EXTREME ENDOSCOPY TOOLBOX: EMR, ESD, AND POEM

Tilak Shah MD, MHS
Interventional Endoscopy
Mcguire Veterans Medical Center
Assistant Professor of Medicine
Virginia Commonwealth University
LEARNING OBJECTIVES

• Understand the layers of the intestine
• Learn about benign and malignant submucosal lesions
• Techniques for removing large polyps
• Techniques for removing submucosal lesions
• Novel technique for dissecting the muscle layer of the intestine
ADVANCED ENDOSCOPIC RESECTION: THE ALPHABET SOUP

- EMR
- ESD
- POEM
- EFTR
- STER
ADVANCED ENDOSCOPIC RESECTION: THE ALPHABET SOUP

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GOAL OF THIS PRESENTATION IS TO DEMYSTIFY THESE ABBREVIATIONS!!
LEARNING OBJECTIVES

• Layers of the intestine
• Benign and malignant submucosal lesions
  • Techniques for removing large polyps
  • Techniques for removing submucosal lesions
  • Novel technique for dissecting the muscle layer of the intestine
INTESTINAL WALL LAYERS

- Mucosa
- Submucosa
- Muscularis propria
  - Inner circular layer
  - Outer longitudinal layer
MUCOSA

- Inner most layer
- Only layer visible during endoscopy
- Examples of mucosal lesions:
  - Adenomas (can turn into cancer)
  - Hyperplastic polyps (benign)
SUBMUCOSA

- Connective tissue layer between mucosa and muscularis propria
- Examples of submucosal lesions:
  - Neuroendocrine tumors (have malignant potential)
  - Lipomas (benign)
MUSCULARIS PROPRIA

• Endoscopy can’t distinguish whether a lesion arises from submucosa versus muscularis propria (requires endoscopic ultrasound)

• Examples of muscularis propria lesions:
  - Gastrointestinal stromal tumors or GIST (have malignant potential)
  - Leiomyomas (benign)
INTESTINAL WALL LAYERS

SUMMARY

• Three layers – mucosa, submucosa, and muscularis propria

• Muscularis propria consists of an innermost circular layer and an outer longitudinal layer

• From each layer can arise lesions that are benign as well as lesions with malignant potential
LEARNING OBJECTIVES

• Understand the layers of the intestine
• Learn about benign and malignant submucosal lesions
• **Techniques for removing large polyps** *(endoscopic mucosal resection, i.e. - EMR)*
• Techniques for removing submucosal lesions
• Novel technique for dissecting the muscle layer of the intestine
CASE

• 58 year old man presented for his first screening colonoscopy
• A 5-cm mass was found across from the ileocecal valve in the cecum
• Biopsies read as tubular adenoma
ENDOSCOPIC MUCOSAL RESECTION (EMR)
STANDARD EMR

• Forceps polypectomy (cold or hot forceps)
• Snare polypectomy (cold snare, snare cautery, and saline assisted snare cautery)
ADVANCED EMR

- WIDE FIELD EMR
- CAP BAND EMR
ADVANCED EMR

• WIDE FIELD EMR
• CAP BAND EMR
WIDE FIELD EMR

- Piecemeal removal of a large sessile polyp > 4 cm in diameter
- Minimally invasive alternative to surgery
WIDE FIELD EMR: TOOLS

- Snares
- Submucosal injection solution
- Forceps
- Argon plasma coagulation (APC)
- Endoclips
- “Better to have it and not need it than need it and not have it”
WIDE FIELD EMR TOOLS: SNARES

- Stiff serrated (spiral) snares are preferred to increase tissue capture
- 20 mm spiral snare is the “workhorse”
- Small thin wire snares are used to remove tissue where more precision is required

Bronte Clinical Gastroenterology and Hepatology 2012
WIDE FIELD EMR TOOLS: SUBMUCOSAL INJECTION

• Creates a cushion between the mucosa and muscularis (reduces perforation risk)
• Normal saline most widely used but cushion rapidly dissipates
• Colloid cushion lasts longer but not widely available in the United States
• OUR UNIT: 3% saline (higher osmolarity so dissipates less slowly than saline)

Moss GIE 2010
WIDE FIELD EMR TOOLS: OTHER

• **Forceps:**
  - Helpful to remove residual tissue not removable by snare

• **APC (Argon plasma coagulation):**
  - Use to fulgurate margins (helps reduce risk of recurrence)

• **Endoclips:**
  - may reduce perforation risk
WIDE FIELD EMR: RISKS

- **Perforation:**
  - 1-2% perforation risk (compared to 1/1000 with polypectomy)

- **Bleeding:**
  - 7% risk of delayed bleeding
WIDE FIELD EMR TIPS

• Schedule enough time for the procedure
• Must plan to complete resection in 1 session
• CO2 preferable to air insufflation
• Low threshold to abort procedure if:
  - Bowel preparation is not excellent or good
  - Non-lifting (suspect deeper invasion)
• Include 1-2 mm margin of normal mucosa
BACK TO OUR CASE

