When Do You Suspect a Luminal Perforation?

- Subcutaneous air/crepitu
- Chest pain
- Abdominal distention
- Pneumothorax
- Endoscopically difficult to maintain endoluminal air/luminal collapse
- Hemodynamic instability (hypotension, tachycardia)
- Respiratory distress (oxygen desaturation, tachypnea)

Baron et al. GIE. Volume 76, Issue 4, Pages 838–859
Proximal Esophageal Perforation

- Rare!

- Patient Symptoms:
  - Dysphagia
  - Sore throat
  - Chest pain
  - Subcutaneous emphysema

- Etiology
  - Blind passage of an endoscope or nasogastric tube
  - Inadvertent passage through Zenker's diverticulum

- Confirm by Esophagogram or CT with Oral Contrast

Proximal Esophageal Perforation Therapy

- Conservative
  - Nasogastric tube feeding
  - Suspension of oral intake
  - Intravenous antibiotics

- Endoscopic (Technically difficult)
  - Endoscopic through-the-scope (TTS) clip closure
    - For perforations < 2cm
  - Endoscopic over-the-scope (OTS) clip closure
    - For perforations 2-3cm in size
  - Stent placement is not technically feasible
Mid and Distal Esophageal Perforations

- **Etiology**
  1. Impaction of the endoscope against osteophytes
  2. Severe retching (Boerhaave's syndrome)
  3. Endoscopic dilation or polyp resection

- Outcomes of endoscopic therapy best when perforation recognized early

- Esophageal perforations that are recognized late (≥12 hours) are better treated by surgery

### Endoscopic Management of Mid and Distal Esophageal Perforations

- Perforations less than 2cm closed by using TTS clip with or without stent placement
- OTSC more effective for closure of esophageal perforations between 2-3cm in size
- Larger esophageal perforations sealed by temporary placement of esophageal FCSEMS and endoscopic suturing (OverStitch)
- Placement of FCSEMSs across the gastroesophageal junction typically results in stent migration
  - I recommend endoscopic suturing of the proximal end of SEMS to reduce stent migration

**Healing Rate=80-100%**
Management of Esophageal Perforation After Closure

- Oral intake must be stopped for 3-5 days
- The patient should be treated with intravenous antibiotics and proton pump inhibitors
- Partial diversion of luminal content may be achieved by insertion of a nasogastric tube
- Post-endoscopy contrast studies recommended within 24 hours after the procedure
- If radiologic investigations show fluid collection in mediastinum, percutaneous drainage indicated

Gastric Perforation Etiology

1. Impaction of the endoscope against the anterior wall of the stomach
2. PEG tube placement
3. Transmural endoscopic drainage interventions
4. EMR and ESD
5. Dilation of gastroenteric anastomotic strictures
6. Over-distension by gas (barotrauma) during argon plasma coagulation
Endoscopic Therapy of Gastric Perforation

**Early Perforation without Sepsis**

- Defect > 20mm: TTS Clips
- Defect > 30mm: OTSC
- Defect ≥ 30mm: Endoscopic Suturing (OverStitch)

Healing Rate = 85-94%

Endoscopic Therapy of Periampullary Duodenal Perforations

- Lateral wall perforations are large and usually caused by the tip of the endoscope
  - Historically, these perforations required immediate surgery
  - Case reports describe OTSCs closure of large lateral wall perforations
- Perforations after biliary sphincterotomy can be treated using:
  - Nasoduodenal tube
  - FCSEMS biliary stent
  - TTS clips
Endoscopic Therapy of Duodenal Perforations

- Duodenal perforations are due to:
  - endoscope trauma
  - duodenal polypectomy
  - attempts to pass forcibly beyond a duodenal stricture
- Typically require surgical intervention
- Use of TTS clips and OTSCs effective in closing duodenal perforations <2 cm
- Covered SEMSs can be placed across duodenal perforations, especially those associated with stricture

Immediate recognition
Endoscopic Closure
Conservative Therapy
Surgery

Delayed recognition (>24 hours)
CT without contrast extravasation
CT with contrast extravasation
Surgery

