The Chicago Classification of Esophageal Motility Disorders, v3.0

International High Resolution Manometry Working Group

Neurogastroenterol Motil. 2015 February ; 27(2): 160–174. doi:10.1111/nmo.12477

THE CHICAGO CLASSIFICATION

International High Resolution Manometry Working Group

Year	City, Country	Version
2008[1]	San Diego, USA	v1.0
2011[2]	Ascona, Switzerland	v2.0
2014[3]	Chicago, USA	v3.0

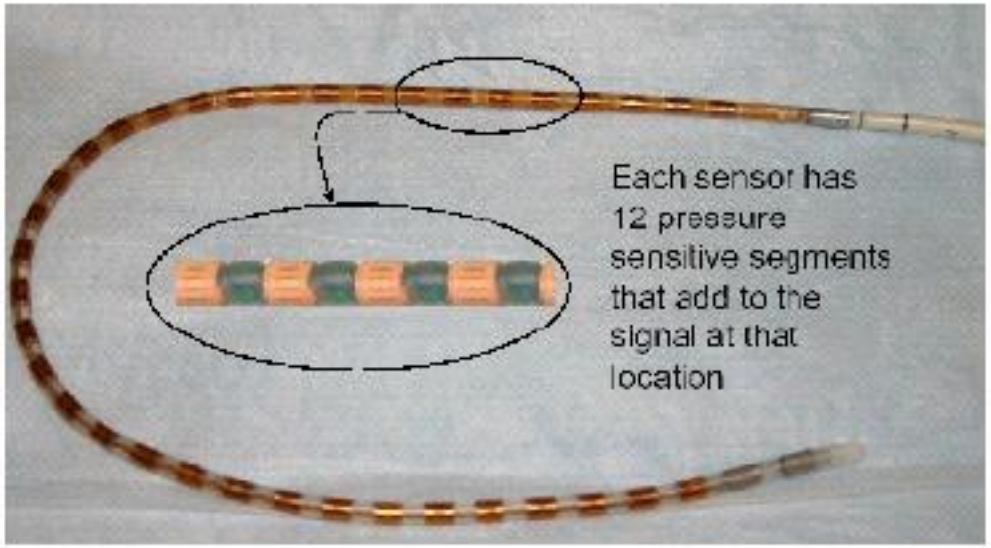
1- Pandolfino JE et al. Neurogastroenterol Motil. 2009; 21(8):796–806.

2- Bredenoord AJ et al. Neurogastroenterol Motil. 2012; 24(Suppl 1):57–65.

3- Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

High Resolution Manometry (HRM)

- like NG tube (flexible)
- 36 solid-state pressure sensors spaced at 1-cm intervals
- spans the entire esophagus
- measures esophageal motility



High Resolution Manometry (HRM)

Normal esophageal HRM after a wet swallow

esophageal pressure topography (Clause's segments)

