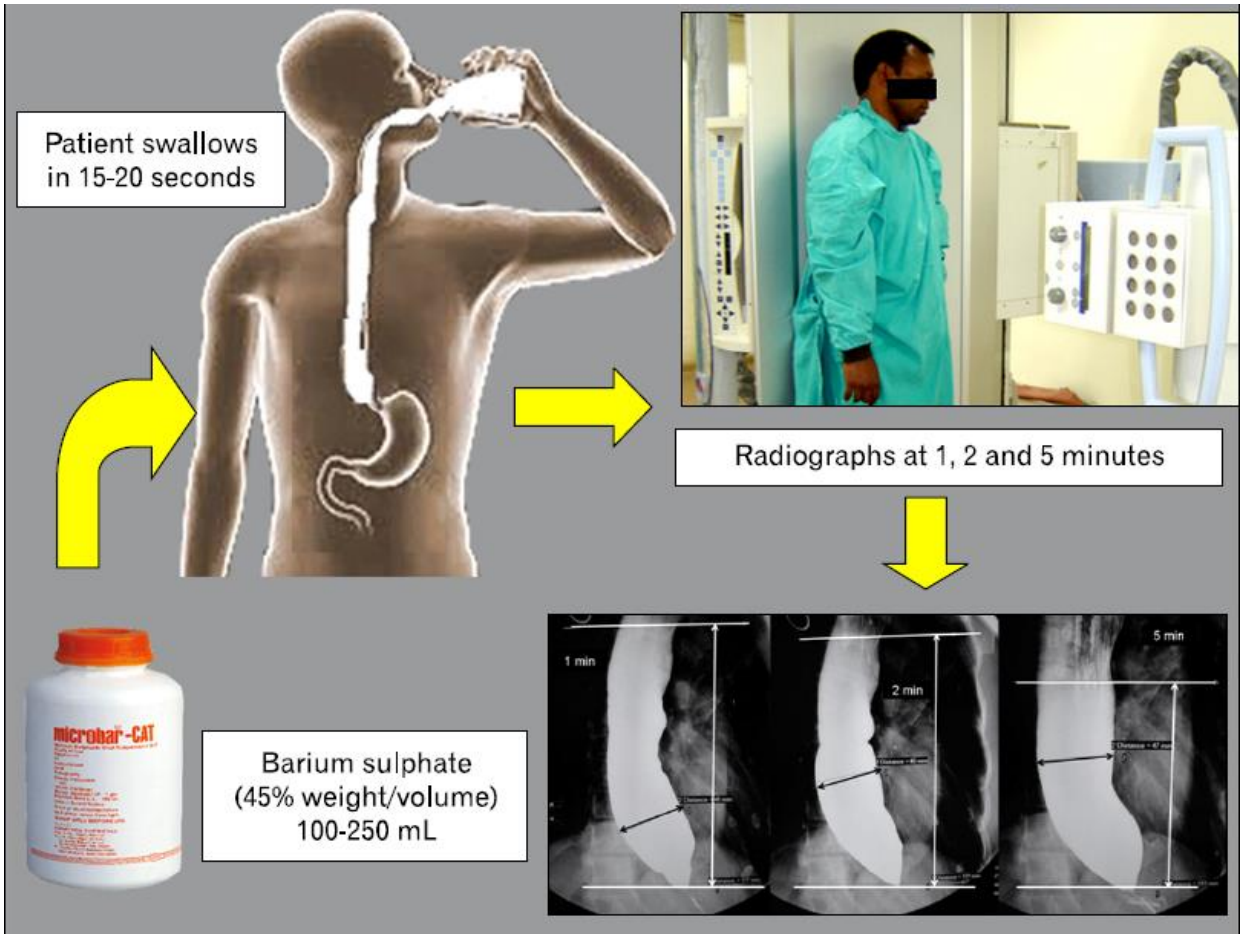
A
B
C

Imaging study

- Timed-barium esophagogram (TBE)



Neyaz Z, Gupta M, Ghoshal UC. How to perform and interpret timed barium esophagogram. Journal of neurogastroenterology and motility. 2013;19(2):251-256.

Imaging study

- Esophageal high-resolution manometry (HRM)
  - Aperistalsis
  - Incomplete LES relaxation
  - Others
    - Increased basal LES pressure
    - Elevated baseline esophageal body pressure
    - Simultaneous non-propagating contractions

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Imaging study

Table 2. Comparison of manometric abnormalities in conventional and high-resolution manometry

Manometric features of achalasia	Conventional manometry Line tracing format	High-resolution manometry Esophageal pressure topography
LES		
	Impaired LES relaxation[a] • Mean swallow induced fall in resting LES pressure to a nadir value of >8 mm Hg above gastric pressure • Complete relaxation to gastric baseline with a short duration (<6 s)[b] *Basal pressure*[b] • >45 mm Hg	*Impaired EGJ relaxation* • Mean 4 s IRP ≥10 mm Hg over test swallows[a]
Esophageal peristalsis		
	Aperistalsis in distal 2/3 of the esophagus • No apparent contractions • Simultaneous contractions with amplitudes <40 mm Hg	*Aperistalsis* • Absent peristalsis (type I) • Pan-esophageal pressurization (type II)
Atypical/variants		
	Vigorous • Preserved peristalsis with esophageal contractions >40 mm Hg • Simultaneous contractions >40 mm Hg -Isobaric -Nonisobaric	• Spastic achalasia (type III)

EGJ, esophagogastric junction; IRP, integrated relaxation pressure; LES, lower esophageal sphincter.
[a]Required for diagnosis.
[b]Supportive for the diagnosis.

