Esophageal Manometry: When and How

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### Normal Manometric Features on Standard Manometry
(Limits defined largely by standard deviations from normal)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal LES pressure</td>
<td>10-45 mm Hg</td>
</tr>
<tr>
<td>LES Relaxation with Swallowing</td>
<td>&lt;8 mm Hg above</td>
</tr>
<tr>
<td>Speed of Peristalsis</td>
<td>1-6 cm/sec</td>
</tr>
<tr>
<td>Wave Amplitude (distal esophagus)</td>
<td>30-180 mm Hg</td>
</tr>
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### Classification of Esophageal Motility Abnormalities

- **Inadequate LES relaxation**
  - Classic achalasia
  - Atypical disorders of LES relaxation
- **Uncoordinated contraction**
  - Diffuse (distal) esophageal spasm
- **Hypercontraction**
  - Nutcracker esophagus
  - Hypertensive LES
- **Hypocontraction**
  - Ineffective esophageal motility

High-Resolution Manometry

36 solid-state sensors spaced at 1 cm intervals

Data processed using computer algorithms and displayed as color-coded, pressure topography graphs

High Resolution Manometry
Normal Swallow

Kahrilas P.
Gastroenterology 2008;134:16
Lower Esophageal Sphincter (LES)

Crural Diaphragm

Esophago-Gastric Junction (EGJ) Pressure

Normal LES Relaxation with Swallowing

<8mm Hg above gastric pressure
High-Resolution Manometry Normal Swallow

Deglutitive EGJ Relaxation Window

**Integrated Relaxation Pressure (IRP)**: Lowest mean relaxation pressure for a 3 or 4-second period

*eSleeve 3-Second Nadir Pressure*: Lowest mean relaxation pressure for a 3-second contiguous period

**Impaired EGJ relaxation**: ≥15 mm Hg
Contractile Front Velocity (CFV)

-speed of peristalsis

• Locate distal margin of transition zone
• Locate contractile deceleration point
• CFV is slope of line between the 2 points (distance/time)

\[ CFV = \frac{14 \text{ cm}}{5 \text{ sec}} = 2.8 \text{ cm/sec} \]

Kahrilas P. Gastroenterology 2008;135:756

Distal Contractile Integral

(Amplitude of Peristalsis)

Volume:
Height (mm Hg) \times Length (cm) \times Width (seconds)

Normal mean DCI is >450 and <5000 mmHg.cm.sec

DCI = 11,885 mmHg.cm.sec

### Normal Manometric Feature Values

<table>
<thead>
<tr>
<th>Feature</th>
<th>Standard Manometry</th>
<th>High Resolution Manometry</th>
</tr>
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<tbody>
<tr>
<td>Basal EGJ pressure</td>
<td>10-45 mm Hg</td>
<td>10-35 mm Hg</td>
</tr>
<tr>
<td>EGJ Relaxation with Swallowing</td>
<td>&lt;8 mm Hg above gastric pressure</td>
<td>&lt;15 mm Hg* (IRP)</td>
</tr>
<tr>
<td>Speed of Peristalsis</td>
<td>1-6 cm/sec</td>
<td>&lt;9 cm/sec (CFV)</td>
</tr>
<tr>
<td>Wave Amplitude (distal esophagus)</td>
<td>30-180 mm Hg</td>
<td>Mean DCI &lt;5000 (mm Hg cm sec)</td>
</tr>
</tbody>
</table>

*Normal IRP value varies with manufacturer

### Indications for Esophageal Motility Studies

- Dysphagia not explained by stenoses or inflammation
- Chest pain not explained by heart disease
- Before fundoplication to exclude achalasia
Demonstration of Motility Abnormalities Does Not Necessarily Indicate Disease

• Causes not known
• Some abnormalities have no physiological consequences
• Symptoms might not respond to therapies that correct abnormalities

Interpretation of Motility Abnormalities

• Fulfillment of manometric criteria for a motility disorder does not establish its clinical importance.
• Ultimate diagnosis of a motility disorder requires consideration of clinical as well as manometric features.
Classic Achalasia
Requisite Standard Manometric Features

- Incomplete LES relaxation (to a nadir value >8 mm Hg above gastric pressure)
- Complete aperistalsis in the esophageal body with low amplitude (<40 mm Hg) or absent contractions

![Classic Achalasia, High Resolution Manometry](image)

Type I

*Kahrilas P. Gastroenterology 2008;134:16*
Achalasia With Pan-Esophageal Compression

Type II

Kahrilas P. Gastroenterology 2008;134:16

Spastic Achalasia

Type III

Kahrilas P. Gastroenterology 2008;134:16
Clinical Relevance of Achalasia Classification by High Resolution Manometry

Overall Positive Response to Therapy 56%  
Overall Positive Response to Therapy 96%  
Overall Positive Response to Therapy 29%

Distal Esophageal Spasm  
Requisite Standard Manometric Features

- **Simultaneous contractions** in >10% of wet swallows and
- Mean amplitude of simultaneous contractions >30 mm Hg

*Simultaneous contractions recognized by speed of peristalsis >6-9 cm/sec*
Measurement of Distal Latency for DES

Distal latency (DL) is the time from start of swallow to CDP. Normal DL is >4.5 sec. DES is defined as DL <4.5 sec in ≥20% of swallows.

Short Distal Latency (DL) Identifies Esophageal Spasm Better than Simultaneous (Rapid) Contractions

1,070 patients with HRM studies
91 patients with rapid propagation (DL<4.5 sec and/or CFV>9 cm/sec)
24 patients premature contractions (DL<4.5 sec)
67 patients rapid contractions (CFV>9 cm/sec, normal DL)

18 Spastic Achalasia
39 Weak Peristalsis
14 Functional EGJ Obstruction
5 Hypertensive Peristalsis
2 Other
7 Otherwise Normal
Hypercontractile (Jackhammer) Esophagus
≥20% of swallows with DCI>8,000 mm Hg.cm.sec


HRM Equivalents of Ineffective Esophageal Motility

Fragmented Peristalsis
Breaks ≥5cm in 20mm Hg isobaric contour, DCI>450

Failed Peristalsis
DCI<100
HRM Equivalents of Ineffective Esophageal Motility

### Chicago Classification

**IRP > upper limit of normal AND…**

- **No peristalsis** → **Achalasia** Types I, II, III
- **Some peristalsis** → **EGJ outflow obstruction**
  - Mechanical obstruction vs. incomplete achalasia
- **Normal IRP AND…**
  - Distal latency < 4.5 sec in ≥20% of swallows → **Distal esophageal spasm**
  - DCI > 8,000 in ≥20% of swallows → **Jackhammer esophagus**
  - 100% failed peristalsis → **Absent contractility**

**Minor Disorders of Peristalsis:**

- **Normal IRP AND...**
  - DCI < 450 in ≥50% of swallows → **Ineffective esophageal motility**
  - DCI > 450, ≥50% fragmented swallows → **Fragmented peristalsis**