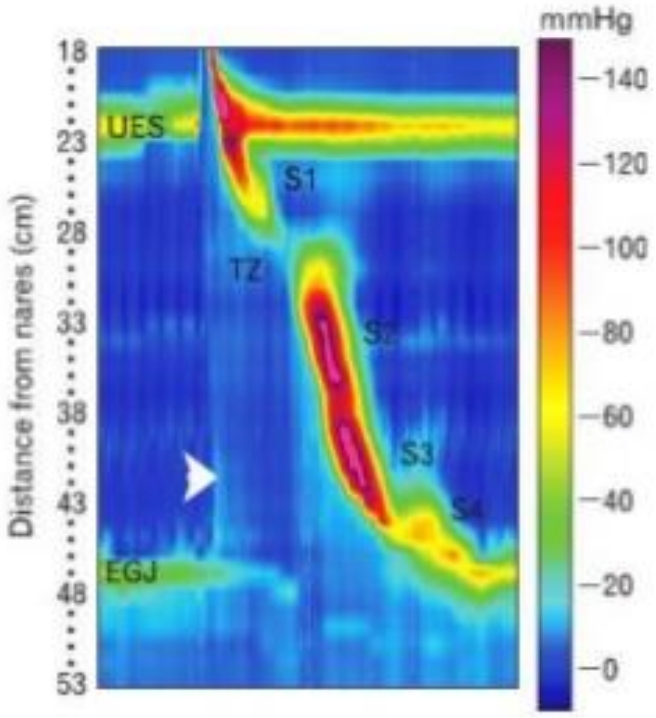
5 ml wet swallow

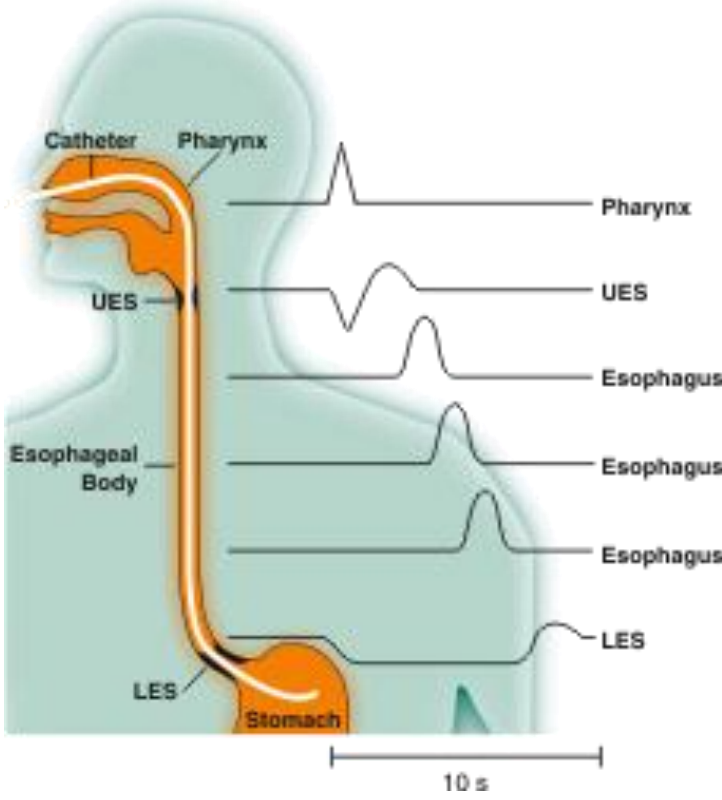
S1: striated esophageal muscles

Transition zone: pressure between S1 & S2

S2 & S3: proximal & distal smooth muscles

S4: LES repositioning at its resting position





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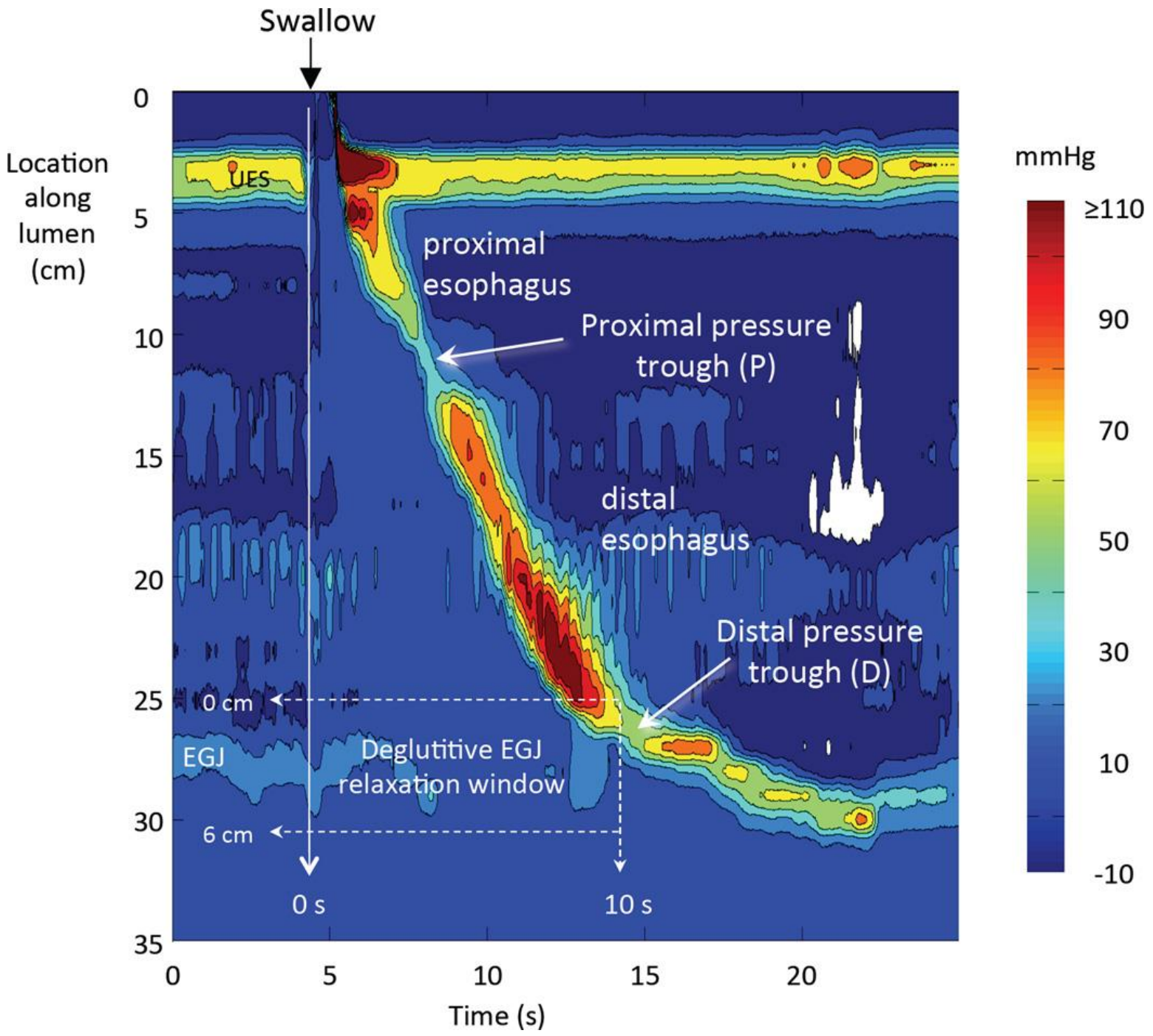
No previous foregut surgery

- Individual scoring of at least ten 5-ml swallows in supine position
- **Metrics of EGJ at rest**
  - EGJ morphology & LES-CD separation
  - EGJ tone
- **Metrics of each swallow**
  - Integrated relaxation pressure (IRP)
  - Contraction vigor
  - Contraction pattern
  - Intra-bolus pressure pattern (pressurization)
- **Absent in CC v3.0**
  - Contractile front velocity (CFV)
  - Small break (2 – 5 cm)
  - No more nutcracker