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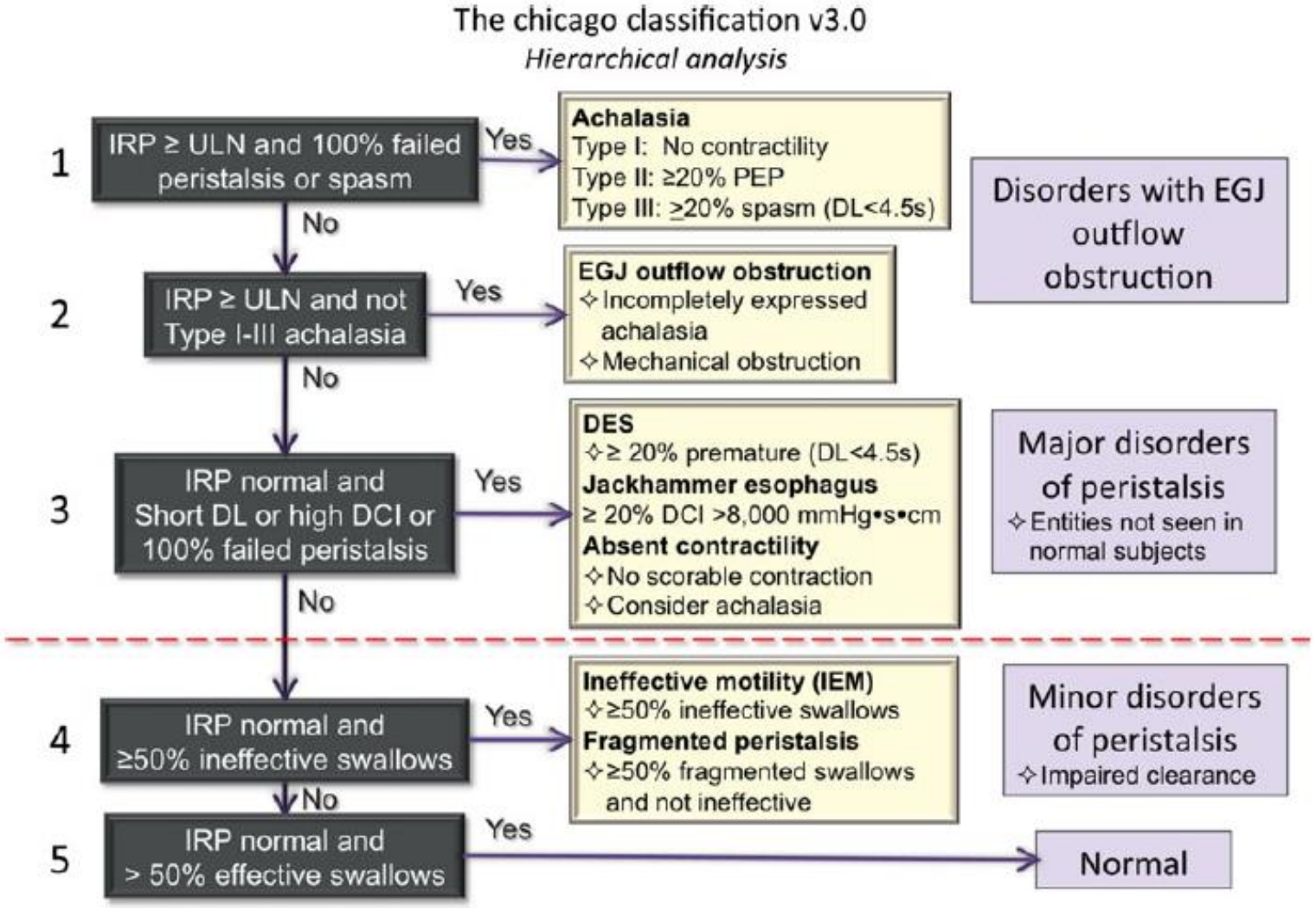
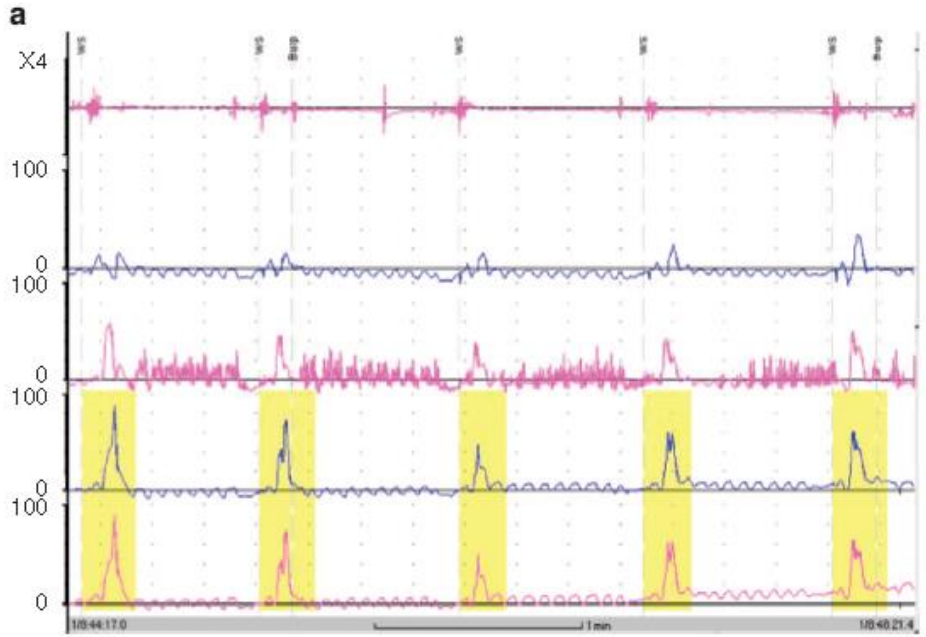
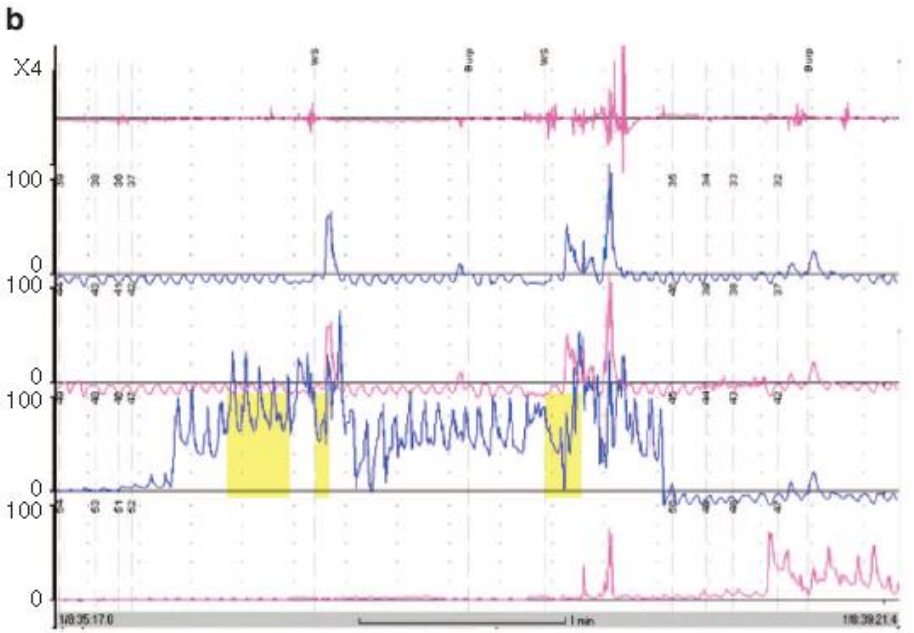
Imaging study

