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Imaging of the Upper GI Tract

Jeremy Flowers, DNP, CNMT, RT(CT, BD), RVS
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Speakers Bureau: AbbVie, Clinical Area – IBD
Overview, Indications, Limitations

- Esophagram
- Video swallow
- UGI series
- Gastric emptying study
- Esophageal manometry
- Ph probe/ambulatory ph/bravo
• Various imaging studies can provide anatomic and physiologic information to compliment clinical examination and endoscopic evaluation

• Every study has limitations that need to be considered in the clinical utility of the study

• Facilities may have variations in protocols and steps in the study but this lecture will provide a general overview of selective anatomical and physiological studies
Esophagram

- This is an imaging study that fluoroscopy to evaluate the esophagus
- Exposes patients to ionizing radiation
- Allowed for anatomical evaluation and some physiological evaluation
- Patient drinks A positive contrast agent (usually barium) or water-soluble contrast
- Contraindications- pregnancy (due to radiation) and concern for perforation (due to barium)
- Does not provide detailed evaluation of swallowing function or pharyngeal anatomy
• Single Contrast examination
  – This includes a full column distension view, mucosal relief view and real-time observation of esophageal motility

• Dual Contrast examination
  – This includes a full column distension view, mucosal relief view, double contrast view and real-time observation of esophageal motility
  – Significant increase in mucosal evaluation over single contrast evaluation
  – Requires more patient participation and mobility than single contrast study
Video Swallow

- Also referenced as a modified barium swallow
- Done in collaboration with a speech therapist
- Evaluates the oropharyngeal swallow
- Oral phase – propelling bolus,
- Pharyngeal phase – Laryngeal penetration, tracheal aspiration, cricopharyngeal dysfunction
- Oral cavity, pharynx, cervical esophagus
- Different textures and attempts with SLP guidance (i.e., chin tuck)
- Does not include full evaluation of esophagus
Gastric Emptying Study

- A small amount of radiation is consumed with a standard meal
- Patients become a radiation source for a short period of time
- Images are acquired over several hours to determine emptying rate of the stomach. Can evaluate for rapid or delayed emptying.
- Usually solids are measured with Tc-99m
- Dual isotope method rarely used in In-111 for liquids
- This study can not exclude obstruction, Gastric outlet obstruction or structural issues
- Strictly a physiologic study
Images are acquired at set times with set parameters for solid:

- 30 min: 70% or less is rapid emptying
- 1 hour: 30% or less is rapid emptying, Over 90% delayed
- 2 hour: Over 60% delayed
- 3 hour: Over 30% delayed
- 4 Hour: Over 10% delayed

Since Tc99-m has a 6 hour half life decay correction needs to be applied to study.
Exam on the Right Had Side of the Screen Has More Counts in the Stomach at Delayed Imaging
Esophageal Manometry

• A pressure transducer is introduced into the esophagus and pressure measurements are taken to evaluate for esophageal motility patterns

• Chicago Classification is a formal mechanism to evaluate the study

• This is a physiologic test not an anatomical examination
### Lower Esophageal Sphincter Region

**Landmarks**
- Proximal LES (from nares)(cm): 43.8
- LES length(cm): 4.3
- Esophageal length (LES-UES centers)(cm): 26.2
- PIP (from nares)(cm): 46.0
- Intraabdominal LES length(cm): 2.1
- Hiatal hernia?: No

**LES Pressures**
- Pressure meas. method: eSleeve e,IRP
- Basal (respiratory min)(mmHg): 49.5
- Basal (respiratory mean)(mmHg): 77.0
- Residual (median)(mmHg): 36.0
- Residual (highest)(mmHg): 39.5
- Percent relaxation(%): 48

### Motility

- Chicago Classification
  - Swallows evaluated: 10
  - % failed: 0
  - % weak: 0
  - % ineffective: 0
  - % panesophageal pressurization: 0
  - % premature contraction: 60
  - % rapid contraction: 10
  - % fragmented: 0

