High Resolution Esophageal Manometry

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Name: Dr. Geoffrey Turnbull

## Conflict of Interest Disclosure

(over the past 24 months)

<table>
<thead>
<tr>
<th>Commercial or Non-Profit Interest</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Medtronic</td>
<td>Speaker, consultant</td>
</tr>
<tr>
<td>Allergan</td>
<td>Speaker</td>
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</table>
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<td>Abbvie</td>
<td>Advisory board</td>
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<tr>
<td>Lupin Pharma Canada</td>
<td>Consultant</td>
</tr>
</tbody>
</table>
**CanMEDS Roles Covered**

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Medical Expert</strong> (as <em>Medical Experts</em>)</td>
<td>Physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centered care. <em>Medical Expert</em> is the central physician Role in the CanMEDS Framework and defines the physician’s clinical scope of practice.</td>
</tr>
<tr>
<td><strong>Communicator</strong> (as <em>Communicators</em>)</td>
<td>Physicians form relationships with patients and their families that facilitate the gathering and sharing of essential information for effective health care.</td>
</tr>
<tr>
<td><strong>Collaborator</strong> (as <em>Collaborators</em>)</td>
<td>Physicians work effectively with other health care professionals to provide safe, high-quality, patient-centred care.</td>
</tr>
<tr>
<td><strong>Leader</strong> (as <em>Leaders</em>)</td>
<td>Physicians engage with others to contribute to a vision of a high-quality health care system and take responsibility for the delivery of excellent patient care through their activities as clinicians, administrators, scholars, or teachers.</td>
</tr>
<tr>
<td><strong>Health Advocate</strong> (as <em>Health Advocates</em>)</td>
<td>Physicians contribute their expertise and influence as they work with communities or patient populations to improve health. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources to effect change.</td>
</tr>
<tr>
<td><strong>Scholar</strong> (as <em>Scholars</em>)</td>
<td>Physicians demonstrate a lifelong commitment to excellence in practice through continuous learning and by teaching others, evaluating evidence, and contributing to scholarship.</td>
</tr>
<tr>
<td><strong>Professional</strong> (as <em>Professionals</em>)</td>
<td>Physicians are committed to the health and well-being of individual patients and society through ethical practice, high personal standards of behaviour, accountability to the profession and society, physician-led regulation, and maintenance of personal health.</td>
</tr>
</tbody>
</table>
Learning objectives

At the end of this session, participants will be able to:

• Identify the role of high resolution esophageal manometry study in your clinical practice

• Utilize Chicago Classification when interpreting esophageal manometry study

• Apply esophageal manometry study in managing patients with dysphagia and other esophageal symptoms
Diagnosis of dysphagia involves evaluating oropharyngeal and esophageal causes. If other alarm symptoms or signs are present, refer for endoscopy ± other imaging studies. If GERD symptoms are present, consider PPI trials. If dysphagia is not resolved, perform esophageal manometry. If structural or inflammatory lesions are identified by endoscopy or barium esophagram, manage the lesions. Otherwise, refer for appropriate evaluation and management.

Liu et al. JCAG (in press).
EMS is definitely indicated…

- To establish the diagnosis of dysphagia in the absence of mechanical obstruction (UGI series, endoscopy)

- For placement of intraluminal devices (e.g. pH probe) when positioning depends on the relationship to functional landmarks (esp. LES)

- For the pre-op assessment for anti-reflux surgery to exclude other primary esophageal dysmotility

EMS is possibly indicated…

• For the pre-operative assessment of peristaltic function in patients being considered for antireflux surgery

• For evaluation of dysphagia in patients status post antireflux surgery or treatment for achalasia

EMS is contraindicated...

- For confirming a suspected diagnosis of GERD

- As the initial test for chest pain or other esophageal symptoms because of the low specificity of the findings and the low likelihood of detecting a clinically significant motility disorder

The Chicago Classification of esophageal motility disorders, v3.0

P. J. KAHRILAS, A. J. BREDENOORD, M. FOX, C. P. GYAWALI, S. ROMAN, A. J. P. M. SMOUT, J. E. PANDOLFINO & INTERNATIONAL HIGH RESOLUTION MANOMETRY WORKING GROUP

Department of Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA
Chicago Classification analysis

• Based on assessment of individual swallows (10 x 5 mL)
• Hierarchical approach
• Two basic steps when looking at manometry study:
  1. Evaluate the function of Integrated Residual Pressure (IRP) of LES
     • Presence or absence of relaxation
  2. Evaluate peristaltic abnormalities
     • Amplitude of contractions
     • “Pattern” of contractions
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
     - Fragmented peristalsis
     - ≥50% fragmented swallows and not ineffective
   - No