~20%
Healing Rate=74-86%
**Etiology of Colon Perforation**

- Sigmoid colon and rectum most common sites of diagnostic perforation due to mechanical injury
- Iatrogenic perforation risk is 0.05%–0.8% for diagnostic colonoscopies
- Therapeutic colonoscopy carries a 5% risk of perforation:
  - advanced polyp EMR and ESR
  - endoscopic balloon dilation
  - colonic stent placement

---

**Colorectal Perforation**

- TTS, OTSC, or Endoscopic Suturing (OverStitch) within 4 hours
- Hospital stay
- Supportive measures
- IV Antibiotics

89-93% Efficacy

- Clinically Stable: Discharge on oral antibiotics
- Clinically Unstable: CT suggests contrast extravasation; **Surgical Repair**
### General Management of Luminal Perforations

- Endoluminal closure (metallic clips, stents, suturing)
- Nasogastric or nasoduodenal decompression
- Abdominal/chest decompression if there is air under tension
- Radiographic evaluation
- Intravenous administration of broad-spectrum antibiotics
- Fluid resuscitation
- Nothing by mouth
- Percutaneous or surgical intervention if needed

### My Thoughts…

- Good evidence that endoscopic treatment of perforations is effective
- Wide use of CT allows early diagnosis in subtle perforation cases
  - This prevents delays in endoscopic or surgical management
- Perforations recognized after 24 hours are better managed surgically
Gastrointestinal Leaks

- Result from:
  - Inflammatory disease
  - Malignancy
  - Postsurgical states
- Goal of endoscopic therapy is interruption of flow of luminal contents across a GI defect
- Undrained cavities and fluid collections must often first be drained percutaneously

Endoscopic Stent Placement

- Stent placement used for luminal disruptions within the upper GI tract
  - Covers the region of leakage
  - FCSEMS are preferred
- Major limitations their migration rate (25%)
- Increased motility of colon allows for easy stent migration
  - This not only prevents fistula closure but also increases the chances of obstruction and perforation
Stent Success to Close Leaks

<table>
<thead>
<tr>
<th></th>
<th>Bakken et al</th>
<th>Senousy et al</th>
<th>Eloubeidi et al</th>
<th>Buscaglia et al</th>
<th>El Hajj et al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients with leaks (%)</td>
<td>22</td>
<td>7</td>
<td>12</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>Overall stent migration rate (%)</td>
<td>28</td>
<td>39</td>
<td>34</td>
<td>33</td>
<td>28</td>
</tr>
<tr>
<td>Long-term closure of leak (%)</td>
<td>✔✔</td>
<td>✔✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Clip Closure of Leaks

- TTS clips useful in small leaks
- Tissue surrounding the leak or fistula must be robust enough to be held within the jaws of the clips.
- OTSCs more robust than TTS for closure of leaks
  - OTSC devices enable reliable closure of larger defects
- Success Rate=83-100%
Protocol for OTSC Closure of Leaks

1. The tissue edges ablated with APC
2. A cytology brush is then used to abrade the lateral aspects
3. OTSC device then deployed
4. Contrast is injected to access adequacy of the closure
5. Any ongoing leak may be managed by further clipping or stenting

Endoscopic Suturing

- Endoscopic suturing is appealing concept for its ability to closely mimic surgical closure
- Significantly more difficult from a technical aspect than clipping
- Sutures appose edges of the tissue at the leak site and are then cinched together
- Suturing systems may be capable of closing larger defects
Suturing Gastro-Gastric Leaks

- Leaks at fistula site closed by sutures reopened in 65%.
- None of fistulae >20 mm remained closed during the follow-up.
- One-third of patients with fistula size ≤10 mm achieved long-term closure.
- For long-term closure, best results for gastro-gastric fistulae are seen with fistulae ≤10 mm.


PRINCIPLES OF ENDOSCOPIC LUMINAL LEAK CLOSURE

- Patients require multispecialty involvement (GI, Surgery, Radiology).
- Delineation of the sites of the leak is needed using contrast radiology studies.
- If fluid collection exists, insertion of percutaneous drain needed before endoscopic closure.
- Main goal is interruption of flow of luminal contents across the defect.
- Adequacy of endoscopic closure should be studied using contrast radiology studies.

Adequacy of endoscopic closure should be studied using contrast radiology studies.