ESOPHAGEAL MOTILITY AND MANOMETRY

Overlook Medical Center
The Digestive Center
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CGRN
Motility of the Esophagus

Objectives:

- Describe the anatomy and physiology of the esophagus.
- Explain normal motility.
- Review number of conditions of the esophagus and their pathophysiology.
Anatomy & Physiology
Esophagus

• Third organ of digestion
• Channel for food
• Hollow muscular tube
  – Length 24/25cm, 10/11in (adult)
  – Width 2-3 cm, 1in

3 Layers
Mucosa, Submucosa, Muscularis
<table>
<thead>
<tr>
<th>Mucosa</th>
<th>Submucosa</th>
<th>Muscularis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous epithelium</td>
<td>Connective tissue</td>
<td>Inner layer of circular &amp; outer layer of longitudinal muscle</td>
</tr>
<tr>
<td>Lamina propria</td>
<td>Blood vessels</td>
<td>Auerbach’s Plexus</td>
</tr>
<tr>
<td>Muscularis mucosa</td>
<td>Nerve fibers</td>
<td>Mucous glands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connects mouth &amp; stomach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower end passes through the diaphragm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sphincters</td>
</tr>
<tr>
<td>Upper Esophageal Sphincter (UES)</td>
<td>Lower Esophageal Sphincter (LES)</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Hypopharyngeal sphincter</td>
<td>Cardiac sphincter</td>
<td></td>
</tr>
<tr>
<td>Between pharynx and esophagus</td>
<td>Between esophagus and stomach</td>
<td></td>
</tr>
<tr>
<td>Closed – keeps air out of esophagus</td>
<td>Controls passage of food into stomach 2-4 cm in length</td>
<td></td>
</tr>
</tbody>
</table>
Function of Esophagus

Conduction of food

• via peristalsis

Primary peristalsis

• initiated by swallowing

Secondary peristalsis

• begins in hypopharynx; it is caused by esophageal distention
Muscles of Esophagus

- Proximal – Striated – 5%
- Middle – Striated & Smooth – 35/40%
- Distal – Smooth – 50/60%
Pathophysiology

Disorders of the Esophagus
GERD
VARICIES
TUMORS
DIVERTICULA
STRICTURES
Common Symptoms of GERD

- Dyspepsia
- Heartburn and regurgitation
- Dysphagia
- Odynophagia
- Bleeding from erosions
- Esophagitis
- Asthma
- Aspiration pneumonia
Treatment of GERD

Behavior Modifications
- Dietary adjustments
- Weight loss
- Elevation of head of bed
- Smoking Cessation
- Avoidance of food or drink prior to sleep
Varicities

• Most commonly found in:
  distal esophagus
  stomach
  hemorrhoidal plexus

Related to portal hypertension associated with:
alcoholic cirrhosis  portal vein thrombosis
chronic hepatitis  congenital disorders
Treatment

**Historically** treatment of choice for acute bleed – injection of sclerosing agent.

Complications:

- Inflammation
- Perforation
- Stricture
- Ulceration
Today’s treatment

- Esophageal variceal ligation (EVL) endoscopic placement of O-rings on the varicies

Last resort – balloon tamponade
Prognosis is poor with acute variceal bleeding
Tumors

• Benign or cancerous
• Squamous cell carcinoma – most common
• Adenocarcinoma
  – 5% of Barrett’s Esophagus patients
Most common indication:
  dysphagia
  odynophagia
Other symptoms:
Anorexia, weight loss, anemia, hoarseness
& cough.
Diverticulum

• Out pouching of one or more layers of the wall of the esophagus
• Result from a motor abnormality

Zenker’s – immediately above UES
Traction - near midpoint of esophagus
Epiphrenic – immediately above LES
Intramural – along body
STRICTURES

• Usually at the lower end of esophagus.
  - Circumferential or not circumferential
  - Result of caustic injuries, candidiasis, or severe reflux

