COMPLICATIONS AFTER ESOPHAGECTOMY

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Atlanta, Georgia
COMPLICATIONS AFTER ESOPHAGECTOMY

- Esophageal cancer: increasing incidence in US

- Resection +/- neoadjuvant chemotherapy and/or radiation remains a mainstay of therapy (50%)

- Even with potentially resectable disease, overall 5 year survival generally is less than 20%

- Given the poor long-term prognosis, low morbidity and mortality rates after esophagectomy are critical
Complications of Esophageal Resection

• Specific Complications
  – Anastomotic dehiscence
  – Conduit necrosis
  – Anastomotic stricture
  – Recurrent laryngeal nerve injury
  – Chylothorax
  – Functional conduit disorders
    • Dumping
    • Delayed gastric emptying
    • Reflux
Complications of Esophageal Resection

- General Complications
  - Pulmonary
    - Aspiration
    - Pneumonia
    - Mechanical ventilation
  - Cardiac
    - Myocardial infarction
    - SVTs
  - Deep venous thrombosis/ pulmonary embolus
  - Wound complications
    - Superficial infections
    - Fascial dehiscence
  - Neurologic complications
    - CVA
    - Delirium/ alcohol withdrawal
• Nationwide Inpatient Sample database queried using ICD-9 codes for patients undergoing TTE or THE

• 1999 - 2003: 17,395 pts. in database underwent esophagectomy

• Transhiatal Esophagectomy (THE) = 11,914 pts

• Transthoracic Esophagectomy (TTE) = 5,481 pts

J Am Coll Surg 2007;205:735-740
Comparing Outcomes after Transthoracic and Transhiatal Esophagectomy: A 5-Year Prospective Cohort of 17,395 Patients

Rafe C Connors, MD, Brian C Reuben, MD, Leigh A Neumayer, MD, FACS, David A Bull, MD, FACS

### Table 2. Patient Demographics and Overall Outcomes

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Transhiatal esophagectomy</th>
<th>Transthoracic esophagectomy</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td>0.769</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>61.9 ± 13.1</td>
<td>62.0 ± 12.6</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>61.4–62.4</td>
<td>61.4–62.6</td>
<td></td>
</tr>
<tr>
<td>Gender, % (men/women)</td>
<td>65.9/34.1</td>
<td>69.8/30.2</td>
<td>0.006</td>
</tr>
<tr>
<td>Race, %</td>
<td></td>
<td></td>
<td>0.384</td>
</tr>
<tr>
<td>Caucasian</td>
<td>84.1</td>
<td>85.3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>15.9</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Mortality, %</td>
<td>8.91</td>
<td>8.36</td>
<td>0.520</td>
</tr>
<tr>
<td>Charlson Comorbidity Index</td>
<td></td>
<td></td>
<td>0.110</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>6.09 ± 3.67</td>
<td>6.27 ± 3.67</td>
<td></td>
</tr>
<tr>
<td>95% CI</td>
<td>5.96–6.23</td>
<td>6.10–6.45</td>
<td></td>
</tr>
<tr>
<td>Hospital length of stay, d, mean ± SD</td>
<td>18.39 ± 16.80</td>
<td>18.02 ± 17.21</td>
<td>0.904</td>
</tr>
</tbody>
</table>
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Table 1. Factors Included in Identifying Patient Complications