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

EPT-specific metrics

Metric	Description
IRP (mmHg) *Integrated Relaxation Pressure*	Median of the 4s of maximal deglutitive relaxation in the 10-s window beginning at UES relaxation. Contributing times can be contiguous or non-contiguous (eg interrupted by diaphragmatic contraction). Referenced to gastric pressure.
DCI (mmHg-s-cm) *Distal Contractile Integral*	**Amplitude x duration x length** (mmHg·s·cm) of the distal esophageal contraction exceeding 20 mmHg from the transition zone to the proximal margin of the LES (Clouse, 2nd and 3rd contractile segments)
CDP (time, position) *Contractile Deceleration Point*	Inflection point along the 30 mmHg isobaric contour (or pressure greater than intrabolus pressure in instances of compartmentalized pressurization) at which propagation velocity slows, demarcating peristalsis from ampullary emptying. The CDP must be localized within 3 cm of the proximal margin of the LES
DL(s) *Distal Latency*	Interval between UES relaxation and the CDP



Metric
IRP (mmHg) *Integrated Relaxation Pressure* ➔ ***LES relaxation pressure***
DCI (mraHg-s-cm) *Distal Contractile Integral* → ***Peristaltic amplitude***
CDP (time, position) *Contractile Deceleration Point*
DL(s) *Distal Latency*

EPT-specific metrics : IRP *Integrated Relaxation Pressure*

- **LES relaxation pressure** : The closest equivalent in conventional manometry

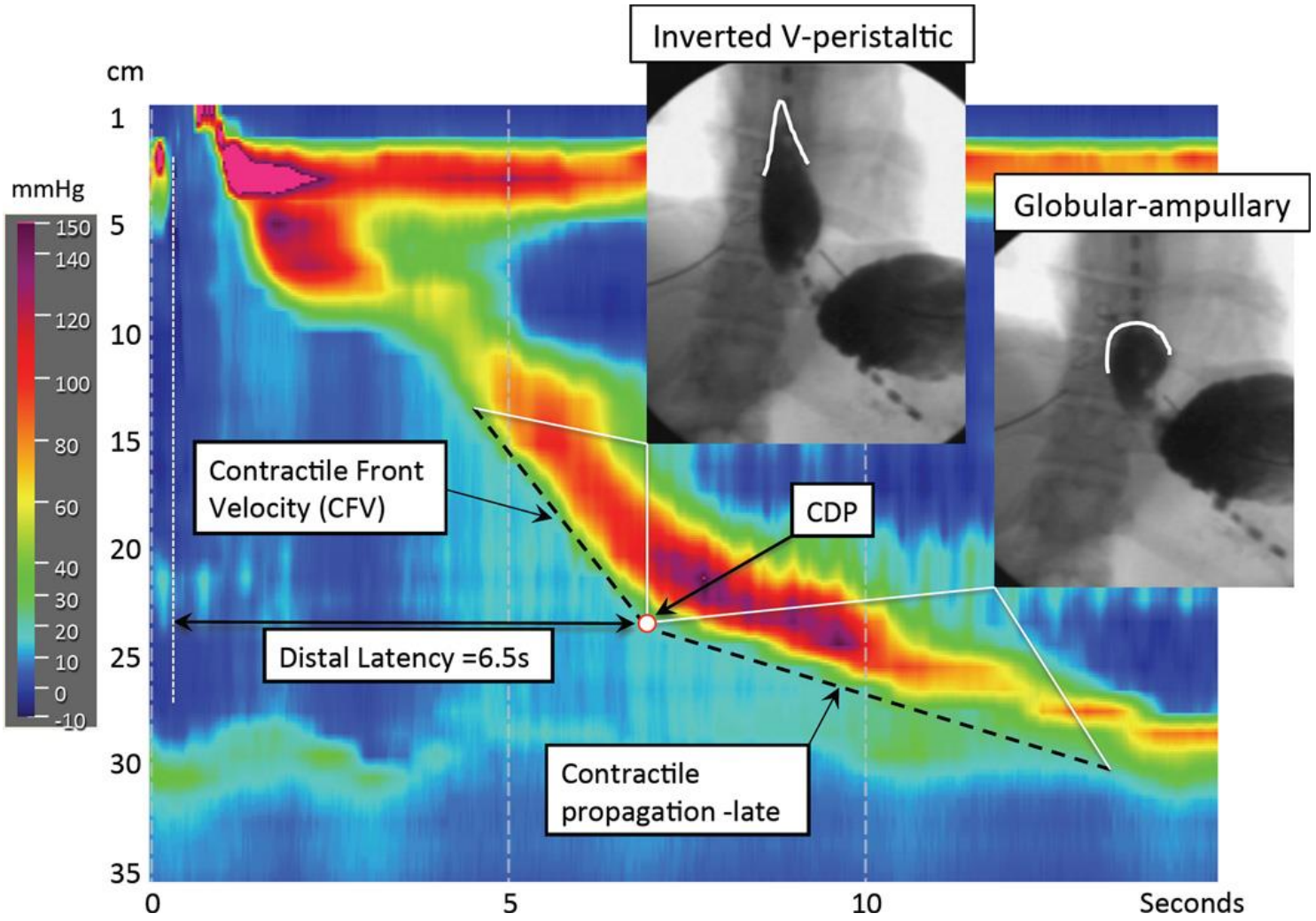
- The IRP is a complex metric as it involves accurately localizing the margins of the EGJ, demarcating the time window following deglutitive upper sphincter relaxation within which to anticipate EGJ relaxation to occur, applying an e-sleeve measurement within that 10 second time box and then finding the four seconds during which the e-sleeve value was least. The IRP is the mean pressure during those four seconds, necessarily being influenced not only by LES relaxation, but also by crural diaphragm contraction and intrabolus pressure (ie outflow obstruction) in the post-deglutitive period. These four seconds are not necessarily continuous but can be scattered over the 10-second time window.