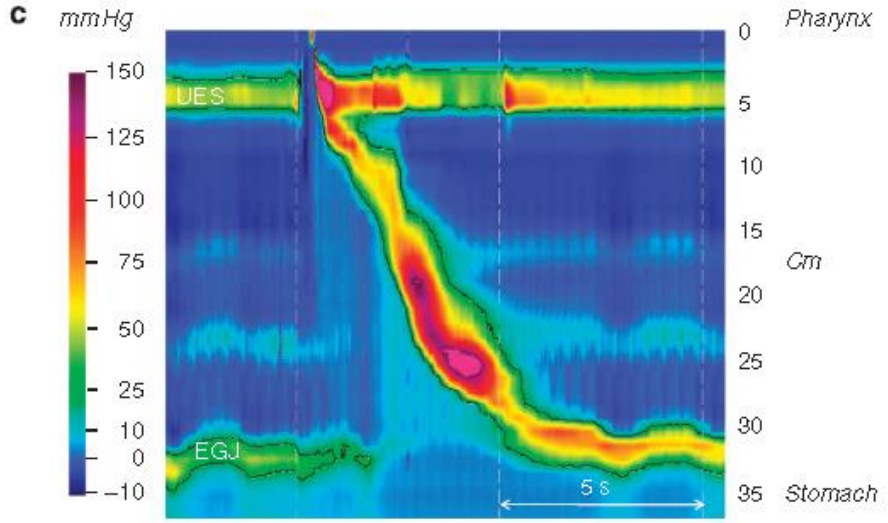


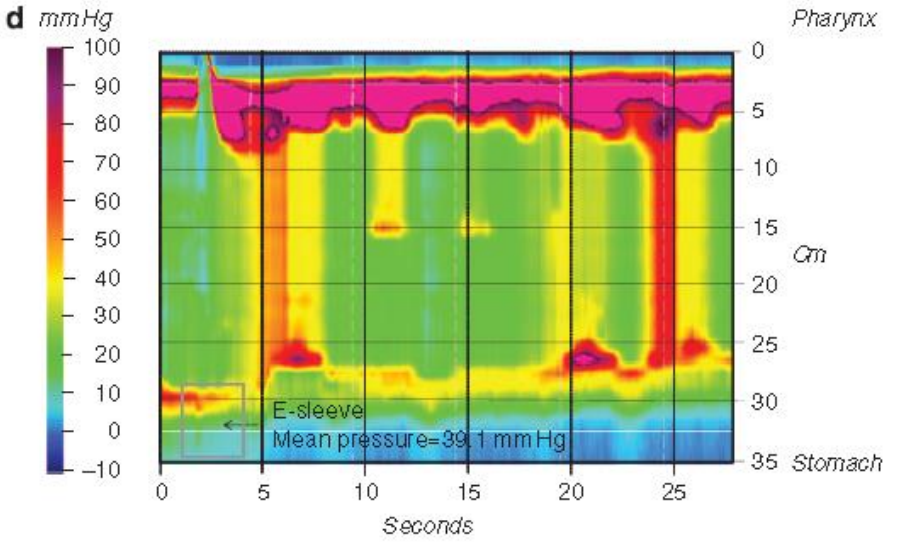
Kahrilas PJ, Bredenoord AJ, Fox M et al. The Chicago Classification of esophageal motility disorders, v3.0. Neurogastroenterol Motil 2015;27:160-74.

Imaging study

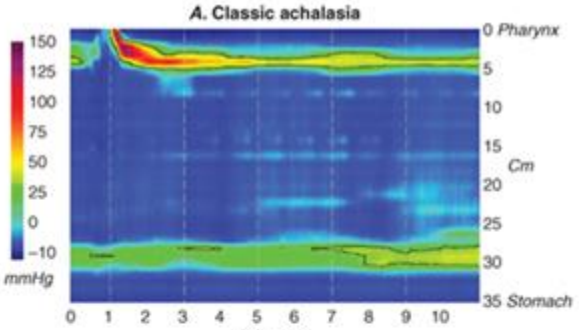








Imaging study



- **A: Classic**
  - minimal pr
    esophagea

Achalasia subgroup	LES: Inhibitory	LES: Excitatory	Distal (smooth muscle) esophagus: Circular muscle inhibitory	Distal (smooth muscle) esophagus: Circular muscle excitatory	Distal (smooth muscle) esophagus: Longitudinal muscle excitatory
Type I (classic)	– –	– –	– –	– –	– – to –
Type II (with compression)	–	– to++	–	–	+ to ++
Type III (spastic)	–	+ to++	–	+ to++	+ to++
EGJ outflow obstruction[a]	–	– to++	– to +	– to++	+ to++

Source: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J: Harrison's Principles of Internal Medicine, 18th Edition: www.accessmedicine.com
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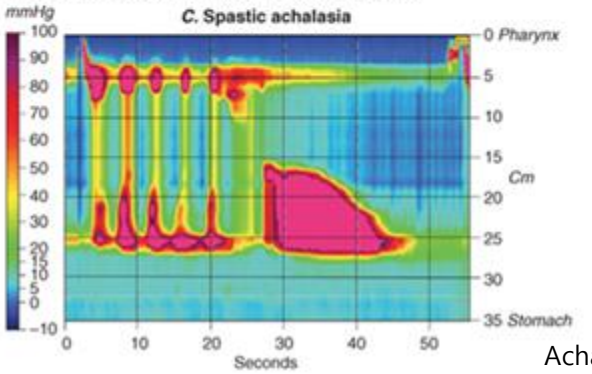
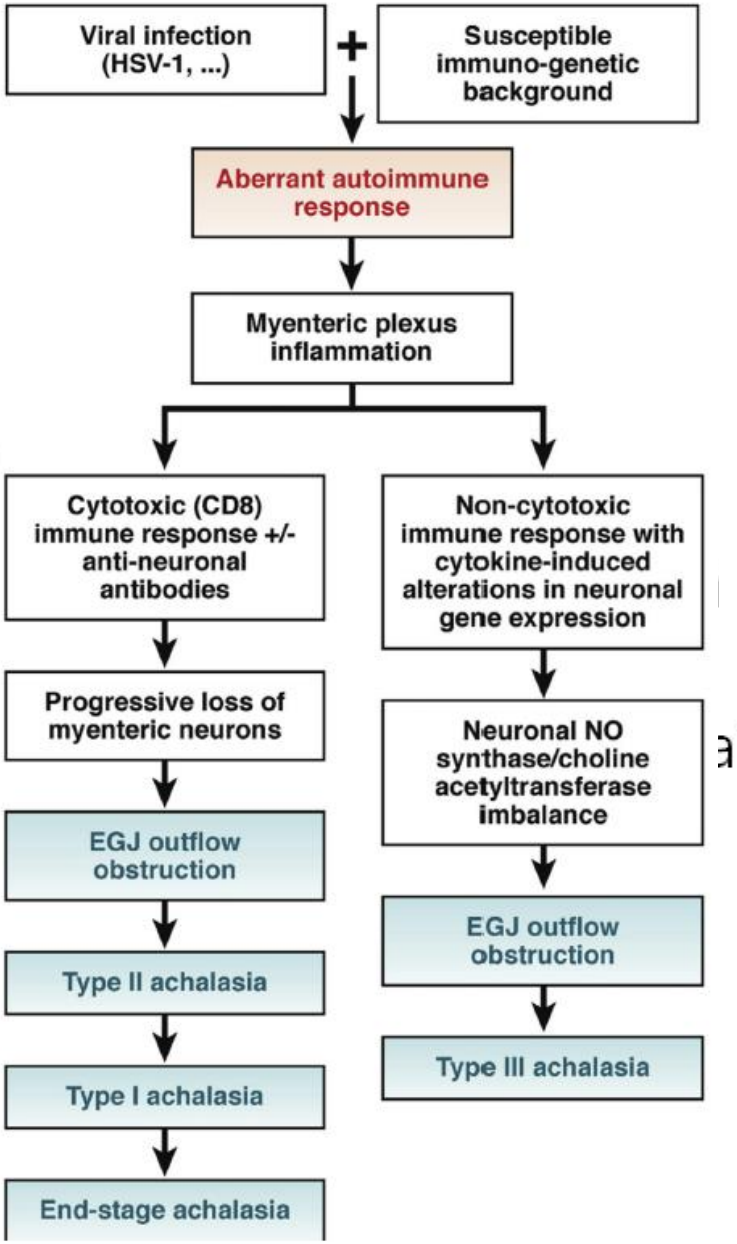