5. IRP normal and > 50% effective swallows
   - Yes: Minor disorders of peristalsis
     - Impaired clearance
   - No: Normal

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Likely to cause clinical symptoms

Requires clinical judgement to determine significance for patient
UES: Upper esophageal sphincter
LES: Lower esophageal sphincter
CDP: Contractile deceleration point
EGJ: Esophagogastric junction
CS: Contractile segment
- 1st: UES
- 2nd & 3rd: Esophageal body
- 4th: LES

Transition zone = pressure between 1st & 2nd CS

Kahrilas et al. Neurogastrol Motil 2015
High resolution manometry, UpToDate 2015, Graphic 86104 Version 2.0
### Principal Parameters for Chicago Classification v. 3.0

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IRP (4 sec; mmHg)</strong></td>
<td>Integrated Relaxation Pressure</td>
<td>&lt; 15 mmHg*</td>
</tr>
<tr>
<td><strong>CDP (time, position)</strong></td>
<td>Contractile Deceleration Point</td>
<td></td>
</tr>
<tr>
<td><strong>DL (sec)</strong></td>
<td>Distal Latency</td>
<td>&gt; 4.5 sec</td>
</tr>
<tr>
<td><strong>DCI (mmHg-cm-sec)</strong></td>
<td>Distal Contractile Integral</td>
<td>450-8000*</td>
</tr>
<tr>
<td><strong>Pattern</strong></td>
<td>Fragmentation</td>
<td>Break &gt; 5 cm in 20 mmHg isobaric contour</td>
</tr>
</tbody>
</table>

* = normal values used by Manoview

Kahrilas et al. Neurogastrol Motil 2015
Median of the 4 s of maximal relaxation of the LES in the 10-s window beginning at UES relaxation
IRP of Lower Esophageal Sphincter

Distance from nares (cm)

IRP = 4.2 mmHg

IRP = 27.6 mmHg
Contractile Deceleration Point (CDP) and Distal Latency (DL)
Distal Contractile Integral (DCI)

- Amplitude x Duration x Length (mmHg-s-cm) of any contraction exceeding 20 mmHg: from the transition zone to the proximal margin of the LES
- Summarizes the distal contractile vigor
Amplitude of Contractions

- **Failed**: DCI < 100 mmHg-s-cm
- **Weak**: DCI > 100 mmHg-s-cm, but < 450 mmHg-s-cm
- **Normal**: DCI ≥ 450 mmHg-s-cm but ≤ 8000 mmHg-s-cm
- **Hypercontractile**: DCI > 8000 mmHg-s-cm

Kahrilas et al. Neurogastro Motil 2015
“Pattern” of Contractions

- **Premature:** DL <4.5 s

- **Fragmented:** Large break (>5 cm length) in the 20-mmHg isobaric contour with DCI >450 mmHg-s-cm

- **Intact:** Not achieving the above diagnostic criteria
Normal EMS
Case #1

Jeff, a 32 y.o. male pharmacist, referred to you in your outpatient clinic with a complaint of “I feel something stuck when I eat”.

- PMHx: none
- Medications: Ranitidine 150mg PRN
- Physical Exam: BMI 30, Normal chest/cardiovascular exam, Benign abdomen
- Bloodwork: Normal CBC, lytes, Cr
Case #1

Jeff tells you:
- dysphagia is intermittent, started 3-4 years ago, gradually getting more frequent
- difficulty swallowing with solid and liquids
- increasing heartburn lately
- using Ranitidine almost on a daily basis for the past month

What is your differential diagnosis?
Case #1

On further questioning:
- lost 5 kg over past 3 months due to difficulty swallowing, but no other B symptoms
- family history positive for esophageal cancer in a paternal uncle
- chronic intermittent heartburn x few years, recent onset of regurgitation
- no chest pain
- denies skin thickening/tightening, joint pain, Raynaud’s phenomenon
- ex-smoker quitted 5 years ago, social alcohol use
- never had endoscopy
Case #1

What would you do now for Jeff?

What can you do in the meantime while patient awaits for endoscopy?

Trial of PPI BID x 4 weeks
On endoscopy…

What is the diagnosis?
On EMS...
Treatment

• Jeff proceeded with pneumatic dilatation

EMS one month later...
Case #2

- 56 yr male, “Sugarbaker” operation for pseudomyxoma peritonei (previous adenoCA appendix 18 yrs ago), postop unable to swallow, even saliva.
- Previously had food obstruction 16 years ago treated with gastroscopy + dilatation, no problems with swallowing since, no heartburn, no problems swallowing prior to surgery.
- Upper GI xray was performed
Achalasia on Barium Swallow

Bird-Beak
Case #2

- Achalasia appearance reported on the X-ray
- Upper GI endoscopy performed; partial gastrectomy + Billroth II gastrojejunostomy
- No esophageal stricture or esophagitis seen, successful dilatation of esophagus to 17 mm
- Dysphagia returned within a day
- EMS with impedance performed
## Motility Report