- Additional High Resolution Parameters
  - Distal latency: 4.4
  - Distal contractile integral(mean)(mmHg-cm-s): 8425.1
  - Evaluated @ 3.0 - 11.0 above LES
    - Peristaltic (velocity ≤ 6.25 cm/s)(%): 10
    - Simultaneous (vel. ≥ 6.25 cm/s)(%): 90
    - Failed(%): 0
  - Evaluated @ 3.0 & 7.0 above LES
    - Mean wave amplitude(mmHg): 266.6
    - Mean wave duration(s): 6.5
    - Double-peaked waves(%): 30
    - Triple-peaked waves(%): 0
    - Velocity (11.0-3.0 above LES)(cm/s): 8.3
  - Impedance analysis
    - Incomplete bolus clearance(%): 0
    - Bolus transit time (sec): 3.9

### Upper Esophageal Sphincter

- Mean basal pressure(mmHg): 85.4
- Mean residual pressure(mmHg): -11.5

### Pharyngeal / UES Motility

- No. swallows evaluated: 10
- Evaluated @ 2.0 & 3.0 above UES
  - Mean peak pressure(mmHg): -0.8
Normal Pressure Measurements

- The upper esophageal sphincter is the top color horizontal line
- Lower esophageal sphincter is the lower color horizontal line
- Esophageal body is the space between the sphincters that represent esophageal activity
Diffuse Esophageal Spasms
Normal Study Again
EGJ Outflow Obstruction
Ph Probe/Ambulatory Ph/Bravo

- Different methods to measure pH exposure to parts of the GI track
- Can be done on and off of acid reducing medications
- Most commonly done in distal esophagus to measure acid reflux
- Can keep symptoms activity log to correlate with pH measurements
- Bravo pH capsule system
  - Wireless device is placed in the distal esophagus. Suctioned to esophagus and will pass without need for retrieval
- Catheter based systems will need to exit the nose/mouth to record data
- More likely to be uncomfortable or limited data collection duration
Bravo PH Measurement

**REFLUX MONITORING SUMMARY**

<table>
<thead>
<tr>
<th>Acid Exposure Summary</th>
<th>Total</th>
<th>Normal</th>
<th>Upright</th>
<th>Normal</th>
<th>Supine</th>
<th>Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid exposure time (%)</td>
<td>16.4</td>
<td>&lt;4.9</td>
<td>8.4</td>
<td>&lt;7.3</td>
<td>12.4</td>
<td>&lt;1.4</td>
</tr>
<tr>
<td>Longest reflux (min)</td>
<td>29.2</td>
<td>&lt;16.0</td>
<td>9.7</td>
<td>78.2</td>
<td>9.7</td>
<td></td>
</tr>
<tr>
<td>DeMeester Score</td>
<td>42.5</td>
<td>&lt;14.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symptom Association Summary</th>
<th>Belch</th>
<th>Heartburn</th>
<th>Regurg.</th>
<th>Cough</th>
<th>Chest Pain</th>
<th>Hiccup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of occurrences</td>
<td>12</td>
<td>2</td>
<td>1</td>
<td>16</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Symptom index for reflux (%)</td>
<td>16.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>7.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Symptom association prob. (SAP)*</td>
<td>98.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>76.7</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Note: all normal values in the report are from publications wherein subjects are not taking acid suppressive medication, irrespective of the medication selection in the Diary.*
Ph Probe Measurement

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<td>2.0</td>
<td>&lt;4.2</td>
<td>3.9</td>
<td>&lt;6.3</td>
<td>0.1</td>
<td>&lt;1.2</td>
</tr>
<tr>
<td>Longest reflux (min)</td>
<td>3.3</td>
<td>&lt;9.2</td>
<td>3.3</td>
<td>0.4</td>
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<thead>
<tr>
<th>Reflux Episode Activity Summary</th>
<th>Total</th>
<th>Upright</th>
<th>Supine</th>
</tr>
</thead>
<tbody>
<tr>
<td>All reflux episodes*</td>
<td>34</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Proximal episodes</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Bolus Exposure Time (%)</td>
<td>1.1</td>
<td>1.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Bolus Exposure Time (%)&lt;sup&gt;(Normal)&lt;/sup&gt;</td>
<td>&lt;2.3</td>
<td>&lt;4.2</td>
<td>&lt;1.6</td>
</tr>
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* not normalized

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<tr>
<td>Longest reflux (min)</td>
<td>0.1</td>
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<td>0.2</td>
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</tr>
<tr>
<td>Bolus Exposure Time (%)&lt;sup&gt;(Normal)&lt;/sup&gt;</td>
<td>&lt;2.1</td>
<td>&lt;3.2</td>
<td>&lt;0.2</td>
</tr>
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