- **C: spastic a**
  - spastic eso
    observed v



Achalasia, 이풍렬교수님 강의록

Kahrilas PJ, Bredenoord AJ, Fox M et al. The Chicago Classification of esophageal motility disorders, v3.0. Neurogastroenterol Motil 2014.

Differential diagnosis

- GERD
- Pseudoachalasia (e.g., Cardia cancer, Infiltrating tumor)
- Secondary achalasia
  - Chagas disease
  - Fundoplication
  - Gastric banding

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Treatment

- Medications
  - Nitrates, CCB, NO donors (e.g., sildenafil)
  - Others (e.g., anticholinergics, β-blockers, theophylline)

Medication	Efficacy
CCB	- Symptom improvement (0 ~ 75%) - LES pressure decrease (13 ~ 49%) - Nifedipine 10 ~ 30mg (30 ~ 45mins before meals)
Nitrates	- Symptom improvement (53 ~ 87%) - LES pressure decrease (30 ~ 65%) - Isosorbide dinitrate 5mg (10 ~ 15mins before meals)

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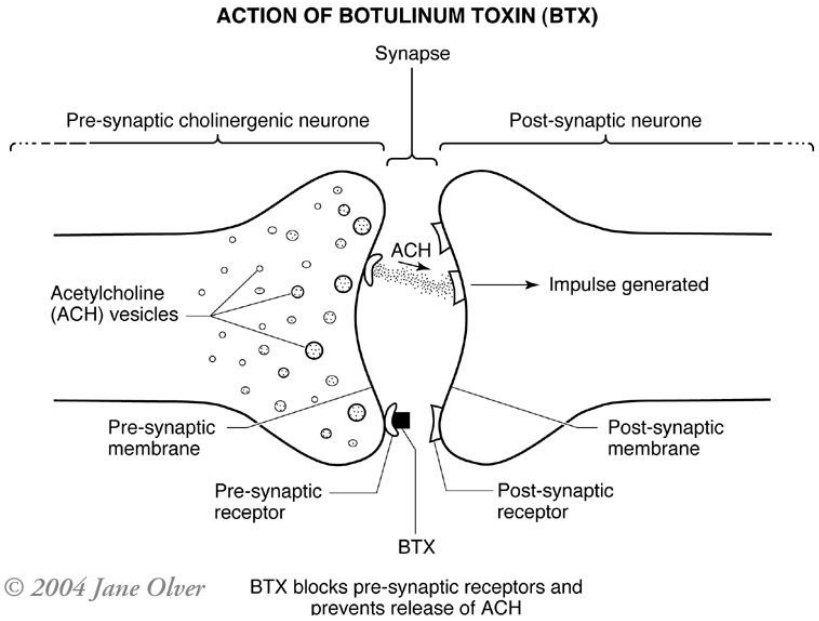
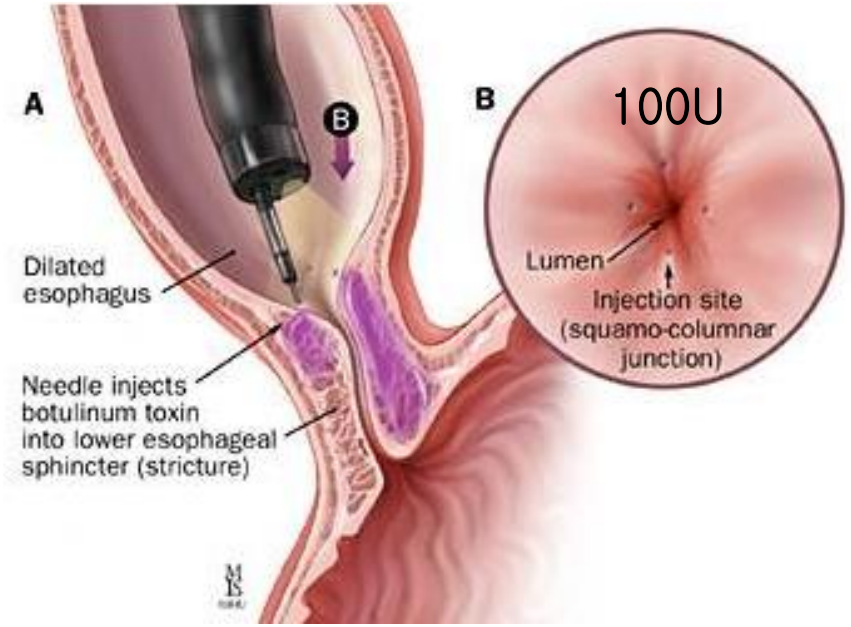
Treatment

- Endoscopic treatment
  - Endoscopic botulinum toxin injection (EBTI)





  - Endoscopic pneumatic balloon dilatation
  - Peroral endoscopic myotomy (POEM)