<table>
<thead>
<tr>
<th>Factor</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound</td>
<td>Pulmonary</td>
</tr>
<tr>
<td>Hematoma/seroma</td>
<td>Atelectasis/pneumonia</td>
</tr>
<tr>
<td>Disruption of wound</td>
<td>ARDS</td>
</tr>
<tr>
<td>Fistula</td>
<td>Pneumothorax</td>
</tr>
<tr>
<td>Infections</td>
<td>Pulmonary edema</td>
</tr>
<tr>
<td>Skin/wound infection</td>
<td>Respiratory failure</td>
</tr>
<tr>
<td>Systemic infection</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>Abscess</td>
<td>Ileus/bowel obstruction</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Nausea/vomiting</td>
</tr>
<tr>
<td>Cardiac related</td>
<td>Pancreatitis</td>
</tr>
<tr>
<td>DVT/PE</td>
<td>Anastomosis complications</td>
</tr>
<tr>
<td>Stroke</td>
<td>Systemic</td>
</tr>
<tr>
<td>Phlebitis/thrombophlebitis</td>
<td>Fever</td>
</tr>
<tr>
<td>Procedure</td>
<td>Shock</td>
</tr>
<tr>
<td>Bleeding</td>
<td>SIRS</td>
</tr>
<tr>
<td>Accidental puncture/laceration</td>
<td>Mediastinitis</td>
</tr>
</tbody>
</table>

Table 3. Percentage of Complications Comparing Transhiatal Esophagectomy with Transthoracic Esophagectomy

<table>
<thead>
<tr>
<th>Complication</th>
<th>Total, %</th>
<th>THE, %</th>
<th>TTE, %</th>
<th>Univariate p value</th>
<th>Multivariate p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>50.7</td>
<td>49.3</td>
<td>53.5</td>
<td>0.011</td>
<td>0.087</td>
</tr>
<tr>
<td>Wound</td>
<td>5.3</td>
<td>5.6</td>
<td>4.7</td>
<td>0.239</td>
<td>0.788</td>
</tr>
<tr>
<td>Infection</td>
<td>6.9</td>
<td>6.8</td>
<td>7.2</td>
<td>0.640</td>
<td>0.338</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>29.7</td>
<td>29.7</td>
<td>32.1</td>
<td>0.025</td>
<td>0.303</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>15.0</td>
<td>14.1</td>
<td>17.1</td>
<td>0.010</td>
<td>0.048</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>10.4</td>
<td>10.4</td>
<td>10.2</td>
<td>0.801</td>
<td>0.463</td>
</tr>
<tr>
<td>Systemic</td>
<td>2.2</td>
<td>2.0</td>
<td>2.8</td>
<td>0.103</td>
<td>0.038</td>
</tr>
<tr>
<td>Procedure</td>
<td>7.9</td>
<td>7.9</td>
<td>7.8</td>
<td>0.991</td>
<td>0.762</td>
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<tr>
<td>Mediastinitis</td>
<td>1.7</td>
<td>1.8</td>
<td>1.5</td>
<td>0.477</td>
<td>0.649</td>
</tr>
</tbody>
</table>

THE, transhiatal esophagectomy; TTE, transthoracic esophagectomy.
Esophagectomy associated with Morbidity of 50.7% and In-Hospital Mortality of 8.8%
### Table 1

Studies of the impact of hospital volume on operative mortality following esophagectomy

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Period</th>
<th># of Patients (Data Source)</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>(P^a)</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birkmeyer et al, 2002 [5]</td>
<td>1994–1999</td>
<td>6337 (Medicare Part A; NIS^†)</td>
<td>20.3</td>
<td>14</td>
<td>8.1</td>
<td>&lt;0.001</td>
<td>hospital and 30-day</td>
</tr>
<tr>
<td>Wanner et al, 2005 [14]</td>
<td>1987–1996</td>
<td>1429^f (Sweden)</td>
<td>10.4</td>
<td>6.3</td>
<td>3.5</td>
<td>0.02</td>
<td>hospital</td>
</tr>
</tbody>
</table>

\(^a\) Adjusted for patient demographics and comorbidities.
Volume-Performance Relationships in Esophagectomy

• Medicare data 1994-99
• n = 6,337 pts
• Operative mortality = in-hospital or 30 day mortality

Volume-Performance Relationships in Esophagectomy: Surgeon Volume

- Medicare data 1998-99
- \( n = 1,640 \) pts
- Both hospital and surgeon volume remain independent predictors of operative mortality

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Table 5. Mean Percentage of Mortality and Complications Comparing Esophageal Resections at High-Volume Centers Versus Low-Volume Centers