Clinical presentation:
- Progressive dysphagia

Treatment:
Dilation

Complication:
Perforation is the primary – pain after dilation
Esophageal Motility Disorders

- Primary
- Secondary
- Nonspecific
Primary Disorders

• Dysfunction limited to the esophagus:
  – Achalasia
  – Diffuse Esophageal Spasm
  – Hypertensive LES
  – Nutcracker Esophagus (Hypertensive peristalsis)
  – Jackhammer Esophagus (Hypercontractile esophagus)
Achalasia

- “failure to relax”
- Poorly relaxing LES
- Cause – unknown.
  Hereditary, degenerative, autoimmune and infectious factors are possible causes.

- Symptoms: Dysphagia, regurgitation, heartburn, chest pain, coughing, choking, aspiration pneumonia, and weight loss.
- All patients have at least 2 manometric abnormalities:
  – Abnormal LES residual pressure & no normal peristalsis.
Achalasia is never cured. Treatment is directed to reduce the pressure across the LES: pneumatic dilation, Heller Myotomy, and drug therapy (botulinum toxin, CCC, nitrates)
Secondary Esophageal Motility Disorders

- Collagen – Vascular disease - scleroderma
- Endocrine & Metabolic disorders – diabetes
- Neuromuscular diseases – myasthenia gravis, MS, Parkinson’s
- Chronic idiopathic intestinal pseudo-obstruction
- Chagas’ disease
Nonspecific esophageal motility disorders

• The symptoms of the swallowing disorder are present but the pattern of the dysfunction does not fit into the other categories.
Esophageal Manometry Objectives:

• Define Manometry
• Describe the equipment and techniques usually used in manometry studies
• Review indications and contraindications for this procedure involving the esophagus and stomach.
• Review tracings of common abnormal findings
• Review disorders diagnosed using esophageal manometry
Manometry

- Detects esophageal motility abnormalities.
- Assessments for anti-reflux surgery.
- Measures intraluminal pressure and coordination of esophagus muscles.
- Function of UES & LES and the esophageal body.
- Location of proximal border of LES
Equipment

Esophageal catheter

- Water perfusion

- Solid State
  - Pressure Sensor
    - Traditional 4-5 sensors
    - HRM catheter 30 sensors (entire length of the esophagus)

Systems

- Infusion (water perfusion)
- Transducers
- Computer
## Manometry Catheter

<table>
<thead>
<tr>
<th>Water Perfusion</th>
<th>Solid State</th>
<th>Solid state High Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Water perfusion catheter</td>
<td>• 5 sensors</td>
<td>• 30 Sensors</td>
</tr>
<tr>
<td>• Pump needed</td>
<td>• No pump needed</td>
<td>• No pump needed</td>
</tr>
<tr>
<td>• Less expensive</td>
<td>• More expensive</td>
<td>• Most expensive</td>
</tr>
<tr>
<td>• Graph display only</td>
<td>• HLD of catheter</td>
<td>• HLD of catheter</td>
</tr>
<tr>
<td></td>
<td>• Longer acquisition time</td>
<td>• Shorter acquisition time</td>
</tr>
<tr>
<td></td>
<td>• Pull through needed</td>
<td>• No pull through needed</td>
</tr>
<tr>
<td></td>
<td>• May have more discomfort</td>
<td>• Less discomfort</td>
</tr>
<tr>
<td></td>
<td>• Graph only</td>
<td>• High Resolution display</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &amp; graph display</td>
</tr>
</tbody>
</table>

- HLD: High Level Display
Water Perfusion Catheter and infusion pump
Solid State Catheter

5 sensors

30 sensors
Normal esophageal motility

Conventional Manometry tracing
Normal Esophageal Manometry
High Resolution Esophageal Manometry
Achalasia
Achalasia

Achalasia – conventional Manomometry

Barium Swallow
Achalasia

• Progressive dysphagia for solids & liquids
  - weight loss, nocturnal regurgitation and pulmonary symptoms