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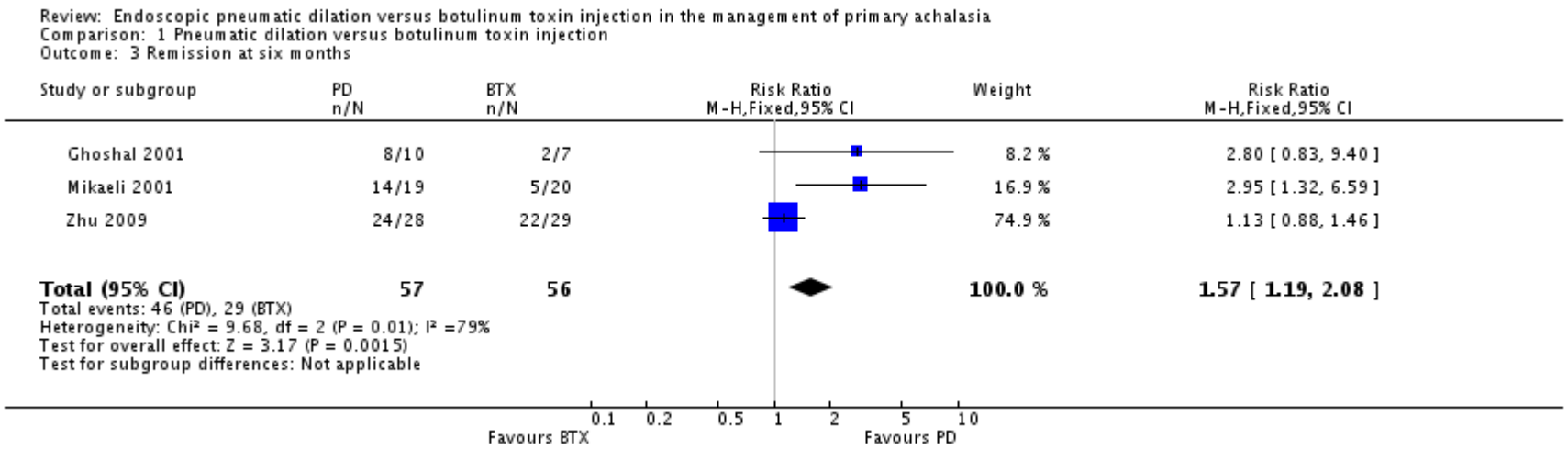
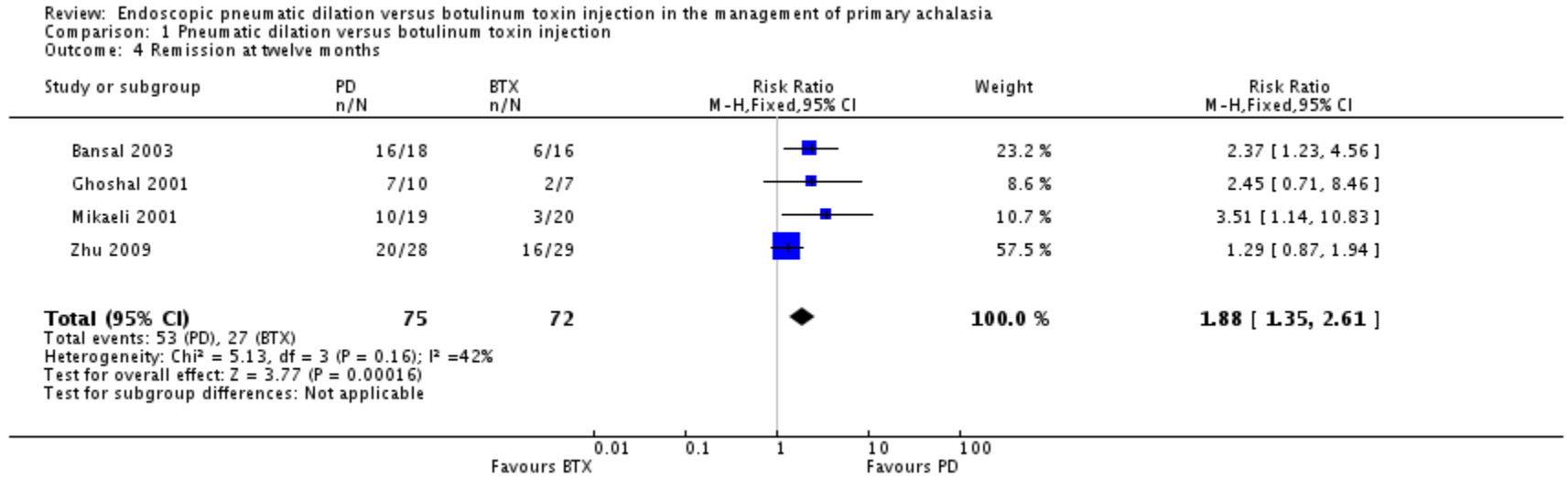
Treatment





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Treatment

- Surgery
  - Heller's myotomy

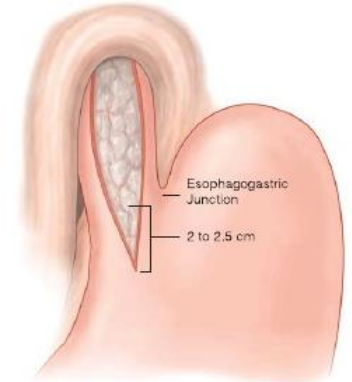


Figure 4 Laparoscopic Heller myotomy with partial

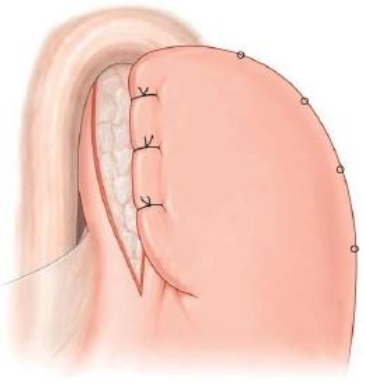
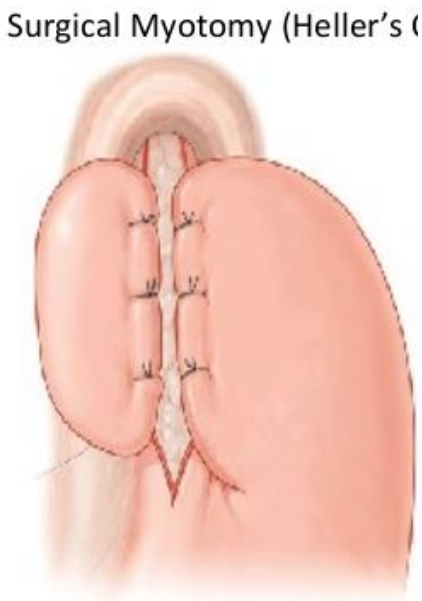
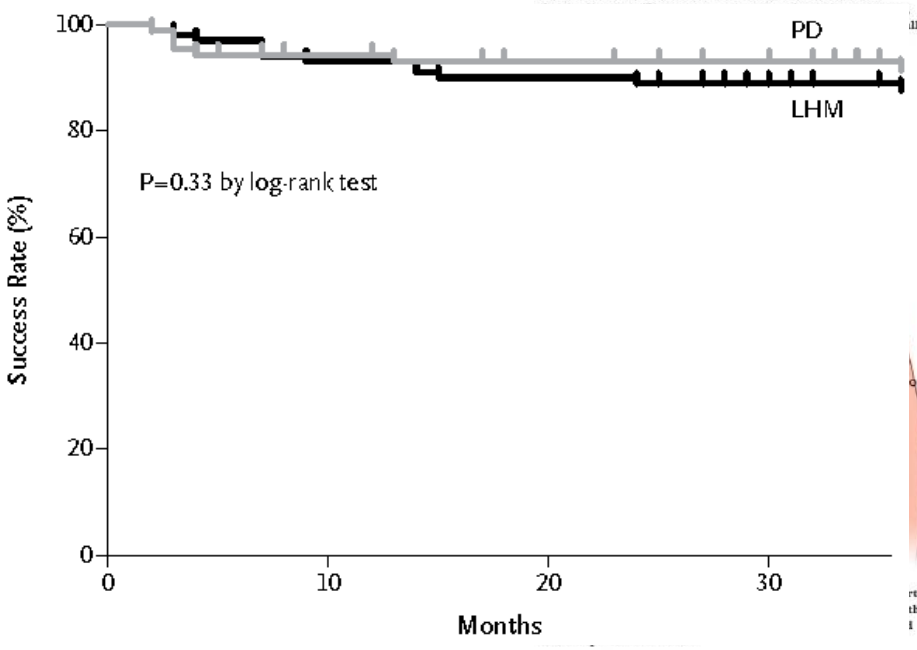