<table>
<thead>
<tr>
<th>Mortality and complications</th>
<th>Total, %</th>
<th>High volume, %</th>
<th>Low volume, %</th>
<th>Univariate p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>8.7</td>
<td>5.8</td>
<td>10.6</td>
<td>≤ 0.001</td>
</tr>
<tr>
<td>Overall morbidity</td>
<td>50.8</td>
<td>49.6</td>
<td>51.6</td>
<td>0.192</td>
</tr>
<tr>
<td>Wound</td>
<td>5.2</td>
<td>5.1</td>
<td>5.2</td>
<td>0.849</td>
</tr>
<tr>
<td>Infection</td>
<td>7.0</td>
<td>6.8</td>
<td>7.1</td>
<td>0.771</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>29.9</td>
<td>25.6</td>
<td>32.7</td>
<td>≤ 0.001</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>14.9</td>
<td>17.0</td>
<td>13.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>10.4</td>
<td>11.9</td>
<td>9.5</td>
<td>0.010</td>
</tr>
<tr>
<td>Systemic</td>
<td>2.2</td>
<td>1.8</td>
<td>2.5</td>
<td>0.102</td>
</tr>
<tr>
<td>Procedure</td>
<td>7.8</td>
<td>6.9</td>
<td>8.4</td>
<td>0.062</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>1.7</td>
<td>1.0</td>
<td>2.1</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Predictors of Major Morbidity and Mortality after Esophagectomy for Esophageal Cancer: An STS General Thoracic Surgery Database Risk Adjustment Model

Cameron Wright, MD, John Kucharaczuk, MD, Joshua Grab, MS and Mark Allen, MD

AATS 2008
Jan 2002 to June 2007, 1,986 esophagectomies for cancer in the STS GTDB

68 sites contributed data

Major morbidity in 23% (reoperation for bleeding, leak, pneumonia, reintubation, initial ventilation > 48 hours, death)

Adverse events occurred in 57%

Overall mortality 2.5% (11% in those with major morbidity)
Multivariate Risk Factors for Major Morbidity after Esophagectomy

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;75</td>
<td>1.50</td>
<td>1.11-2.01</td>
<td>0.005</td>
</tr>
<tr>
<td>Race-black</td>
<td>1.84</td>
<td>0.90-3.34</td>
<td>0.051</td>
</tr>
<tr>
<td>CHF</td>
<td>2.68</td>
<td>1.28-4.85</td>
<td>0.005</td>
</tr>
<tr>
<td>PVD</td>
<td>1.70</td>
<td>1.06-2.59</td>
<td>0.014</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.99</td>
<td>1.12-3.23</td>
<td>0.010</td>
</tr>
<tr>
<td>Smoker</td>
<td>1.31</td>
<td>1.00-1.72</td>
<td>0.023</td>
</tr>
<tr>
<td>ASA rating 3 or 4</td>
<td>1.45</td>
<td>1.08-1.91</td>
<td>0.005</td>
</tr>
<tr>
<td>BMI &gt; 35</td>
<td>1.67</td>
<td>1.13-2.34</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Wright et al. AATS 2008
ANASTOMOTIC LEAKS AND CONDUIT NECROSIS
Side to Side Stapled Anastomosis

Orringer MB JTCVS. 2000; 119(2): 277-88
Gastric Conduit

Orringer MB. JACS. 2008; 207:151.
Predisposing Factors for Anastomotic Leak: Patient/Operative Factors

• Conduit Ischemia
  – Overaggressive mobilization (devascularization)
  – High anastomosis (tension)
  – Anastomosis near gastric tube staple line
  – Compression or twisting (venous obstruction)
  – Gastric distension

• Esophagus
  – No serosa
  – Longitudinal muscle fibers hold suture poorly

• Other
  – Nutrition - hypoalbuminemia
  – Operative blood loss
  – Positive margins
  – Radiation
Predisposing Factors for Anastomotic Leak: Anastomotic Location

