Conduits When Stomach Fails…
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Disney Duke Masters of Minimally Invasive Thoracic Surgery
Orlando, 2016
Objectives

- To review options for long-segment esophageal replacement
- To review equipment and techniques
- To share our outcomes and experience
Disclosure

• I have no relevant disclosures related to this presentation & will not be discussing off-label device or medication usage
Outline

• History
• Replacement options for esophagus
• SPJ technical features
• SPJ Outcomes
• Case Review
• Conclusions
Esophageal Replacement is a bit like swimming with sharks...
>100 Years of work…

- Roux describes small bowel for eso replacement
- Oschner: subcutaneous jejunum eso replacement
- Reinhold: subcutaneous jejunum eso replacement with pedicle
- Longmire: subcutaneous jejunal jejunum graft
- Peptic stricture of distal esophagus
- Androsof completes first jejunal graft
- Jurkiewicz: free jejunum graft
- O'Rourke: "super-charged" colon interposition
- Okazaki (Tokyo): double-pedicle duodenal jejunum transfer
- Ascoli: SPJ in 26 pts over 4 yrs at MDACC
- Blackmon: 60 SPJ MDACC & HMH
### Conduit Alternatives for Esophagus

<table>
<thead>
<tr>
<th>Conduit</th>
<th>Blood Supply</th>
<th>Selection/Placement</th>
</tr>
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<tbody>
<tr>
<td>Stomach</td>
<td>Gastroepiploic</td>
<td>First choice for total esophageal replacement</td>
</tr>
<tr>
<td>Colon</td>
<td>Marginal artery of Drummond</td>
<td>Second choice for total esophageal replacement</td>
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<tr>
<td>Long-segment supercharged pedicled jejunum</td>
<td>Superior: mesenteric anastomosis to LIMA/LIMV or cervical vessels Inferior: SMA</td>
<td>Second choice for total esophageal replacement</td>
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<tr>
<td>Free jejunum</td>
<td>Mesenteric anastomosis to LIMA/LIMV or cervical vessels</td>
<td>Isolated short-segment cervical esophageal reconstruction</td>
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<tr>
<td>Pedicled jejunum</td>
<td>SMA</td>
<td>Optimal for vagal-sparing jejunal interposition (Merendino procedure) resection (vagus-sparing resection) or short segmental resection</td>
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<tr>
<td>Skin/forearm</td>
<td>Radial artery anastomosis to LIMA/LIMV or cervical vessels</td>
<td>Optimal for segmental neck resection, small area patch</td>
</tr>
<tr>
<td>Myocutaneous flap</td>
<td>Flap artery anastomosis to LIMA, LIMV, cervical vessels, or AV loop</td>
<td>Last choice when no other options remain</td>
</tr>
</tbody>
</table>

Jejunal Interposition Results: ROL

Table 1 Literature search of jejunal conduit studies

<table>
<thead>
<tr>
<th>1st Author last name (Ref)</th>
<th>Year of publication</th>
<th>n, Jej conduits</th>
<th>Route (major)</th>
<th>Mortality (%)</th>
<th>Leak (%)</th>
<th>Graft loss (%)</th>
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<tbody>
<tr>
<td>Iwata (7)</td>
<td>2012</td>
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<tr>
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<td>Poh (8)</td>
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<td>RS (61%)</td>
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<td>25</td>
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<td>NR</td>
<td>24</td>
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<td>27</td>
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<td>Total</td>
<td>1987-2012</td>
<td>290</td>
<td>RS</td>
<td>0-10.5</td>
<td>0-36.4</td>
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- 290 pts, RS route, 1-11% mortality, 0-36% Leak, 0-11% graft loss

Colon Interposition Results: ROL

<table>
<thead>
<tr>
<th>1st Author last name (Ref)</th>
<th>Year of publication</th>
<th>n, Colon conduits</th>
<th>Route (major)</th>
<th>Mortality (%)</th>
<th>Leak (%)</th>
<th>Graft loss (%)</th>
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<td>Kesler (21)</td>
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<td>11</td>
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<tr>
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<td>43</td>
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<td>Mine (23)</td>
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<td>RS</td>
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Skin Conduits

Microvascular augmentation
Musculocutaneous flap replacement
This is typically reserved for patients who do not have a colon or jejunal option left ...
Esophageal Replacement Options

The gastric conduit is standard of care in most circumstances...
The Dreaded Dead Conduit…

Dead conduit is worse situation…
Indications for Alternate Conduits:

• Recurrence of esophageal tumor\(^1,2,3\)
• Dead gastric conduit\(^2\)
• Injury to GE Vessel or prior surgical alteration
• Cancer extending Into eso & stomach