Figure 6 Laparoscopic Heller myotomy with anterior partial fundoplication (Dor procedure). The second and third stitches in the first row incorporate only the fundus and the left side of the esophageal wall.





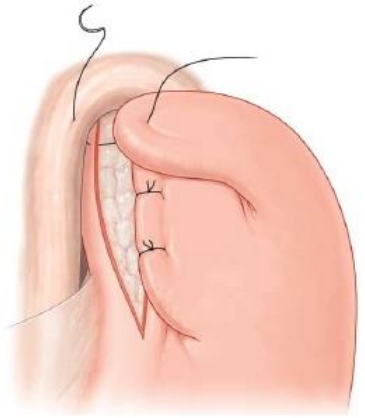


Figure 7 Laparoscopic Heller myotomy with anterior partial fundoplication (Dor procedure). The uppermost stitch in the second row incorporates the fundus, the esophageal wall, and the right crus.

- Poor response predictor : Megaesophagus
- Complications : Reflux esophagitis ± Stricture
  Barrett's esophagus

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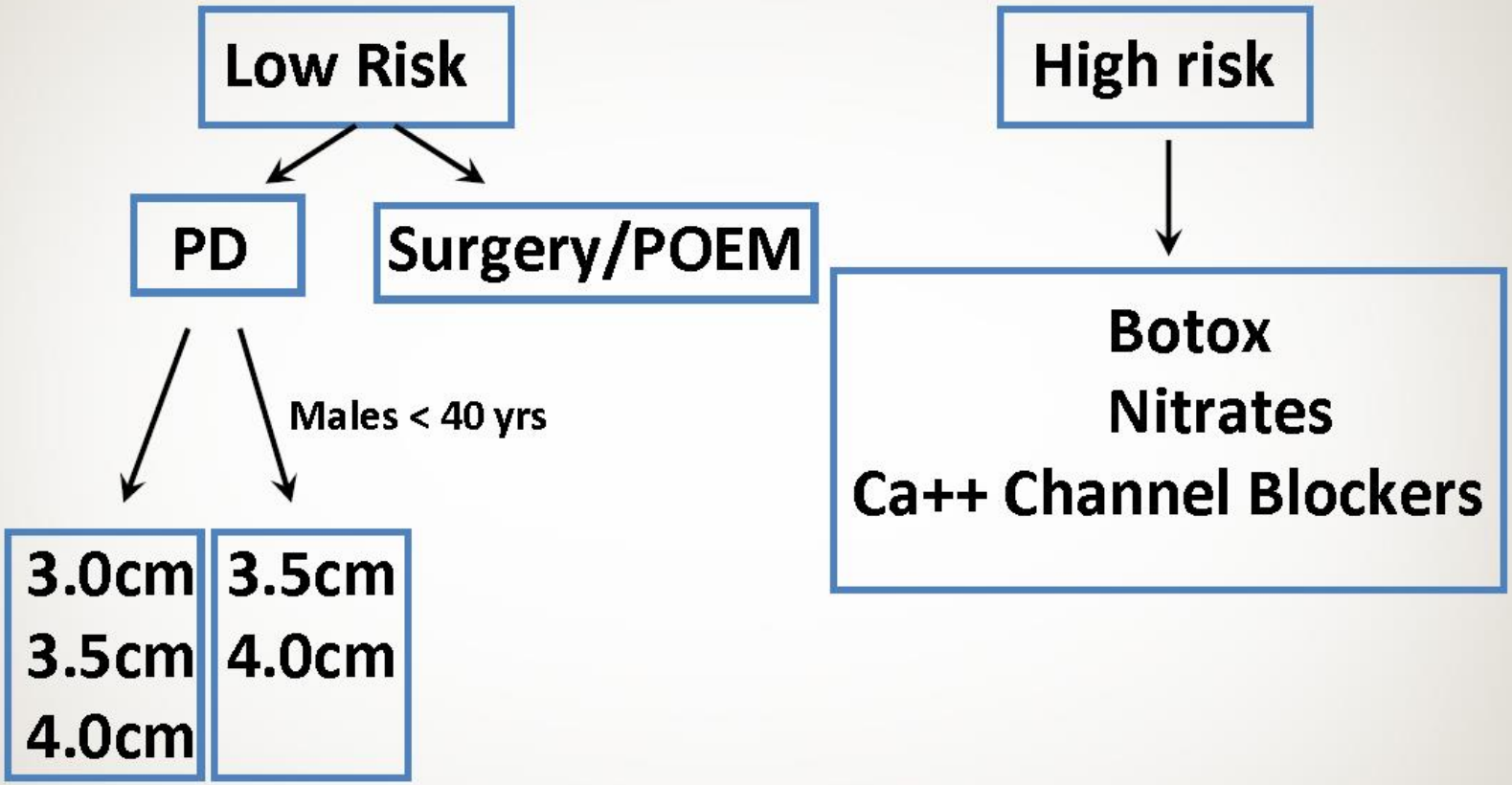
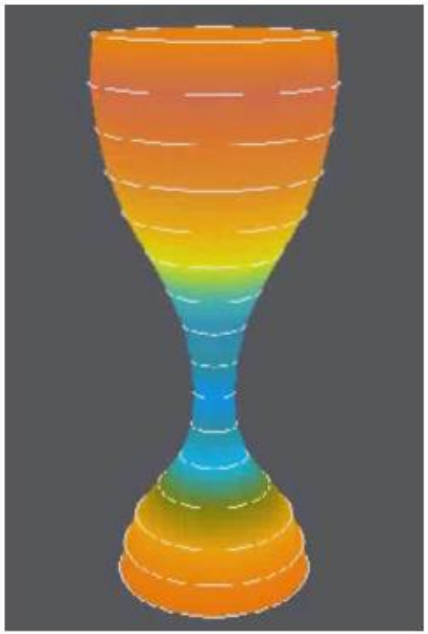
Algorithm



