Faculty Disclosure

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Dr. DeMeester has listed no financial interest/arrangement that would be considered a conflict of interest.
Prolonged pH Monitoring: Which, Why, When?

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GERD

- Typical symptoms:
  - Heartburn
  - Regurgitation
  - Dysphagia

- Atypical symptoms (extra-esophageal symptoms)
  - Chest pain
  - Chronic cough, frequent throat clearing
  - Hoarseness / Sore throat (laryngeal symptoms)
  - Respiratory symptoms
Diagnosis of GERD

- Symptoms
- Response to PPI
- Barium swallow
- Scintigraphy
- Objective findings on tests for GERD
The Objective Diagnosis of GERD

- Endoscopy
- Histology
- pH testing
  - Standard pH
  - Bravo pH
  - Dual-probe pH
  - Restech
  - Impedance - pH
pH Testing

- Determines whether there is increased (abnormal) esophageal exposure to refluxed gastric juice (acid)
- Does not indicate quantity of refluxed juice
- Sensitive to placement, by convention needs to be 5 cm above proximal border of LES (normals)
  - Motility necessary to do accurate pH test
- By convention assess exposure to ph < 4, so anything above 4 will not be evaluated
Indications for pH Monitoring

- Rule in or out GERD as cause of symptoms
- Assess for GERD in patients with atypical or extra-esophageal symptoms
- Post-operative evaluation of symptoms or to confirm function of the fundoplication in patients with Barrett’s esophagus
- Assess efficacy of medical therapy in patients with persistent symptoms or in those with Barrett’s esophagus
Ambulatory pH Monitoring

- Catheter based (24 hours)
- Bravo wireless (48 hours)

- Same data and indications
- Both should be placed trans-nasally based on manometry (5 cm above proximal border of LES)
- Bravo can be placed endoscopically (6 cm above GEJ)
Bravo™ Esophageal pH Testing

- Detachable pH probe
- 24 – 48 hours of pH data
- Transmits to belt-worn receiver
- Self-detaches and passes out GI tract in 4 – 10 days
Interpretation of pH Recording

- % time pH < 4 (normal < 4%)
  - Varies by sex

- 24-hour pH composite score (normal < 14.76)
  - % time pH < 4
  - % upright time pH < 4
  - % supine time pH < 4
  - Total number of reflux episodes
  - Number of reflux episodes ≥ 5 min
  - Longest reflux episode (min)
Bravo Interpretation

- Day 1 (normal score < 14)
- Day 2 (normal score < 14)
- Combined 48 hours (normal score < 16)

If either day is positive then test is abnormal and indicates increased esophageal exposure to gastric juice

pH Monitoring

- Standard pH
- Bravo pH
- Dual-probe pH
- Restech
- Impedance - pH
Dual Probe pH Monitoring

- Distal sensor placed 5 cm above proximal border of manometrically determined LES
- Second sensor fixed proximally, usually 15 cm above distal probe
Problems with Dual Probe

With proximal probe located 15 cm above distal probe 31% of subjects would have had inappropriately high placement

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**Normals for Proximal Acid Exposure**

Results of Proximal 24-hour pH Monitoring in 59 Normal Subjects

<table>
<thead>
<tr>
<th>Components</th>
<th>Mean (SD)</th>
<th>Median (IQR)</th>
<th>95th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Total time pH &lt; 4</td>
<td>0.19 (0.3)</td>
<td>0.1 (0-0.3)</td>
<td>0.90</td>
</tr>
<tr>
<td>% Upright time pH &lt; 4</td>
<td>0.28 (0.5)</td>
<td>0.1 (0-0.4)</td>
<td>1.2</td>
</tr>
<tr>
<td>% Supine time pH &lt; 4</td>
<td>0.03 (0.1)</td>
<td>0 (0-0)</td>
<td>0.40</td>
</tr>
<tr>
<td>Number of reflux episodes</td>
<td>6.32 (7.8)</td>
<td>5 (0-10)</td>
<td>24.0</td>
</tr>
<tr>
<td>Number of episodes &gt; 5 min</td>
<td>0.05 (0.2)</td>
<td>0 (0-0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Duration of the longest episode (min)</td>
<td>0.95 (1.48)</td>
<td>0 (0-1)</td>
<td>5.0</td>
</tr>
<tr>
<td>Composite Score</td>
<td>6.0 (4.7)</td>
<td>4.3 (2.8-7.2)</td>
<td>16.4</td>
</tr>
</tbody>
</table>

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Restech Proximal pH Monitoring

- Designed specifically to monitor the pharynx
- Micro sensor needs less fluid to operate
- Detects both liquid and aerosolized acid
- Resists drying and teardrop shape minimized fouling
## Table 4
The 95th Percentile Values (Normal) for the Components and Composite Score of Pharyngeal pH Exposure at the Discriminating pH Thresholds

<table>
<thead>
<tr>
<th></th>
<th>Upright pH&lt;5.5</th>
<th>Supine pH&lt;5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Time</td>
<td>0.13 min (8 s)</td>
<td>5.15 min (309 s)</td>
</tr>
<tr>
<td>No. of episodes</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Longest episode (min)</td>
<td>0.71</td>
<td>18.97</td>
</tr>
<tr>
<td>RYAN(^a) Score</td>
<td>9.41</td>
<td>6.79</td>
</tr>
</tbody>
</table>

\(^a\) Composite pH score for pharyngeal acid exposure

pH Monitoring

- Standard pH
- Bravo pH
- Dual-probe pH
- Restech
- Impedance - pH
Impedance

A small AC voltage is applied to two electrodes on a catheter.

This generates a small current that is proportional to the conductivity of the organ and its contents.

Impedance \( Z = \frac{U}{I} \)
How Does Impedance Change?

When the organ is empty and relaxed, the impedance is high.

When the organ contains a bolus and expands, the impedance is low.
Impedance-pH

- Detects both acid and non-acid reflux events
- Provides information about bolus transport to correlate with motility
- No wireless option
Impedance-pH

- Useful in patients with persistent symptoms on PPI therapy (particularly regurgitation and respiratory symptoms)

- Gives an assessment of the height of reflux events, may correlate with GERD related respiratory symptoms
Medical Therapy for Reflux

Conclusions

- Objective confirmation of increased esophageal acid exposure (GERD) is best done with pH testing.
- Standard pH testing is done off acid-suppression medications either with the traditional trans-nasal catheter or the newer Bravo wireless system.
- Primary respiratory symptoms should prompt the use of a dual-probe pH study ± Restech study.
- If alkaline or weak acid events suspected to be causing persistent symptoms an impedance-pH test can be useful.