- 58 year old man presented for his first screening colonoscopy
- A 5-cm mass was found across from the ileocecal valve in the cecum
- Biopsies read as tubular adenoma
WIDE FIELD EMR STEP 1: SUBMUCOSAL INJECTION

INJECT 3% SALINE MIXED WITH 1:10,000 EPINEPHRINE AND A FEW DROPS OF METHYLENE BLUE
WIDE FIELD EMR STEPS 2 AND 3

• STEP 2: piecemeal removal with snares, forceps
• STEP 3: APC to fulgurate the margin
WIDE FIELD EMR STEP 4: CLOSE THE DEFECT

- Place multiple clips starting at one edge and moving towards the other ("zipper closure")
- May reduce risk of perforation and bleeding BUT time consuming and expensive
ADVANCED EMR

- WIDE FIELD EMR
- CAP BAND EMR
CAP BAND EMR

- Common indications:
  - Resection of early stage esophageal or gastric cancer
  - Resection of small submucosal lesions (neuroendocrine tumors)
CASE

- 40 year old man with a 13 mm mass on EGD
- Pathology revealed mass was a cancer
- Mass appeared to extend past the mucosa layer and into the submucosa on EUS
CAP BAND EMR STEP 1: BAND THE LESION

• Gastroscope fitted with cap-band kit (very similar to a banding kit)
• Mass sucked into cap and band deployed
CAP BAND EMR STEP 2: RESECT THE LESION

- Snare placed under the band and mass resected
CAP BAND EMR STEP 3: RETRIEVE THE SPECIMEN

- Resection specimen is retrieved
- Pathology showed adenosquamous carcinoma with negative margins (i.e. cancer was completely removed)
LEARNING OBJECTIVES

• Understand the layers of the intestine
• Learn about benign and malignant submucosal lesions
• Techniques for removing large polyps

• **Technique for removing submucosal lesions (endoscopic submucosal dissection, i.e.– ESD)**

• Novel technique for dissecting the muscle layer of the intestine
ENDOSCOPIC SUBMUCOSAL DISSECTION (ESD)
ESD INDICATIONS

• Removing large colon polyps, early esophageal and gastric cancer in one piece (i.e. - en bloc)
• Removing lesions that arise from the submucosa layer (e.g. – neuroendocrine tumors)
ESD TOOLS

- Transparent distal cap
- Submucosal injection solution (lots!!)
- Grounding pad (dissection uses monopolar cautery)
- Coagrasper
- CO2 is mandatory!
ESD TOOLS

KNIVES

- Needle Knife
- Insulated Tip (IT) Knife
- Hook Knife
- DuaKnife
- Triangle Knife
- Hybrid Water Jet Knife
ESD TECHNIQUE

STEP 1: DEFINE MARGIN

- Visual inspection (NBI, FICE, or i-SCAN)
- Chromoendoscopy (methylene blue or indigo carmine spray)
- Use APC or knife to circumferentially define margin with 1-2 cm of normal tissue
ESD TECHNIQUE STEP 2: INJECT AND DISSECT THE MARGIN
ESD TECHNIQUE STEPS 3, 4 AND 5

• STEP 3: Inject, dissect
• STEP 4: Use clear plastic cap on distal end of scope to ease scope into submucosal layer
• STEP 5: Inject, dissect
• Coagulate blood vessels encountered during dissection with coagrasper
ESD EN BLOC RESECTION
# LARGE COLON POLYPS:
## ESD VS. WIDE FIELD EMR

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<thead>
<tr>
<th></th>
<th>ESD</th>
<th>WIDE FIELD EMR</th>
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<tbody>
<tr>
<td>Technical difficulty</td>
<td>Much more technically challenging</td>
<td>Less technically challenging than ESD</td>
</tr>
<tr>
<td>Equipment</td>
<td>Requires specialized equipment</td>
<td>Uses tools already available in most endoscopy units</td>
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<tr>
<td>Perforation risk</td>
<td>Higher</td>
<td>Lower</td>
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<tr>
<td>Incomplete resection, recurrence risk</td>
<td>&lt;5%</td>
<td>20-40%</td>
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*Saito Surgical Endoscopy 2010*
ESD: BARRIERS TO ADOPTION IN THE UNITED STATES

- Volume
- Training
- Reimbursement
LEARNING OBJECTIVES

• Understand the layers of the intestine
• Learn about benign and malignant submucosal lesions
• Techniques for removing large polyps
• Techniques for removing submucosal lesions
• **Novel technique for dissecting the muscle layer of the intestine, i.e. – POEM (per oral endoscopic myotomy)**
PERORAL ENDOSCOPIC MYOTOMY (POEM)

A novel endoscopic technique for the management of achalasia
BEFORE WE DISCUSS POEM...