Long Segment Esophageal Replacement Options

- Stomach
- Jejunum- +SC
- Colon- +/- SC
Background

• Full-length esophageal reconstruction using a pedicled jejunal flap augmented by cervical or thoracic vascular microanastomosis—a long-segment supercharged pedicled jejunum, (SPJ)—to recreate esophageal continuity after resection represents *decades* of surgical evolution...
Colon Conduit 1988

Indications, Surgical Technique, and Long-Term Functional Results of Colon Interposition or Bypass

TOM R. Demeester, M.D., KARL-ERIK JOHANSSON, M.D., INGRID FRANZE, M.D.,* ERNST EYPASCH, M.D., CHIEN-TAI LU, M.D.,† JAMES E. McGill, M.D.,* and GIOVANNI ZANINOTTO, M.D.
Mayo Clinic Experience: 1995

32 pts, colon, 65% L colon, 9% mortality

Esophageal Replacement by Colon Interposition

Robert J. Cerfolio, MD, Mark S. Allen, MD, Claude Deschamps, MD, Victor F. Trastek, MD, and Peter C. Pairolero, MD

Section of General Thoracic Surgery, Mayo Clinic and Mayo Foundation, Rochester, Minnesota

Between 1985 and 1993, 32 patients (24 male and 8 female) underwent colon interposition for replacement of the esophagus at the Mayo Clinic. Median age was 58.5 years (range, 1 to 79 years). The colon was used because of an inadequate stomach in 27 patients (84%) and as the conduit of choice in 5 (16%). Esophageal cancer was present in 15 patients (47%). The left colon was used in 20 patients (63%) and the right, in 12 (38%). The colon was placed substernally in 19 patients (59%) and in the esophageal bed in 13 (41%). The operative mortality was 9%; cause of death was ischemic necrosis of right colon conduits in 2 patients and adult respiratory distress syndrome in 1 patient. Major complications occurred in 4 additional patients and included ischemic colitis of a right colon conduit, Roux-en-Y limb obstruction, chylothorax, and an anastomotic leak. Follow-up was complete for all patients and ranged from 15 months to 7 years (median follow-up, 2.3 years). Eleven patients died during follow-up. The cause of death was metastatic esophageal cancer in 9 patients, myocardial infarction in 1 patient, and respiratory failure in 1 patient. At last follow-up, 26 of the 29 operative survivors had little or no difficulty eating. Two patients had dumping symptoms, and 1 patient had severe dysphagia. Seven patients required dilation of the esophagocolonic anastomosis. We conclude that colon interposition for esophageal replacement provides acceptable long-term function; however, early morbidity and mortality are considerable.

K Mansour: Jejunal Conduits: 1997

129 patients
133 conduits

Bowel Interposition for Esophageal Replacement: Twenty-Five-Year Experience

Kamal A. Mansour, MD, F. Curtis Bryan, MD, and Grant W. Carlson, MD

Joseph B. Whitehead Department of Surgery, Divisions of Cardiothoracic and Plastic and Reconstructive Surgery, Emory University School of Medicine, Atlanta, Georgia

25 yrs of bowel interposition - Mansour et al.

- 85 R colon
- 18 L colon
- 4 transv colon
- 23 jejunal interpositions
- 3 free jejunal interpositions

Fig 1. Distribution of conduits in benign disease (n = 97).

Fig 2. Distribution of conduits in malignant disease (n = 36).

Joe Miller: Jejunal Experience

Jejunal Interposition for Esophageal Replacement

William A. Cooper and Joseph I. Miller, Jr

The evolution of operations on the esophagus date back to Billroth in 1877.1 Roux2 in 1907 was the first to describe use of the small bowel for esophageal replacement. The development of these techniques in the early part of the twentieth century paralleled those that used stomach and colon.3

In 1942, Reinhoft4 successfully replaced the esophagus with a jejunal pedicle graft. Merendino and Dillard5 followed in 1955 with the use of jejunal interposition for peptic stricture of the distal esophagus. As the techniques of microsurgical anastomosis became more readily available, Jurkiewicz and colleagues6,7 reported advantages to the jejunum are its availability and reliable transport of food. The diameter and wall thickness of the jejunum closely resembles that of the esophagus. Its isoperistaltic placement provides some defense against gastroesophageal reflux.

The major disadvantage to the use of jejunum is its arterial supply. Variations in the jejunal arcades may limit the amount of length that can be gained when the jejunum is used as an interposition or Roux limb.