EPT-specific metrics : DCI *Distal Contractile Integral*

- **Peristaltic amplitude** : the nearest equivalent of the DCI in conventional manometry

- **Amplitude × duration × length (mmHg-s-cm)** of the distal esophageal contraction greater than 20 mmHg from proximal (P) to distal (D) pressure troughs

EPT-specific metrics : CDP *Contractile Deceleration Point* DL *Distal Latency*



- the rate of contractile propagation in the distal esophagus
- **CDP**: The inflection point along the 30 mmHg isobaric contour where propagation velocity slows
- **transition from peristaltic propagation to the late phase of esophageal emptying**
- **DL** is measured from the time of upper sphincter relaxation to the CDP, again making it reflective of **peristaltic timing** and the period of deglutitive inhibition rather than the late phase of esophageal emptying

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(1) Incomplete LES relaxation	Achalasia (type I - II - III)
	EGJ outflow obstruction (EGJOO)
(2) Major motility disorders	Absent contractility
never seen in asymptomatic controls	Distal esophageal spasm
	Hypercontractile esophagus
(3) Minor motility disorders	Ineffective esophageal motility
can be seen in asymptomatic controls	Fragmented peristalsis
(4) Normal esophageal motility	Not fulfilling any of the above

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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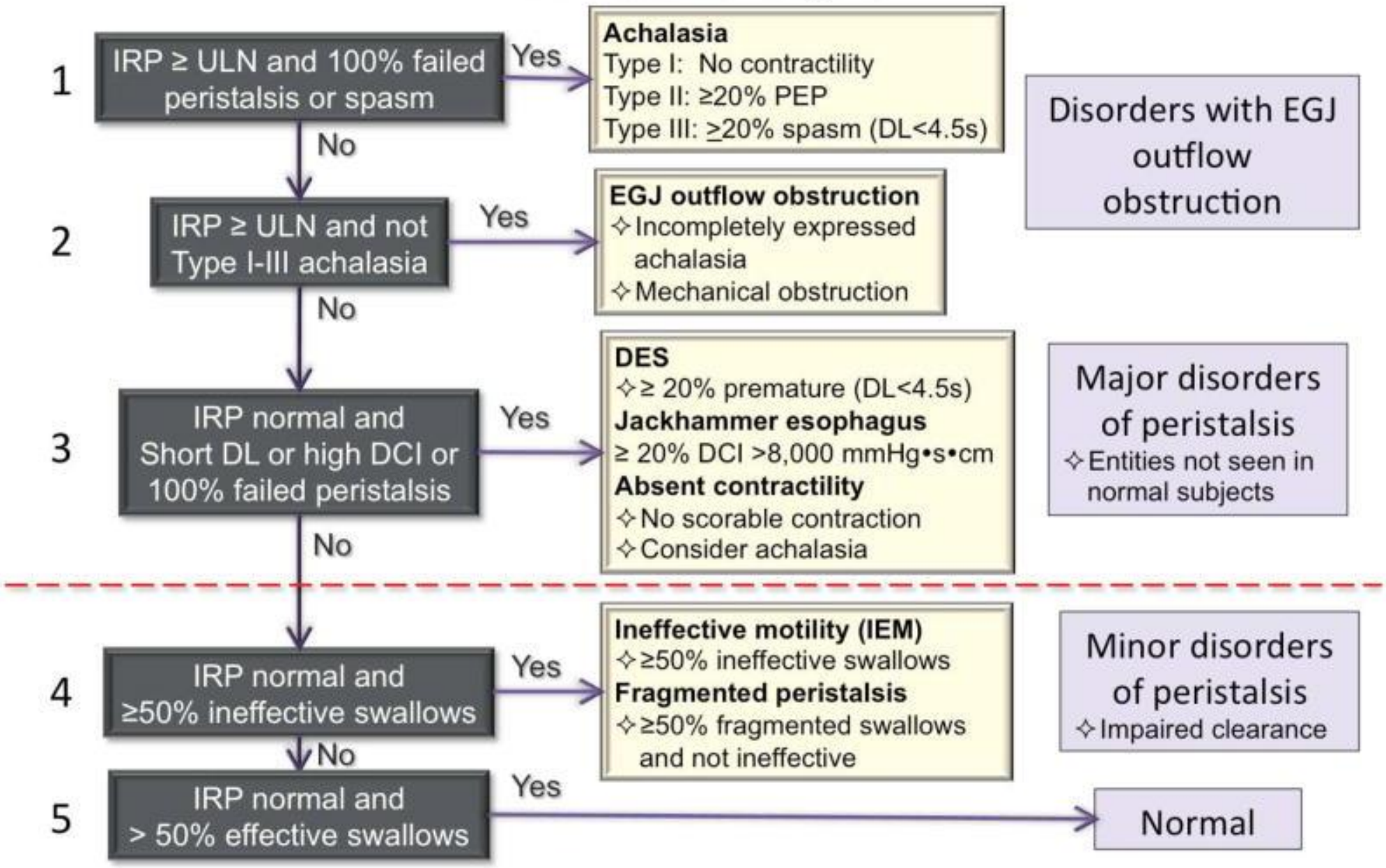
Hierarchical analysis



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Achalasia type I / Classic Achalasia

