# THE CHICAGO CLASSIFICATION

International High Resolution Manometry Working Group

<table>
<thead>
<tr>
<th>Year</th>
<th>City, Country</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>San Diego, USA</td>
<td>v1.0</td>
</tr>
<tr>
<td>2011</td>
<td>Ascona, Switzerland</td>
<td>v2.0</td>
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<tr>
<td>2014</td>
<td>Chicago, USA</td>
<td>v3.0</td>
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</table>

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
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
THE CHICAGO CLASSIFICATION v3.0

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

# EPT-specific metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>IRP</strong> (mmHg) <strong>Integrated Relaxation Pressure</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>DCI</strong> (mmHg-s-cm) <strong>Distal Contractile Integral</strong></td>
<td>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)</td>
</tr>
<tr>
<td><strong>CDP</strong> (time, position) <strong>Contractile Deceleration Point</strong></td>
<td>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</td>
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<tr>
<td><strong>DL(s)</strong> <strong>Distal Latency</strong></td>
<td>Interval between UES relaxation and the CDP</td>
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</table>
**Metric**

<table>
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<tr>
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<tr>
<td>IRP (mmHg)</td>
<td></td>
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<tr>
<td>Integrated Relaxation Pressure</td>
<td>(\Rightarrow) LES relaxation pressure</td>
</tr>
<tr>
<td>DCI (mraHg-s-cm)</td>
<td></td>
</tr>
<tr>
<td>Distal Contractile Integral</td>
<td>(\Rightarrow) Peristaltic amplitude</td>
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• 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
<table>
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<th>Category</th>
<th>Description</th>
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<tr>
<td>(1) Incomplete LES relaxation</td>
<td>Achalasia (type I - II - III)</td>
</tr>
<tr>
<td></td>
<td>EGJ outflow obstruction (EGJOO)</td>
</tr>
<tr>
<td>(2) Major motility disorders</td>
<td>Absent contractility</td>
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<tr>
<td></td>
<td>Distal esophageal spasm</td>
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<tr>
<td></td>
<td>Hypercontractile esophagus</td>
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<tr>
<td>(3) Minor motility disorders</td>
<td>Ineffective esophageal motility</td>
</tr>
<tr>
<td></td>
<td>Fragmented peristalsis</td>
</tr>
<tr>
<td>(4) Normal esophageal motility</td>
<td>Not fulfilling any of the above</td>
</tr>
</tbody>
</table>

The Chicago Classification v3.0

Hierarchical analysis

1. IRP ≥ ULN and 100% failed peristalsis or spasm
   - Yes: Achalasia
     - Type I: No contractility
     - Type II: ≥20% PEP
     - Type III: ≥20% spasm (DL<4.5s)
   - No

2. IRP ≥ ULN and not Type I-III achalasia
   - Yes: EGJ outflow obstruction
     - Incompletely expressed achalasia
     - Mechanical obstruction
   - No

3. IRP normal and Short DL or high DCI or 100% failed peristalsis
   - Yes: DES
     - ≥ 20% premature (DL<4.5s)
     - Jackhammer esophagus
       - ≥ 20% DCI >8,000 mmHg•s•cm
     - Absent contractility
     - No scorable contraction
     - Consider achalasia
   - No

4. IRP normal and ≥50% ineffective swallows
   - Yes: Ineffective motility (IEM)
     - ≥50% ineffective swallows
   - No

5. IRP normal and > 50% effective swallows
   - Yes: Fragmented peristalsis
     - ≥50% fragmented swallows and not ineffective
   - No: Normal

Disorders with EGJ outflow obstruction

Major disorders of peristalsis
- Entities not seen in normal subjects

Minor disorders of peristalsis
- Impaired clearance
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

Achalasia type I / Classic Achalasia

IRP 17.6 mmHg, nadir LES pressure 23.3 mmHg
Absent peristalsis

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

Achalasia type II / with esophageal compression

IRP 26.5 mmHg

Pressurization spanning the entire length of esophagus without peristalsis

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

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”

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
  - Esophageal wall stiffness (infiltrative disease or cancer)

- **Other investigations:** EUS or CT to clarify etiology

EGJ outflow obstruction / Obstructive stricture

Patient have distal esophageal stenosis
Based on compartmentalized pressurization & elevated IRP (18.4mmHg)
Normal DL (6.0 sec)

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   - No: Fragmented peristalsis
     - ≥50% fragmented swallows and not ineffective

5. IRP normal and > 50% effective swallows
   - Yes: Normal
   - No:

Disorders with EGJ outflow obstruction

Major disorders of peristalsis
- Entities not seen in normal subjects

Minor disorders of peristalsis
- Impaired clearance
**Absent contractility**

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

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Absent contractility

Failed peristalsis - Normal median IRP

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

Distal esophageal spasm

Premature contraction (DL < 4.5 sec) with DCI > 450 mmHg.s.cm
Premature contractions uniformly associated with chest pain/dysphagia

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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

Hypercontractile esophagus (jackhammer)

restricted to the esophagus

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

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