EGJ Distensibility Index (EGJ-DI)

$$\text{Distensibility Index} = \frac{\text{EGJ cross-sectional area}}{\text{Intra-balloon Pressure}}$$



Pre-op: 1.1 $mm^2/mmHg$

Post-POEM: 6.4 $mm^2/mmHg$ [4]

Northwestern Medicine®

1. Teitelbaum, et al. *Surgical Endoscopy*. 2014

NOTES

- Nephrectomy and Natural Orifice Translumenal Endosurgery (NOTES): Transvaginal, Transgastric, Transrectal, and Transvesical Approaches

Natural orifice translumenal endoscopic drainage for pancreatic abscesses

Peroral endoscopic myotomy (POEM) for esophageal achalasia*

initial experience

Original article

Transgastric hybrid cholecystectomy

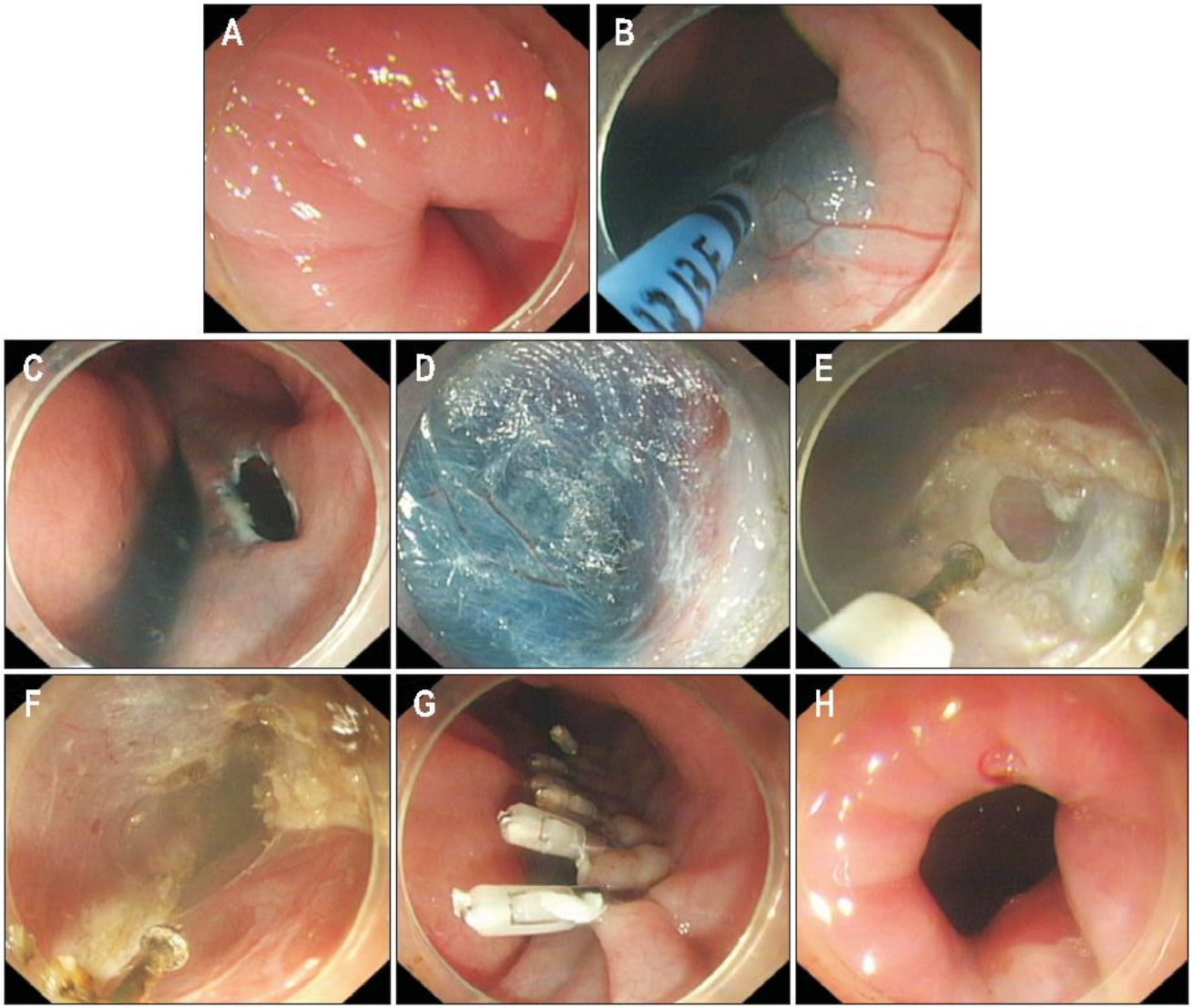
Transvesical Peritoneoscopy: Initial Clinical Evaluation of the Bladder as a Portal for Natural Orifice Translumenal Endoscopic Surgery

Peroral endoscopic myotomy (POEM)

- Hybrid techniques with endoscopic approach
  - Natural orifice transluminal endoscopic surgery (NOTES)

www.youtube.com

Peroral endoscopic myotomy (POEM)



Li QL, Zhou PH. Perspective on peroral endoscopic myotomy for achalasia: Zhongshan experience. *Gut and liver.* 2015;9(2):152-158.

Advantages of POEM over HM

Peroral Esophageal Myotomy Versus Laparoscopic Heller's Myotomy for Achalasia: A Meta-analysis.
Wei M, Yang T, Yang X, Wang Z, Zhou Z.J Laparoendosc Adv Surg Tech A. 2015 Feb;25(2):123-9.

- 4 studies compared the outcomes between POEM and LHM. All studies were from the United States and published in 2013. POEM was associated with **comparable complications** (odds ratio [OR]=1.17, 95% [CI] 0.53-2.56, P=.70), **gastroesophageal reflux** (OR=1.00, 95% CI 0.38-2.61, P=1.00), and **symptomatic recurrence by Eckardt score** (OR=0.24, 95% CI 0.04-1.55, P=.13). Other outcomes including pain score, operating time, and hospital stay were assessed with no significant difference between POEM and LHM.

David Rattner, Laparoscopic Heller Myotomy DDW 2016
Lee Swanstrom, So POEM Works - Now What?