- Elevated median IRP (> 15 mmHg)
- 100% failed peristalsis (DCI < 100 mmHg)
- DL < 4.5 sec with DCI < 450 mmHg.s.cm meet criteria for failed peristalsis

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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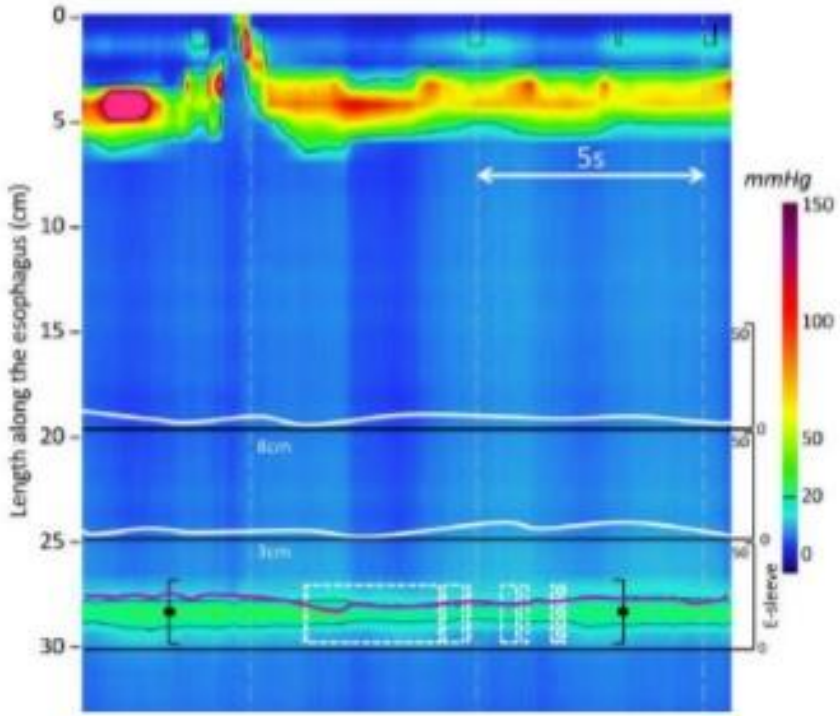
Achalasia type I / Classic Achalasia



IRP 17.6 mmHg, nadir LES pressure 23.3 mmHg

Absent peristalsis

Carlson DA and Pandolfino JE. Gastroenterol Clin North Am 2013; 42(1): 1–15.

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Achalasia type II / with esophageal compression

- Elevated median IRP (>15 mmHg)
- 100% failed peristalsis
- Panesophageal pressurization with at least 20% of swallows

  Contractions may be masked by esophageal pressurization & DCI should not be calculated

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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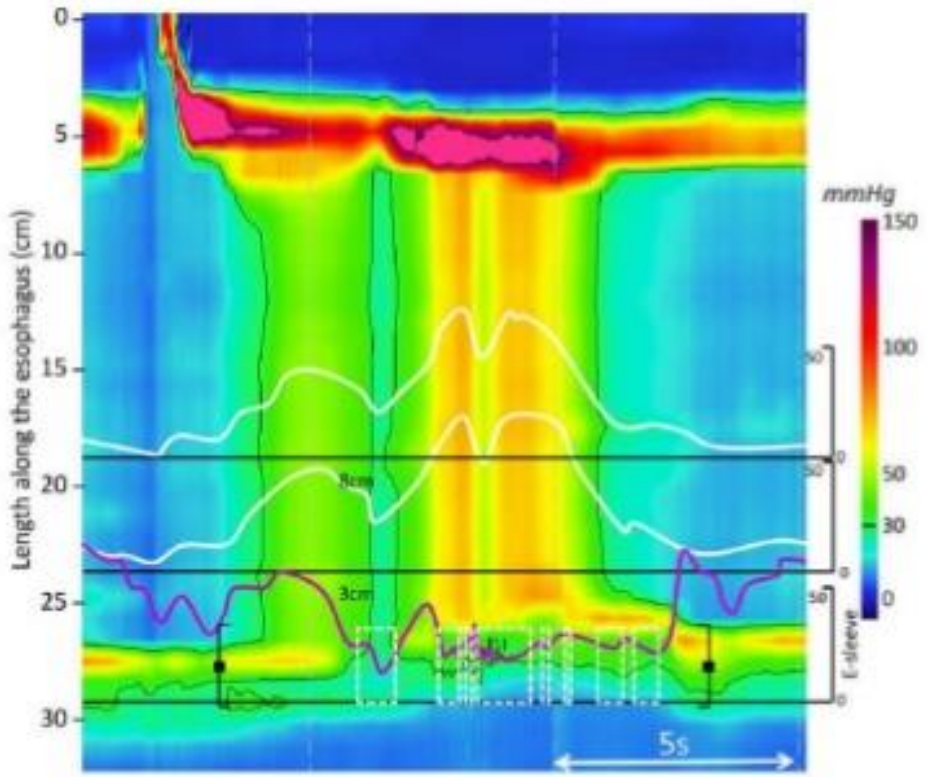
Achalasia type II / with esophageal compression



IRP 26.5mmHg

Pressurization spanning the entire length of esophagus without peristalsis

Carlson DA & Pandolfino JE. Gastroenterol Clin North Am 2013; 42(1): 1–15.