• Cervical (Transhiatal or McKeown)
  – 8 - 15% leak rate
    12% leak rate in 2007 transhiatal esophagectomies
  – Salivary fistula

• Thoracic (Ivor Lewis or thoracoabdominal)
  – 0 - 7% leak rate
    4.5% leak rate in 220 Ivor Lewis esophagectomies
  – Potentially lethal mediastinitis
Cervical Anastomotic Leak

Predisposing Factors for Anastomotic Leak: Anastomotic Technique

• Hand sewn – (Churchill and Sweet)
  – *Hietmiller et al. Dis Esophagus. 1999;12:264.* 0.8% leaks in 262 patients

• Circular end to end anastomosis (CEEA) stapler
  – 0 - 4% leak rate in experienced centers
  – Late stricture rate seems higher, particularly with smaller staplers

• Side to side stapled anastomosis
  – *Orringer MB JTCVS. 2000; 119(2): 277-88.* 2.7% leaks in 111 transhiatal esophagectomies
Predisposing Factors for Anastomotic Leak: Conduit Selection

- Stomach
- Colon
- Jejunum

Not intensively studied with conflicting reports
- *Briel JW. JACS. 2004; 198(4):536-41. Greater with stomach*
Diagnosis of Anastomotic Leak

• Fulminant leak
  – Systemic sepsis with purulent CT drainage or empyema
  – 48 - 72 hour presentation
  – Conduit necrosis or technical error

• Cervical Leak
  – Fever
  – Wound drainage, erythema
  – 5 - 10 days post-op

• Intrathoracic leak
  – May be insidious
  – Low grade fever, leukocytosis and malaise
  – Intrathoracic collection (may fistulize: airway, aorta)
  – Chest tube output may remain serous, occasionally bilious
Diagnosis of Anastomotic Leak

• Diagnostic Modalities:
  – Contrast Esophagram
    • Frequently routine
    • Barium more sensitive, possible foreign body reaction
    • Water soluble contrast may cause pneumonitis
  – CT scan
    • Mediastinal air, loculated fluid
  – Flexible esophagoscopy
    • Evaluate proximal conduit for vascular insufficiency
    • Mucosal sloughing does not prove full thickness necrosis
Case #1

• 67 y/o male with a locally advanced adenocarcinoma carcinoma of the distal esophagus.

• Received induction chemotherapy and radiation and obtained a good response.

• Transhiatal esophagectomy performed.
• POD #6 - normal appearing contrast swallow

• PO liquid diet started, nasogastric tube removed

• POD #8 - developed fever, tachycardia and leukocytosis
Repeat Swallow
• Esophagoscopy - extensive necrosis of the gastric mucosa at the anastomosis with a large hole posteriorly.

• Right thoracotomy performed and anastomosis taken down.

• Proximal five centimeters of the stomach completely resected.

• Cervical esophagostomy and G and J tube fashioned.

• Mediastinum was widely drained.
Management Principles for Fulminant Leak

- Fluid resuscitation, antibiotics, operative intervention

- Some conduit necrosis typically encountered
  - Ischemic portion of conduit resected
  - Cervical esophagostomy, gastrostomy (exclusion)
  - Substernal colonic interposition at later date
  - Focal insults occasionally amenable to local resection, repair and coverage with vascularized flap
Case #2

- 75 yo with adeno
- 3 Hole (McKeown)
- Erythema and swelling at cervical incision on POD7
- Barium swallow
Management Principles for Cervical Leak

• Small, well-contained leak
  – NPO
  – Contrast study to document healing

• Large, non-contained leak with local erythema and drainage
  – Open neck wound
  – Dressing changes (minimum bid)
  – Most heal within 2 weeks
  – Silastic T-tube occasionally used
  – Failure to respond: possible undrained collection or conduit necrosis
  – Dilate early to promote distal passage of fluid
Case #3

- 65 yo mid-esophagus squamous cell
- Neoadjuvant tx then Ivor Lewis
- POD5 fever and leukocytosis
- BAS and CT
Management Principles for Intrathoracic Leak