Anatomical Considerations

Jejunal Arterial Anatomy

- Vasa recta
- Marginal artery
- Arcades
- Jejunal Branches
- SMA
Esophageal Replacement Options: Jejunum

VSE

- Also called the “Merendino procedure”
- Advantage of having intact Vagi
- Motility of bowel interposition
- Cannot do full dissection of lymphatics
- More difficult to perform

Pedicled Segmental jejunal Interposition as a Roux
Pedicled Segmental jejunal Interposition to Stomach

How do I do SPJ?
Indications for SPJ

- To reach the pharynx
- To replace entire length of esophagus when a gastric conduit is not available

Background

• Long segment esophageal reconstruction can be accomplished with “super-charged” jejumum (SPJ), colon, or stomach

• In patients in whom a gastric conduit is not possible, SPJ has advantages:
  • Does not require formal preparation
  • Usually free of disease
  • Similar in diameter to esophagus
  • Intrinsic segmental peristalsis
  • May not undergo senescent lengthening

Background

- Adequate length can be obtained to replace the entire esophagus when cervical microvascular augmentation is performed as part of the reconstruction
Esophageal Reconstruction

- SPJ = pedicled segment of jejunum is transposed to the neck and the superior arcade of the bowel is connected to chest/neck vessels while the inferior arcade is left attached to the native SMA branches
1. Positioning and Pre-op

head

feet
2. Incisions
3. Abdominal Exploration & J Tube
Congenital Variations in Jejunal Mesenteric Vascular Patterns
4. Bowel Trans-illumination
Reach of Jejunal Vascular Pedicle

vs

Length of Bowel

(1:3)
4. Bowel Trans-illumination
4. Bowel Trans-illumination
• Regardless of the route, the thoracic inlet is typically enlarged with a hemi-manubriectomy & resection of the head of the clavicle and first rib; occasionally the 2nd rib is also removed, as was done in this case.
5. Neck Dissection
6. LIMA Preparation
7. Creating the Tunnel for Conduit
7. Creating the Tunnel for Conduit
8. Jejunal Testing & Ligation
8. Jejunal Testing & Ligation
Jejunal Route
9. Delivering the Jejunum to Neck
Microscopic Anastomoses
10. Microscopic Venous Anastomosis
11. Microscopic Arterial Anastomosis
12. Resecting Redundant Bowel
13. Creating the Proximal Bowel
14. Making the Monitoring Flap
15. Closing the Neck
16. Creating the Roux (Distal Bowel Anastomosis)
17. Closing the Mesenteric Defect
18. Feeding Jejunostomy
19. Closing the Diaphragmatic Defect
20. Abdominal Closure
Post-Operative Management

• No IV pressors
  (give volume for hypotension)
• Hourly doppler examination
• No pressure on the flap/monitoring segment
20 Steps to SPJ

1. Positioning & pre-op
2. Incisions
3. Abdominal exploration
4. Bowel trans-illumination
5. Neck dissection
6. LIMA Prep
7. Creating the tunnel for the conduit
8. Selecting jejunal route, testing the blood flow, and ligation of $3^{rd}$ arcade
9. Delivering the jejunum to the neck
10. Microscopic venous anastomosis
11. Microscopic arterial anastomosis
12. Resecting redundant bowel
13. Creating the bowel neck anastomosis
14. Making the monitoring flap
15. Closing the neck
16. Creating the roux
17. Feeding jejunostomy
18. Closing the mesenteric defect
19. Closing the diaphragmatic defect
20. Abdominal closure
What about Technical Outcomes?
Supercharged Pedicled Jejunal Interposition for Esophageal Replacement: A 10-Year Experience

Shanda H. Blackmon, MD, Arlene M. Correa, PhD, Roman Skoracki, MD, Pierre M. Chevray, MD, PhD, Min P. Kim, MD, Reza J. Mehran, MD, David C. Rice, MD, Jack A. Roth, MD, Stephen G. Swisher, MD, Ara A. Vapourciyan, MD, Peirong Yu, MD, Garrett L. Walsh, MD, and Wayne L. Hofstetter, MD

Department of Thoracic and Cardiovascular Surgery, The University of Texas MD Anderson Cancer Center, and Department of Surgery, The Methodist Hospital, Houston, Texas; Department of Surgery, Weill Cornell College of Medicine, New York, New York; Department of Plastic Surgery, The University of Texas MD Anderson Cancer Center, and Department of Surgery and Institute for Reconstructive Surgery, The Methodist Hospital, Houston, Texas

Background. Esophageal continuity after esophagectomy can be established without a viable stomach conduit by using the colon or jejunum. The current study evaluated the technical outcomes of the long-segment supercharged jejunal interposition (SPJ) interposition.