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Achalasia type III / Spastic achalasia

- Elevated median IRP (>15 mmHg)
- No normal peristalsis
- Premature contractions with DCI > 450 mmHg.s.cm for ≥ 20% of swallows
- May be mixed with panesophageal pressurization

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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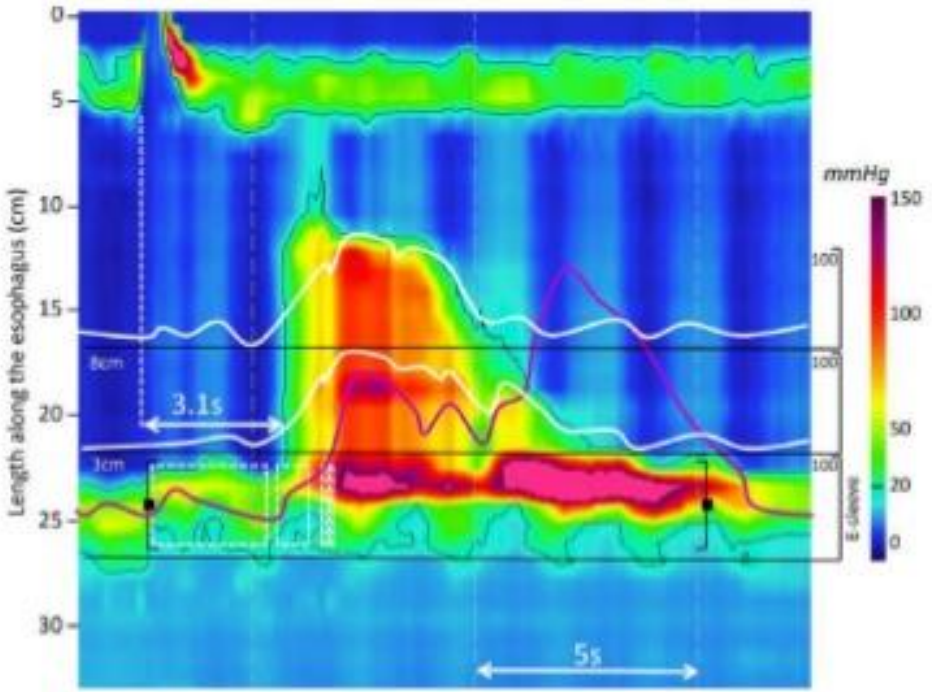
Achalasia type III / Spastic achalasia



IRP 46.5 mmHg, nadir LES pressure 42.3 mmHg

Fragments of distal peristalsis and/or premature contractions

Elevated wave amplitudes on CM labeling as "**vigorous achalasia**"

Carlson DA & Pandolfino JE. Gastroenterol Clin North Am 2013; 42(1): 1–15.

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EGJ outflow obstruction (EGJOO)

- **Criteria**
- Elevated median IRP (>15 mmHg)
  Sufficient peristalsis (criteria of achalasia not met)
- **Potential etiologies**
  Incompletely expressed achalasia (achalasia variant)
  Manifestation of hiatal hernia
  Vascular compression of distal esophagus
  Esophaygeal wall stiffness (infiltrative disease or cancer)
- **Other investigations:** EUS or CT to clarify etiology

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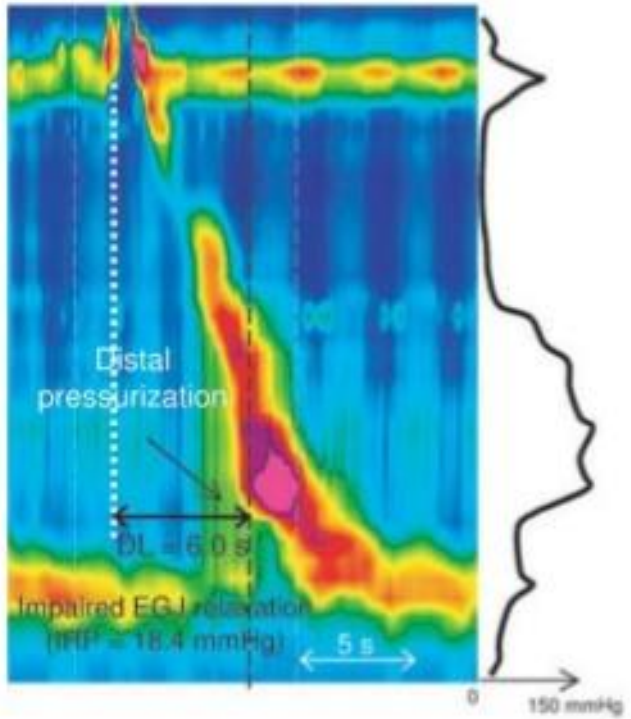
EGJ outflow obstruction / Obstructive stricture



Patient have distal esophageal stenosis

Based on compartmentalized pressurization & elevated IRP (18.4mmHg)

Normal DL (6.0 sec)

