Chicago Classification 4.0: Advances in High-resolution Esophageal Manometry

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Disclosures

- No relevant disclosures
Outline

• Reminder: what a manometry tells you
• Review of Chicago Classification
• Updates to Chicago Classification (4.0)
• Clinical scenarios/relevance
Esophageal Peristalsis

• Primary peristalsis = Sequential contraction of circular smooth muscle layer proximal to distal initiated by voluntary swallow
• Secondary peristalsis = peristaltic wave reflexively initiated by retained bolus (not preceded by UES relaxation)
• Velocity of wave = 3-5 cm/sec
• Longitudinal muscle also contracts with swallowing
  • Shortens on average 2cm
• Repetitive swallowing: Why doesn’t the lumen opposing contraction occurring with one swallow not interfere with the one directly after it?
  • Rapid swallowing shows a pattern of inhibition of the esophageal body until the last swallow is done (“Deglutitive inhibition”)
Indications for esophageal manometry

• Evaluation of patients with non-obstructive dysphagia
• To aid in placement of pH or pH-impedance probe for reflux monitoring
• Prior to esophageal surgery; fundoplication
• For evaluation of patients with non-cardiac chest pain
  • After failure of PPI trial
Technique + Protocol

• Topical lidocaine only
• Probe placed transnasally, crossing LES into stomach
• Patient lies supine
• Series of ten sips of liquid for single swallows
• +/- Multiple rapid swallow
• +/- upright swallows
• +/- Rapid drink challenge
• +/- viscous/solid challenge, test meal
• Probe removed
High resolution catheter

• 36 sensors
• Circumferential pressure data (12 points)
• Sensors spaced 1 cm apart
• 432 data points
• Data displayed as “pressure topography”
Baseline/Rest

X axis: Time

Y axis: Position in esophagus

Warm = high pressure

Color = “Z axis”

Cool = low pressure
Normal swallow/peristalsis
Normal swallow/peristalsis

1. UES first relaxes
Normal swallow/peristalsis

2. Striated muscle contracts
Normal swallow/peristalsis

3. Transition zone = mixed smooth and striated, normal to see small break
Normal swallow/peristalsis

4. Sequential smooth muscle contraction
Normal swallow/peristalsis

Note the LES is relaxing, 2 s after initiation of swallow
Normal swallow/peristalsis

“Contraction Deceleration point” = slowing of velocity
Normal swallow/peristalsis

Pressure topography

LES aftercontraction
The Chicago Classification

- International HRM Working group devised classification scheme - v.1 2008
  - Version 4 published 1/2021
- Objective is to apply standardized reproducible metrics to HRM to classify esophageal motility disorders
## HRM metrics - each swallow

<table>
<thead>
<tr>
<th>Metric</th>
<th>Definition</th>
<th>Notes</th>
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| IRP (integrated relaxation pressure) | Lowest mean EGJ pressure for 4 contiguous or non-contiguous sec of relaxation | [essentially measures les relaxation after a swallow]  
  Normal <15 supine  
  Normal <12 upright |
| DCI (distal contractile integral) | Amplitude x duration x length (mmHg-s-cm) of the distal esophageal contraction greater than 20 mmHg from transition zone to LES | [essentially measures the “vigor” of the contraction; including duration and length makes sure you’re not just looking at peak amplitude]  
  Normal >450, <8000  
  Ineffective >100 but <450  
  Failed <100  
  Hypercontractile >8000 |
| DL (distal latency)  | Interval between UES relaxation and the contractile deceleration point (CDP). | [measures how premature a contraction is]  
  Normal >4.5 |

Pandolfino et al, Gastro 2011; 141(2)
Examples of peristaltic patterns

Kahrilas PJ et al, Neurogastroenterol Motil 2015; 27
Chicago Classification Algorithm 3.0

*Based on 10 supine liquid swallows

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: EGJ outflow obstruction
     - Incompletely expressed achalasia
     - Mechanical obstruction

2. IRP ≥ ULN and not Type I-III achalasia
   - Yes: EGJ outflow obstruction
     - Incompletely expressed achalasia
     - Mechanical obstruction
   - No: Major disorders of peristalsis
     - Entities not seen in normal subjects