Why: Failure of the LES to relax

1. Hypertensive LES sphincter with incomplete/no sphincter relaxation.
2. Absent peristalsis in the body
3. Increase in intraesophageal baseline pressure
4. Radiology findings show Bird’s Beak image
Achalasia

- **Meaning**: “failure to relax”
- **Poorly relaxing LES**
- **Cause** – unknown.
  - Hereditary, degenerative, autoimmune and infectious factors are possible causes.
- **Symptoms**: Dysphagia, regurgitation, heartburn, chest pain, coughing, choking, aspiration pneumonia, and wgt. loss.
- All patients have at least 2 manometric abnormalities:
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Diffuse Esophageal Spasm (DES)

Characterized by chest pain and dysphagia

1. High amplitude contractions or prolonged contractions.

2. Simultaneous contractions or repetitive contractions along with intermittent normal peristalsis.

3. Simultaneous contractions seen in greater that 10% of wet swallows.
Connective Tissue Disease as in Scleroderma

• Normal peristalsis occurs in the proximal skeletal muscles in the upper third of the esophagus.
• Affects the smooth muscle of the esophagus creating aperistalsis
• LES Pressure is decreased or absent.
Nutcracker esophagus

**Peristalsis** with high-pressure esophageal contractions exceeding 180 mmHg (greater than 2 X’s the normal range) and contractile waves with a long duration exceeding 6 sec

Peristalsis is normal in sequence

Elevated LES pressures
Nonspecific Esophageal Motor Disorder (NEMD)

- Motor disorders that do not fall into other categories
- Decreased or low amplitude that equal weak contractions
- Decreased peristalsis, peristalsis of prolonged duration, or retrograde peristalsis.
- Incomplete LES relaxation
- Increase number in repetitive contractions.
Esophageal Manometry procedure

- NPO
- Current medical history & physical
- Procedural consent
- Adults usually performed without sedation, may interfere with swallowing & esophageal motility. Children may require sedation.
procedure - continued

- Nitrates, calcium channel blockers, anticholinergics, and promotility agents can effect normal esophageal function
- Catheter inserted nasally but can be placed orally.
- Topical anesthetic may be used for comfort.
- Patient seated or left lateral position
procedure - continued

- When catheter is in back of throat, chin lowered to chest & swallow. Sips of water through a straw will be helpful in advancing catheter through LES into stomach (approx. 60 cm). Patient lays supine or left lateral.

- Check placement of catheter by asking patient to take a deep breath. There will be an increase in pressure noted in the recording.
Performing the Motility Study

• Three Parts:
  – Lower Esophageal Sphincter (LES) Study
  – Esophageal Body Study
  – Upper Esophageal Study (UES) Study
LES Study

Two parts:
LES pressure and location
LES relaxation

Parameters measured:
1. Resting pressure of the LES
2. Relaxation of the LES
3. Length of the LES
4. Locate proximal border of LES
The Esophageal Body Study

Determines the contractile response of the muscles during swallowing.

Distal catheter is placed 3 cm above the proximal border of the LES (conventional)

- 10 wet swallows are given with
  - 5 ml of room temperature water
UES Study

Measures:
• Resting pressure
• Relaxation
Chicago Classification

- Developed to facilitate the interpretation of high resolution esophageal pressure topography (EPT) studies.
- Initially proposed based on the analysis of clinical studies performed at Northwestern University, so subsequently named the Chicago Classification of esophageal motility disorders.
- Updated periodically by the international working group to incorporate ongoing clinical and research experience.
Contraindications

• Patients with an inability to tolerate nasal intubation
• Patients with significant bleeding disorders
• As the initial test for chest pain.
• Uncooperative patient, cardiac instability, recent gastric surgery, severe esophageal ulcers, known esophageal obstruction, or large diverticulum.
• Patients who have received sedation or narcotics.

Complications:
Rare but aspiration can occur
References