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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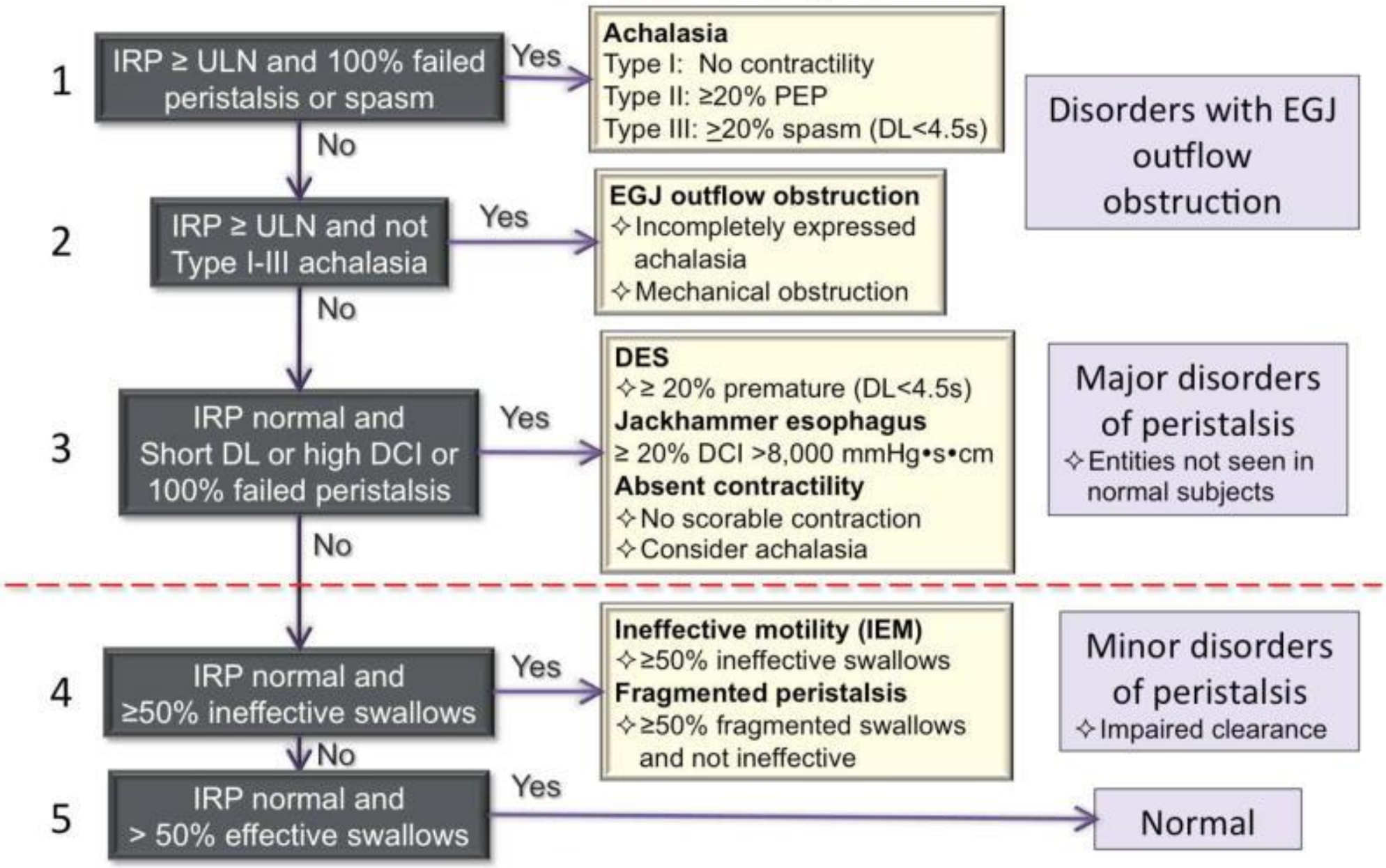
Hierarchical analysis



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Absent contractility

Absent peristalsis

Rare

- **Criteria** 100% failed peristalsis
  Normal median IRP
  Consider achalasia if borderline IRP & pressurization
- **Etiologies** Typically associated with scleroderma
  Systemic diseases: diabetes, myxedema, MS, ….
  In the absence of systemic disease

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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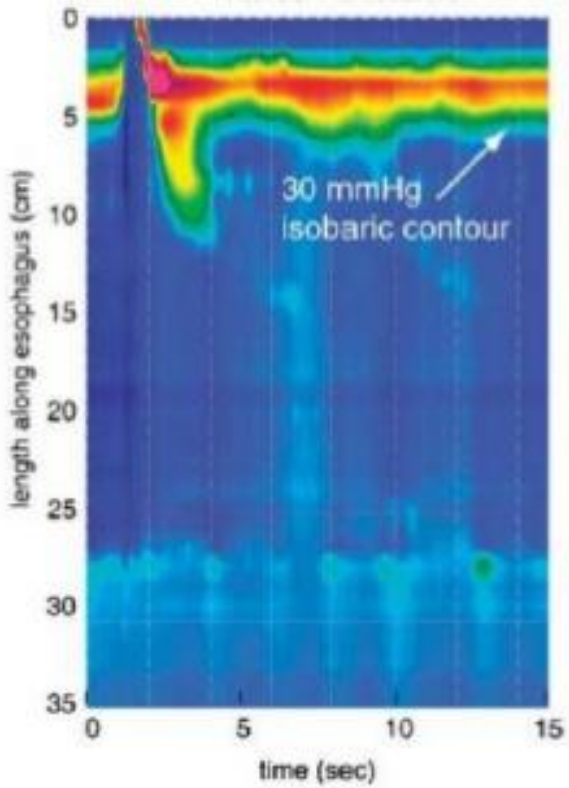
Absent contractility



Failed peristalsis - Normal median IRP

Kahrilas PJ. J Clin Gastroenterol 2008; 42(5): 627-635.