3. IRP normal and Short DL or high DCI or 100% failed peristalsis
   - Yes: DES
     - ≥20% premature (DL<4.5s)
     - Jackhammer esophagus
     - Absent contractility
     - No scorable contraction
     - Consider achalasia
   - No: Minor disorders of peristalsis
     - Impaired clearance

4. IRP normal and ≥50% ineffective swallows
   - Yes: Ineffective motility (IEM)
     - ≥50% ineffective swallows
     - Fragmented peristalsis
     - ≥50% fragmented swallows and not ineffective
   - No: Normal

5. IRP normal and > 50% effective swallows
   - Yes: Normal

Kahrilas PJ et al, Neurogastroenterol Motil 2015; 27
Chicago Classification: Benefits

- Standardization in clinical and research realm, common language
- Increased sensitivity to detect Achalasia
- Prognostic and therapeutic implications in Achalasia subtypes
- Defined more homogeneous population with distal esophageal spasm
- Clear Role in “Major motility disorders”

1 Roman S et al, *Am J Gastro* 2016;111(3)
2 Rohof W et al, *Gastro* 2013;144(4)
3 Pandolfino J et al, *Gastro* 2011;141
CC 3.0 limitations: addressed in 4.0

• EGJOO:
  • heterogeneous condition, ?artifact, hernia, opiates, asymptomatic
  • May spontaneous resolve in >50% patients
  • Clinical conundrum- is it real or not?

• Ineffective Esophageal Motility
  • Failed swallow more likely to cause impaired bolus clearance than weak
  • Dysphagia scores the same for “IEM v 3.0” pt and “controls”
  • Clinically heterogeneous

• No provocative testing in V3.0

1 Ong AML et al, J Gastroenterol hepatol 2018
2. Jain A et al, NGM 2018;30(6)
3 Chugh P et al, DDS 2019;64(3)
4. Shetler KPet al, Dis Esoph 2017;30
EGJO: changes in v4.0

- Diagnosis supported by elevated IRP in both supine and upright positions
- Diagnosis supported by presence of clinical symptoms
  - Dysphagia, chest pain
- Diagnosis supported by second modality
  - Timed barium esophagram (TBE), Functional lumen imaging probe (FLIP)
EGJO0: changes in v4.0

• Diagnosis supported by elevated IRP in both supine and upright positions
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*FYI definition of Distal esophageal spasm (DES) and Hypercontractile esophagus (Jackhammer) also now requires presence of clinical symptoms
IEM: changes in 4.0

• Definition IEM = >70% ineffective swallows, or >50% failed (from v3.0 was >50% either)
  • Ineffective between 50-70% is “inconclusive”
  • Supporting evidence includes poor bolus clearance using impedance, and poor aftercontraction on MRS
Provocative testing

• CC 4.0 now highlights provocative testing as a tool to increase diagnostic confidence
• Following 10 liquid supine swallows….
• 1 multiple rapid swallow (repeated PRN)- 5 2ml swallow 2-3sec apart
• 5 Upright swallows
• Rapid drink challenge (200ml water with straw)
• PRN:
  • Solid challenge, pharmacologic challenge
  • Post-prandial boservation (rumination/belching)
Multiple Rapid Swallow

• Assesses deglutitive inhibition and aftercontraction
MRS clinical relevance

- DCI of MRS > mean DCI indicates peristaltic reserve in IEM\(^1\)
- DCI MRS ratio <1 predicts post-fundoplication dysphagia
- IRP>19 during MRS seen in 47% EGJOO patients \(^2\)

1 Shaker A et al, Am J Gastro 2013;108 figure from Gyawali PC et al, 2 Leopold A et al, DDS 2019;64(8) NGM 2019; 31
Rapid Drink Challenge

• Assesses deglutitive inhibition of the body and LES
RDC clinical relevance

• Suppressed contractility not noted in achalasia and hypercontractile conditions \(^1\)
• IRP during RDC predicts symptomatic EGJOO \(^2\)

1. And D et al, NGM 2017; 29(1)
2. Woodland P et al, J NGM 2018;30
Take home points

• High resolution manometry allowed us to capture wealth of data on esophageal motor patterns
• The Chicago Classification served to standardize metrics that characterized each swallow and diagnose motility disorders
• Version 4.0’s change in definition of EGJOO, IEM, Hypercontractile (likely) defines a patient population that is less heterogeneous, more clinically relevant
• Use of provocative testing increases our diagnostic confidence
Thank you!