- Drain fluid collection
- NPO, enteral feeds
- Endoscopic self expanding covered metallic stents to occlude leak occasionally used
- Spontaneous healing in 1 - 3 weeks
- Failure to respond or noncontained leak – operative exploration
Case #4

• 22 y/o male found to have large inflammatory myofibroblastic tumor at GE junction.
• Underwent Ivor Lewis esophagectomy.
“Small pooling of contrast at level of the anastomosis likely related to edema at the anastomosis vs. redundant mucosal fold. ”
• Clear liquid diet started.
• AM POD #8 – awoke with cough productive of copious thin green fluid
• Bronchoscopy revealed small TE fistula 5 cm proximal to carina
• Right thoracotomy performed.
• Patient too unstable to repair fistula:
  – Anastomosis taken down
  – Cervical esophagostomy fashioned
  – G – tube fashioned
Gastrobronchial Fistula
Gastrobronchial Fistula

Figure 1. Preoperative esophagogram. An “H”-type fistula (large arrow) communicating the gastric tube and the airway (small arrows) is shown.

Figure 2. Preoperative CT scan. The metallic wall-stent prosthesis compresses the anterior wall of the gastric tube against the “pars membranacea” of the right main bronchus.

Management Principles for Gastrobronchial Fistula

• Division of fistulous tract
• Repair of airway and anastomotic defects
• Interposition of well vascularized flap

• Fistulization into major blood vessel
  – Often fatal
  – May have herald bleed
Anastomotic Stricture

- Present with dysphagia (2 - 6 months post-op)

- No standard definition, true incidence unknown (0 - 63%)

- Esophageal dilatation serves as surrogate for stricture

- Early strictures
  - Leak
  - Ischemia
  - Small anastomosis (21 or 25 mm CEEA)

- Late strictures (> 1 year)
  - Tumor recurrence
  - Reflux
Anastomotic Stricture: Management

- Anastomotic diameter increases over time
- Serial dilatations with Maloney or Savory dilators
- Proton pump inhibitors to prevent reflux damage

Recurrent Laryngeal Nerve Injury

- Major source of morbidity after esophagectomy

- Incidence greater with cervical than intrathoracic anastomosis

- True incidence may depend on how aggressively one looks for RLN injury

- Patients with RLN injury after esophagectomy should be managed aggressively
Recurrent Laryngeal Nerve Injury
Recurrent Laryngeal Nerve Injury

  - Meta-analysis (>4,000 pts.)
  - TTE: 3.5%; THE 9.5%

  - Meta-analysis (>5,000 pts.)
  - TTE: 4.8%; THE 11%

  - Transhiatal (2,000 pts.)

  - Ivor-Lewis (220 pts.)
  - 0.9% vocal cord paralysis
Management Principles for Recurrent Laryngeal Nerve Injury

• Avoidance:
  – Avoid metal retractors in TE groove
  – Minimize electrocautery
  – Don’t dissect out nerve

• Manifestations:
  – Hoarseness
  – Dysphagia
  – Aspiration/pneumonia
    • Major pulmonary complications associated with RLN palsy; 24% vs. 2.4% (Hulscher et al. Br J Surg. 1999;86: 1583)
    • Pts. with RLN palsy had decreased vital capacity and greater difficulty climbing stairs (Baba et al. JACS. 199;188:231)
Management Principles for Recurrent Laryngeal Nerve Injury

- **Diagnosis:** laryngoscopy

- **Management:**
  - Transoral injection medialization
    - Hydroxyapatite, hyaluronic acid, fat, collagen, teflon
  - Laryngoplastic phonosurgical reconstruction
    - Thyroplasty
    - Arytenoid adduction therapy
  - Voice and swallowing therapy