• What is achalasia?
• What are current treatment options for achalasia?
• What is a submucosal tunnel and a safety valve mucosal flap?
WHAT IS ACHALASIA?

• Recall that the muscularis propria consists of inner circular and outer longitudinal layer

• In achalasia, the circular muscle layer of the lower esophageal sphincter does not relax (“A” = no; “chalasia” = to relax)

• Since food cannot pass through the LES, patients develop dysphagia, regurgitation, and weight loss
ACHALASIA

Circular muscle at LES does not relax, leading to a “tight” LES

Esophagus

Stomach
# ACHALASIA

## THERAPEUTIC OPTIONS

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<th>THERAPY</th>
<th>DESCRIPTION</th>
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| Pneumatic dilation    | • 85% efficacy in the short term  
• 33% have symptom relapse in 5 years  
• 2% perforation risk |
| Botox injection       | • Botulinum toxin poisons the excitatory (acetylcholine-releasing) neurons that increase LES smooth muscle tone.  
• >50% require retreatment in 6-12 mo |
| Heller myotomy        | • LES is weakened by surgically cutting the muscle fibers  
• >90% efficacy in the short term  
• Risk of GERD, perforation, pneumothorax, bleeding, infection, vagus nerve injury |
SAFETY VALVE MUCOSAL FLAP
HISTORICAL BACKGROUND

• In 1999, A successful endoscopic appendectomy was described in India
• Led to enthusiasm for performing natural orifice surgery (NOTES)
• **Barrier to NOTES** ... how do you prevent soiling when you enter the thoracic or peritoneal space via the esophagus or stomach?
SAFETY VALVE MUCOSAL FLAP

- Developed by investigators at the Mayo clinic
- First reported in 2007
- A submucosal tunnel is mechanically created before dissecting the muscle layer and entering the thoracic cavity or peritoneum
- The free overlying mucosa acts as a sealant flap to prevent soiling
POEM

• In 2008, Dr. Inoue combined the concepts of ESD and the safety valve mucosal flap to perform the first Per Oral Endoscopic Myotomy (POEM)

• Endoscopically doing the same thing as a Heller myotomy (i.e. – cutting the circular muscle at the LES)
POEM TECHNIQUE STEP 1: CREATE MUCOSAL ENTRY

- Submucosal lift 10 cm above the GE junction
- Dissect mucosa
- Inject dissect, inject dissect
- Advance scope into the submucosal space
POEM TECHNIQUE STEP 2: SUBMUCOSAL TUNNEL

- Inject and dissect submucosa
- Coagrasper to coagulate blood vessels encountered during dissection
- Continue injection, dissection until there is a tunnel that extends 2 cm below the GE junction (i.e. – 12 cm tunnel)
SUBMUCOSAL TUNNEL

SUBMUCOSA

CIRCULAR MUSCLE

TUNNEL

VISIBLE

FROM

LUMEN

MUCOSAL ENTRY SITE

MUCOSA
POEM TECHNIQUE:
FINAL STEPS

• Incision of circular muscle starting 2 cm below GE junction and extending up 6-10 cm

• Close mucosal entry site with endoclips
• **CO2**: as with ESD, CO2 insufflation is mandatory. Turn off air on processor.
• **Sedation**: usually general anesthesia.
• **Position**: generally performed in supine position, but left lateral also acceptable.
• **Post-op care**: admit X 24-48 hrs, gastrografin swallow after 24 hours before advancing diet, no NSAIDs/anticoagulants X 2 weeks
# POEM VERSUS HELLER MYOTOMY

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<tr>
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<th>POEM (n=37)</th>
<th>HELLER (n=101)</th>
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<tbody>
<tr>
<td>Median operative time</td>
<td>120 mins</td>
<td>149 mins (p&lt;0.001)</td>
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<tr>
<td>Median hospitalization</td>
<td>1.1 days</td>
<td>2.2 days (p&lt;0.0001)</td>
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<tr>
<td>1 mo Eckardt score</td>
<td>0.8</td>
<td>1.8 (p&lt;0.0001)</td>
</tr>
<tr>
<td>6 mo Eckardt score</td>
<td>1.2</td>
<td>1.7 (p 0.1)</td>
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<tr>
<td>Resting pressure</td>
<td>16 mm Hg</td>
<td>7.1 mm Hg (p 0.006)</td>
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<tr>
<td>Abnormal acid exposure</td>
<td>39%</td>
<td>32% (p 0.7)</td>
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Bhavani Annals of surgery 2014
EMERGING TECHNOLOGIES

- 1980s: EMR
- 1990s: ESD
- 2008: POEM
- 2010 - present: techniques to remove mucosa, submucosa, and muscle layer for GIST tumors
  -- STER (Submucosal Tunnel + Endoscopic Resection)
  -- EFTR (Endoscopic Full Thickness Resection)
  -- Hybrid resection (surgery + endoscopy)
QUESTIONS?