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Distal esophageal spasm

previously known as "diffuse esophageal spasm"

≥ 20% premature contractions with DCI > 450 mmHg.s.cm

Some normal peristalsis may be present

Normal median IRP

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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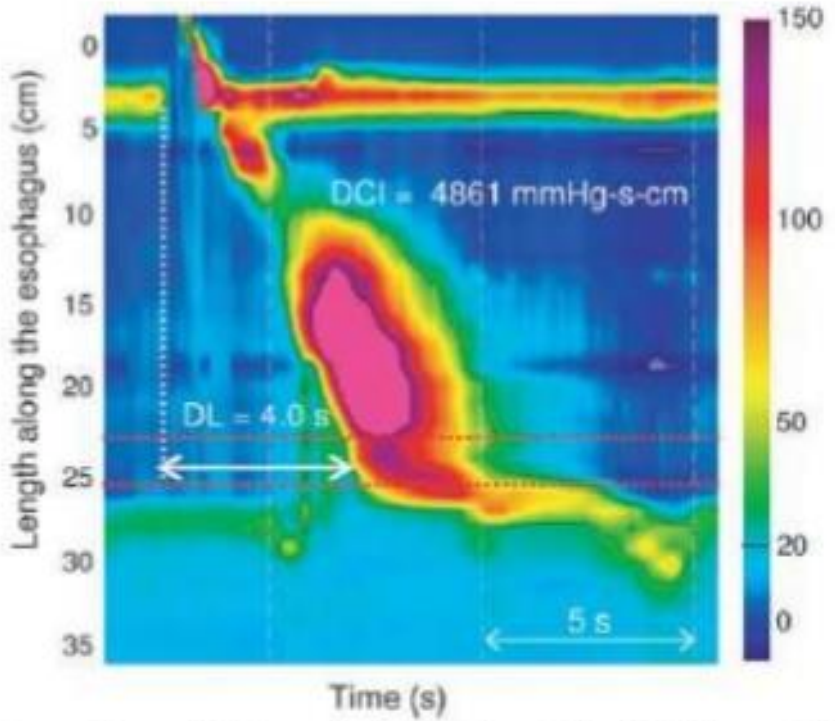
Distal esophageal spasm



Premature contraction (DL < 4.5 sec) with DCI > 450 mmHg.s.cm

Premature contractions uniformly associated with chest pain/dysphagia

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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Hypercontractile esophagus (jackhammer)

- ≥ 20% of swallows with DCI > 8000 mmHg.s.cm & normal latency
- Hypercontractility can involve LES or even be restricted to LES
  Expanding DCI measurement to include EGJ in such instances
- Hypercontractile esophagus can be a manifestation of other esophageal abnormalities such as EGJOO, GERD, or EE

Kahrilas PJ et al. Neurogastroenterol Motil 2015; 27:160-174.

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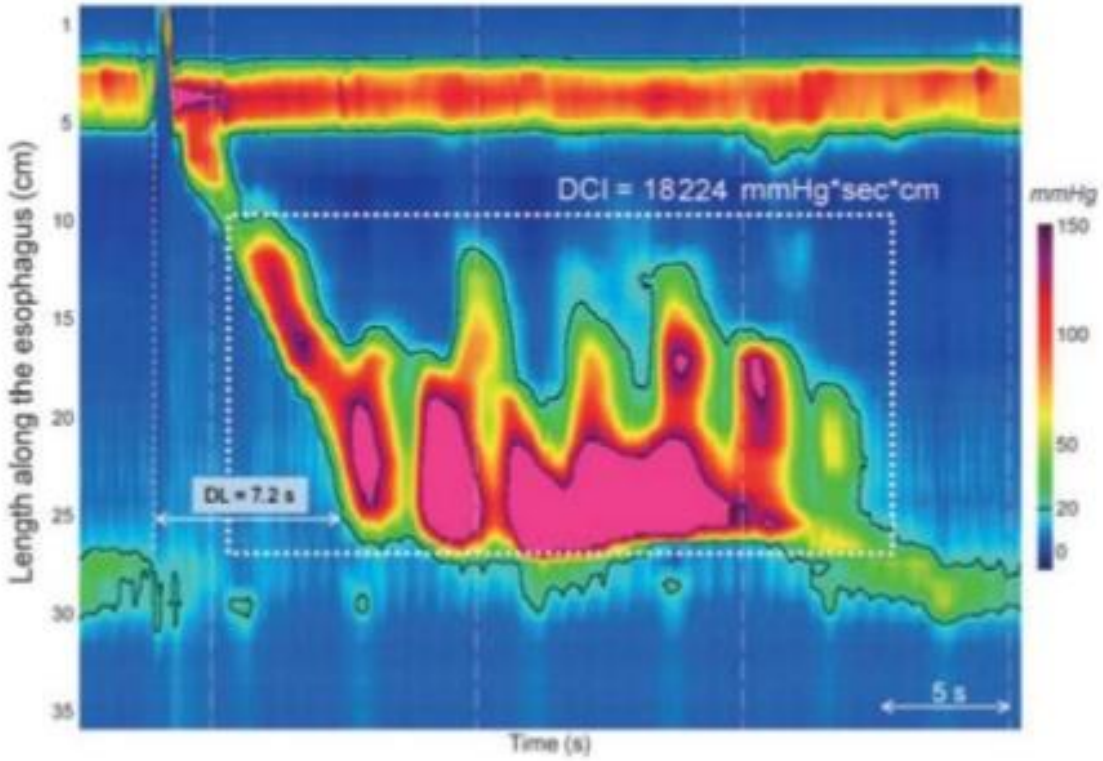
Hypercontractile esophagus (jackhammer)

restricted to the esophagus



At least two swallows with a DCI ≥ 8000 mmHg.s.cm

Roman S & Tutuian R. Neurogastroenterol Motil 2012; 24 (Suppl. 1), 32–39.

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Hierarchical analysis