Fig. 2. Intraoperative photograph after right autologous fat injection, illustrating 30% to 40% overcorrection. The white arrow illustrates the injection site. In general, the injection should be performed at this location or more posteriorly. Injection further anteriorly increases the risk for anterior overcorrection and producing a “strained” voice. (From Sataloff RT, Hawkshaw MJ, Eller RL. Atlas of laryngoscopy. 2nd edition. San Diego (CA): Plural Publishing; 2006. p. 203; with permission.)
Chylothorax

Cerfolio. CTSNET. 2005.
Chylothorax

• Presentation:
  – High volume straw or cream colored chest tube output
  – Rapidly expanding pleural effusion
  – Milky white chest tube drainage on diet containing fat

• Incidence:
    • THE 2.1% (n = 2,675)
    • TTE 3.4% (n = 2,808)

• Consequences:
  – Dehydration
  – Malnutrition (albumin loss)
  – Immune suppression (loss of antibodies and lymphocytes)
Management Principles for Chylothorax

• Diagnosis
  – Clinical
  – Triglyceride level $\geq 110$ mg/dL \textit{(Merrigan. Br J Surg. 1997)}
  – Positive Sudan fat stain \textit{(Romero. Chest. 1998)}

• Management
  – Conservative
    • NPO / Fluid resuscitation
    • TPN or Elemental TF
    • Octreotide - anecdotal
  – Mortality 50 - 82% with prolonged conservative management, review of Medline 1996-2001
Chylothorax

• Diagnosis
  – Clinical
  – Triglyceride level $\geq$ 110 mg/dL (Merrigan. Br J Surg. 1997)

• Early and aggressive surgical management is advised
  • TPN
    • Octreotide - anecdotal
    – Mortality 50-82% with prolonged conservative management, review of Medline 1996-2001
Management Principles for Chylothorax

Surgical Management

- Low right thoracotomy or VATS
- Ligation of all tissue on spine between azygous v. and aorta vs. direct ligation
- Administering cream in J-tube may aid identification
- Sclerosis of pleural cavity
- Sealant possible - adjunct

Lymphangiogram – select centers
Embolization – cisterna chyli

Sukumar et al. CTSNET. 2006.
### Functional Conduit Disorders

<table>
<thead>
<tr>
<th>Condition</th>
<th>Resection for Cancer</th>
<th>Resection for High-grade Dysplasia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>107</td>
<td>48</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>16%</td>
<td>13%</td>
</tr>
<tr>
<td>Dumping</td>
<td>50%</td>
<td>15%</td>
</tr>
<tr>
<td>Reflux</td>
<td>60%</td>
<td>68%</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>46%</td>
<td>37.5%</td>
</tr>
<tr>
<td>Postoperative dilation</td>
<td>43%</td>
<td>51%</td>
</tr>
<tr>
<td>Small meals</td>
<td>37%</td>
<td>N/R</td>
</tr>
<tr>
<td>Inability to gain weight</td>
<td>25%</td>
<td>65%</td>
</tr>
</tbody>
</table>

Functional Conduit Disorders: Dumping

- **Early Dumping**
  - 10-30 minutes after meal
  - Rapid transport of hyperosmolar gastric contents to bowel
  - Quick fluid shifts and volume contraction
  - GI hormone secretion altered

- **Late Dumping**
  - 1-3 hours after meal
  - Reactive hypoglycemia resulting from rapid transport and absorption of glucose
  - Characterized by systemic vascular symptoms

---

**Symptoms of dumping syndrome**

<table>
<thead>
<tr>
<th>Early Dumping</th>
<th>Vasomotor Symptoms</th>
<th>Late Dumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal Symptoms</td>
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</tr>
<tr>
<td>Epigastric fullness</td>
<td>Pallor</td>
<td>Perspiration</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Flushing</td>
<td>Shakiness</td>
</tr>
<tr>
<td>Nausea</td>
<td>Headache</td>
<td>Difficulty with concentration</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Diaphoresis</td>
<td>Decreased</td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td>Syncope</td>
<td>Decreased</td>
</tr>
<tr>
<td>Bloating</td>
<td>Faintness</td>
<td>consciousness</td>
</tr>
<tr>
<td>Borborygmi</td>
<td>Fatigue</td>
<td>Hunger</td>
</tr>
<tr>
<td></td>
<td>Palpitations</td>
<td></td>
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<tr>
<td></td>
<td>Desire to lie down</td>
<td></td>
</tr>
</tbody>
</table>