Complications

Table 2. Complications of Peroral Endoscopic Myotomy

Common complications
Mucosal injury
Gas-related complications (intraoperative and postoperative)
Subcutaneous emphysema
Pneumomediastinum
Pneumothorax
Pneumoperitoneum
Pleural effusion
Pneumonitis
Fever (temperature ≥38°C)
Severe postoperative pain
Rare complications
Delay bleeding
Submucosal infection
Gastrointestinal tract leakage

Li QL, Chen WF, Zhou PH, et al. Peroral endoscopic myotomy for the treatment of achalasia: a clinical comparative study of endoscopic full-thickness and circular muscle myotomy. Journal of the American College of Surgeons. 2013;217(3):442-451.

Learning curve

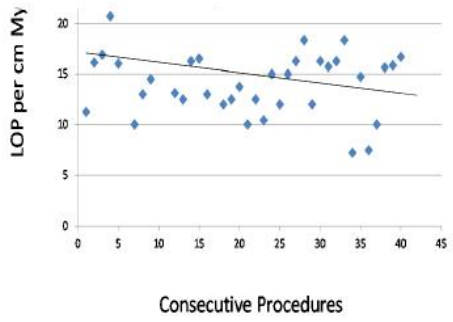
Introducing per-oral endoscopic myotomy (POEM) into clinical practice: defining the learning curve.

Kurian, Swanstrom, Dunst, Bhayani
Gastrointest Endosc, 2012. [in press]

- 48 POEM cases
- Gradual transition of procedures to advanced endocopy fellows
- Time and technical errors as outcomes markers
- Time and error plateaued after **20 cases** for both faculty and fellows

Table 1: Distribution of LOP and Mucosotomy

Groups	Patients	LOP per cm myotomy	No of mucosotomy	
1	1 to 8	16.1 ± 4	8	Attending Primary
2	7 to 16	17.2 ± 5	6	
3	17 to 24	13.5 ± 3	4	Transition
4	25 to 32	15.2 ± 2	0	Fellow Primary
5	33 to 40	13.2 ± 4	1	



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Outcomes of POEM

Table 4. Treatment Outcomes: Eckardt score, Lower Esophageal Sphincter Pressure, and Reflux Esophagitis

Variable	Before POEM	2 mo after POEM	1–2 y after POEM	3 y after POEM	p Value for change at 3 y
Eckardt score, median (range)	6 (5–8)	1 (0–2)	1 (1–2)	1 (1–2)	<0.0001
LES pressure, mmHg, median (range)	25.4 (18.2–35.3)	13.4 (10.5–16.4)	11.9 (7.0–15.9)	11.7 (9.6–14.9)	<0.0001
Endoscopic reflex esophagitis findings, n		LA-A, 140; LA-B, 107; LA-C, 20; LA-D, 1 (follow-up data from 414 patients, 64.7%)	LA-A, 68; LA-B, 25; LA-C, 15; LA-D, 5 (follow-up data from 191 patients, 59.2%)	LA-A, 7; LA-B, 1; LA-C, 1 (follow-up data from 16 patients, 56.3%)	
GERD symptoms		71 (follow-up data from 423, 16.8%)	56 (follow-up data from 289, 19.4%)	13 (follow-up data from 61, 21.3%)	
Prescription of proton pump inhibitor, n (%)		17 (4.0)			
Efficacy		386/423 (91%)	260/286 (91%)	54/61 (88%)	

Inoue H, Sato H, Ikeda H *et al.* Per-Oral Endoscopic Myotomy: A Series of 500 Patients. J Am Coll Surg 2015;221:256-64.

Establishment of standards protocol

- Incision site (**Anterior wall** VS **posterior wall** VS **GC**)
- Myotomy depth (**Circular muscle layer** VS **Full thickness**)
- Devices (**TT knife** VS **Hybrid knife**)
- Closure methods (**Clip** VS **Suture**)

	Full thickness	Circular muscle	*p*
Mean operation time, min	41.7 ± 18.9	48.9 ± 28.6	0.020
Intra-operation complications			
Mucosal injury, n (%)	13 (12.6)	27 (20.6)	0.110
Subcutaneous emphysema , n (%)	8 (7.8)	29 (21.1)	0.000
Post-operation complication			
Pneumoperitoneum, n (%)	1 (1.0)	1 (0.8)	1.000
Pneumonia, n (%)	41 (48.8)	91 (54.5)	0.430
Length of postoperative HD	2.7 ± 1.1	3.6 ± 2.7	0.000
Eckardt score			
Δ value	6.5 ± 2.3	7.0 ± 2.2	0.110
Treatment success (< 3), n (%)	95 (96.0)	115 (95.0)	0.750
LES pressure improvement (Δ value)	18.1 ± 13.9	17.4 ± 10.2	0.750

Li QL, Chen WF, Zhou PH, et al. Peroral endoscopic myotomy for the treatment of achalasia: a clinical comparative study of endoscopic full-thickness and circular muscle myotomy. Journal of the American College of Surgeons. 2013;217(3):442-451.
Stavros Stavropoulos, Per Oral Endoscopic Myotomy : Technique and Outcomes DDW 2016

Recommendation

Recommendation

1. Achalasia must be suspected in those with dysphagia to solids and liquids and in those with regurgitation unresponsive to an adequate trial of proton pump inhibitor (PPI) therapy (strong recommendation, low-quality evidence).

Recommendations

1. All patients with suspected achalasia who do not have evidence of a mechanical obstruction on endoscopy or esophagram should undergo esophageal motility testing before a diagnosis of achalasia can be confirmed (strong recommendation, low-quality evidence).
2. The diagnosis of achalasia is supported by esophagram findings including dilation of the esophagus, a narrow esophagogastric junction with "bird-beak" appearance, aperistalsis, and poor emptying of barium (strong recommendation, moderate-quality evidence).
3. Barium esophagram is recommended to assess esophageal emptying and esophagogastric junction morphology in those with equivocal motility testing (strong recommendation, low-quality evidence).
4. Endoscopic assessment of the gastroesophageal junction and gastric cardia is recommended in all patients with achalasia to rule out pseudoachalasia (strong recommendation, moderate-quality evidence).

Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49; quiz 50.

Recommendation

Recommendations

1. Either graded pneumatic dilation (PD) or laparoscopic surgical myotomy with a partial fundoplication are recommended as initial therapy for the treatment of achalasia in those fit and willing to undergo surgery (strong recommendation, moderate-quality evidence).
2. PD and surgical myotomy should be performed in high-volume centers of excellence (strong recommendation, low-quality evidence).
3. The choice of initial therapy should be guided by patients' age, gender, preference, and local institutional expertise (weak recommendation, low-quality evidence).
4. Botulinum toxin therapy is recommended in patients who are not good candidates for more definitive therapy with PD or surgical myotomy (strong recommendation, moderate-quality evidence).
5. Pharmacologic therapy for achalasia is recommended for patients who are unwilling or cannot undergo definitive treatment with either PD or surgical myotomy and have failed botulinum toxin therapy (strong recommendation, low-quality evidence).

Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49; quiz 50.

Thank you for attention