### Upper Esophageal Sphincter

<table>
<thead>
<tr>
<th>Location (center, fr. naris)(cm)</th>
<th>Normal</th>
<th>Pharyngeal / UES Motility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean basal pressure(mmHg)</td>
<td>21.0</td>
<td>No, swallows evaluated</td>
</tr>
<tr>
<td>Mean basal pressure(mmHg)</td>
<td>12.1</td>
<td>Evaluated @ 2.0 mmHg above UES</td>
</tr>
</tbody>
</table>

### Lower Esophageal Sphincter

<table>
<thead>
<tr>
<th>Landmarks</th>
<th>Normal</th>
<th>Esophageal Motility</th>
</tr>
</thead>
<tbody>
<tr>
<td>LES midpoint (from naris)(cm)</td>
<td>44.0</td>
<td>Number of swallows evaluated 10</td>
</tr>
<tr>
<td>Proximal LES (from naris)(cm)</td>
<td>43.8</td>
<td>Evaluated @ 3.0 - 11.0 above LES</td>
</tr>
<tr>
<td>Distal LES (from naris)(cm)</td>
<td>47.0</td>
<td>Peristaltic velocity ≤ 6.25 cm/sec(%) 10</td>
</tr>
<tr>
<td>LES length(cm)</td>
<td>4.1</td>
<td>Simultaneous (vol. ≥ 2.25 cm³)(%) 20 ≤ 10%</td>
</tr>
<tr>
<td>Esophageal length (LES-LES centers)(cm)</td>
<td>23.8</td>
<td>Failed(%) 70 ≥ 10%</td>
</tr>
<tr>
<td>PIP (from naris)(cm)</td>
<td>45.0</td>
<td>Evaluated @ 3.0 &amp; 7.0 above LES</td>
</tr>
<tr>
<td>Intraluminal LES length(cm)</td>
<td>2.0</td>
<td>Mean wave amplitude(mmHg) 44.0 43-182</td>
</tr>
<tr>
<td>Hiatal hernia</td>
<td>No</td>
<td>Mean wave duration(s) 3.9 2.7-5.4</td>
</tr>
<tr>
<td>Hiatal hernia</td>
<td>No</td>
<td>Double pecked waves(%) 33 ≤ 10%</td>
</tr>
<tr>
<td>LES Pressures</td>
<td></td>
<td>Tri-peeked waves(%) 0 0%</td>
</tr>
</tbody>
</table>

### Esophageal Pressures

<table>
<thead>
<tr>
<th>Pressure measurement method</th>
<th>Above JRP</th>
<th>Above LES(cm/s)</th>
</tr>
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<tbody>
<tr>
<td>Basal respiration(cmHg)</td>
<td>83.7</td>
<td>38-32.0</td>
</tr>
<tr>
<td>Basal respiration(mmHg)</td>
<td>99.0</td>
<td>79-103</td>
</tr>
<tr>
<td>Residual (mean)(mmHg)</td>
<td>19.2</td>
<td>20-160</td>
</tr>
<tr>
<td>Residual (mean)(cmHg)</td>
<td>70.4</td>
<td>45-152</td>
</tr>
<tr>
<td>Percent relaxation(%)</td>
<td>63</td>
<td>0%</td>
</tr>
</tbody>
</table>

### High Resolution Parameters

- Basal contractile integral(mean)(mmHg-cm²) 1342.3 500-5500
- Distal contractile integral(timed)(mmHg-cm²) 2377.4
- Contractile front velocity(cm/s) 17.0 <9.0
- Intraluminal pressure (UESX)(mmHg) 6.2 <5.4
- Intraluminal pressure (avg max)(mmHg) 13.6 <10.0
What approach would you take now?
Recap of the story

- 56 yr male, minimal problems swallowing until he had a major abdominal surgical procedure (Sugarbaker operation)
- Barium swallow shows changes suspicious for Achalasia
- No stricture or esophagitis (or NG tube trauma) seen at gastroscopy
- EMS shows no emptying of esophagus (with Impedance catheter) and high pressure LES
- CT scan shows no evidence of any mass or tumour in the mediastinum, the stomach was well visualized and no tumour, no lesion in the cardia of the stomach.
- A therapeutic procedure was done
Treatment

• Repeat gastroscopy and Botox 100 units injected into the LES
• Patient report marked improvement in swallowing almost immediately
• Continues to have no problems with swallowing
• Repeat EMS done 6 months later…
LES = 9 mmHg
Evaluation and Certificate of Attendance
Please download the CDDW™ app to complete the session evaluation and to receive your certificate of attendance.