Management Principles for Dumping

• Management:
  – Dietary
    • Small, low carbohydrate meals
    • Restrict fluid during meals
    • Avoid simple sugars
  – Medical – 3 - 5% with severe symptoms
    • Octreotide
      – Delays gastric emptying & small bowel transit
      – Inhibits secretion of multiple GI hormones
    • Vasomotor symptoms may be alleviated by propranolol or verapamil
    • Acarbose – delays carbohydrate digestion (late dumping)
  – Prevention
    • *Banki et al. Ann Surg. 2002; 236: 324.* only 10% dumping
    • ? Vagal sparing esophagectomy for intramucosal cancer or HGD
Delayed Gastric Emptying

• Manifestation:
  – Early satiety
  – Reported in up to 50%

• Pathophysiology:
  – Truncal vagotomy/division of stomach
    • Diminished motor function
    • Disrupted pyloric function
    • Loss of gastric reservoir
  – Narrow gastric tubes empty faster
  – Larger gastric tubes regain more motor function
Management Principles for Delayed Gastric Emptying

- **Prevention:** pyloroplasty or pyloromyotomy or Botox injection
  - Palliates impaired pyloric function
  - Risks leak, dumping and biliary reflux

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th># Patients</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huang [97]</td>
<td>1985</td>
<td>35</td>
<td>No difference</td>
</tr>
<tr>
<td>Cheung [98]</td>
<td>1987</td>
<td>72</td>
<td>Favors drainage procedure, fewer symptoms</td>
</tr>
<tr>
<td>Mannell [99]</td>
<td>1990</td>
<td>40</td>
<td>Favors drainage procedure, fewer complications</td>
</tr>
<tr>
<td>Chattopadhyay [100]</td>
<td>1991</td>
<td>24</td>
<td>No difference</td>
</tr>
<tr>
<td>Fok [101]</td>
<td>1991</td>
<td>200</td>
<td>Favor drainage procedure, faster emptying, fewer symptoms</td>
</tr>
<tr>
<td>Bemelman [59]</td>
<td>1995</td>
<td>55</td>
<td>No difference</td>
</tr>
</tbody>
</table>

- **Medical management:**
  - Balloon dilatation of pylorus
  - Erythromycin
    - Motilin agonist
    - Improves gastric emptying in immediate post-op period *(Burt. JTCVS. 1996)*
  - Other agents: metoclopramide, bethanechole and domperidone

Gastroesophageal Reflux Management

• Common: 60 - 80% of patients *Aly. Br J Med. 2004*

• Normal anti-reflux mechanisms obliterated

• Symptoms: “cervical heartburn”, regurgitation, aspiration

• Pyloric drainage procedure improves emptying but predisposes to bile reflux

• Prevention: higher anastomosis
  – Height of anastomosis doesn’t affect reflux *Dresner. Br J Surg. 2003*

• Management: behavioral modifications, PPIs
Atrial Fibrillation Management

- Murthy et al. Atrial fibrillation after esophagectomy is a marker for post-operative morbidity and mortality. JTCVS. 2003; 126: 1162.

- 921 esophagectomies 1982-2000: incidence 22%

- Predictors of AF
  - Age
  - Pre-existing cardiac disease
  - Intraoperative blood loss
  - More extensive thoracic dissection

- More likely to develop other complications (leaks, respiratory failure etc.)

- Mortality
  - Post-operative AF - 23%
  - No AF - 6.3%
Summary

• Complications are common following esophagectomy

• Hospital and surgeon volume appear to correlate with outcomes

• Patient selection and risk stratification are key

• The esophageal surgeon must prevent and be prepared to manage any complications after resection
Questions?