Methods. A database was developed to capture patient characteristics, operative technique, and outcomes for patients with an SPJ interposition at 2 institutions from 2000 to 2010. A multivariable analysis was performed to determine predictors of leak and graft loss. A selective prospective manometric analysis was performed to describe peristalsis of the SPJ.

Results. Of the 60 patients undergoing SPJ reconstruction, 44 (73%) were men, and the median age was 57 years (range, 28 to 76 years). The operation in 23 patients (38%) was performed to reverse esophageal discontinuity, and 57 (95%) patients underwent reconstruction for cancer. Early complications included 18 instances (30%) of pneumonia, 19 anastomotic leaks (32%), and 5 instances of graft loss with diversion (8%). Three patients (5%) died in the hospital or within 30 days. After jejunal reconstruction, 50 patients (83%) were able to return to a regular diet. The 90-day mortality rate was 10% (n = 6). Characteristic postoperative manometric findings included segmental peristalsis, as is typical for in situ jejunum. Median survival was 28 months and the 5-year survival rate was 50%.

Conclusions. An SPJ conduit can reestablish or maintain gastrointestinal continuity in high-risk patients when the stomach is unavailable. This is our preferred conduit for reconstruction of the esophagus over the colon.

Experience

• From June 2000 to December 2010,
  • 60 consecutive patients underwent SPJ
  • 50 patients from MDACC (2000-2010)
  • 10 patients from HMH (2006-2010)
• A database was created to evaluate patient characteristics, operative technique, & outcomes
Results

- Male: 44 (73%)
  - Age: 28
  - LOS: 7

- Female: 16 (27%)
  - Age: 57
  - LOS: 19

### Patient Characteristics

#### Timing
- **Primary immediate reconstruction**: 37 (62%)
- **Reversal of discontinuity**: 23 (38%)

#### Preoperative Therapy (Chemo +/-XRT)
- 25 (42%)

#### Histology of Primary
- **Adenocarcinoma**: 41 (68%)
- **Squamous Cell**: 9 (15%)
- **other**: 7 (12%)
- **Not cancer**: 3 (5%)

---

Jejunal Route

Operative Detail

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<thead>
<tr>
<th></th>
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<th>%</th>
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<tr>
<td>Posterior mediastinum</td>
<td>21</td>
<td>35%</td>
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<tr>
<td>Retrosternal</td>
<td>39</td>
<td>65%</td>
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Jejunal Route

Operative Detail  n  %

Retrocolic  46  77%

Antecolic  14  23%

## Results: Anastomosis

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<tr>
<th>Operative Detail</th>
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</tr>
<tr>
<td>Hand-sewn</td>
<td>51</td>
<td>85%</td>
</tr>
<tr>
<td>Stapled side-to-side</td>
<td>8</td>
<td>13%</td>
</tr>
<tr>
<td>Circular-stapled</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Distal Connection</strong></td>
<td></td>
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<tr>
<td>Jejunum to stomach remnant</td>
<td>29</td>
<td>48%</td>
</tr>
<tr>
<td>Jejunum to jejunum (Roux)</td>
<td>31</td>
<td>52%</td>
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Results: Graft Loss

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<th>Operative Detail</th>
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<th>%</th>
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<tr>
<td>Intra-operative vascular revision</td>
<td>16</td>
<td>27%</td>
</tr>
<tr>
<td>Intra-operative Graft loss</td>
<td>1</td>
<td>2%</td>
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Clinical Outcomes

**SPJ patients**
- n = 60

**survivors**
- n = 54

**90-day/Hosp mortality**
- n = 6

**graft loss**
- n = 4

**Intact**
- n = 52

**Never reconstructed**
- n = 2

**Never re-gained nutritional independence**
- n = 2

**ORAL DIET**
- n = 50

# Results: Operative Events

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<td>Morbidity:</td>
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<tr>
<td>Leak</td>
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<td>32%</td>
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<td>Grade I</td>
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<td>Grade II</td>
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## Results: Post-operative Events

### Early Event

<table>
<thead>
<tr>
<th>Event</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>18</td>
<td>30%</td>
</tr>
<tr>
<td>RLN Injury</td>
<td>10</td>
<td>17%</td>
</tr>
<tr>
<td>NOMI</td>
<td>4</td>
<td>7%</td>
</tr>
<tr>
<td>Jejunal Graft loss/diversion</td>
<td>5</td>
<td>8%</td>
</tr>
</tbody>
</table>

Results: Post-operative Events

<table>
<thead>
<tr>
<th>Late Events</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-day Mortality</td>
<td>6</td>
<td>10%</td>
</tr>
<tr>
<td>Later Revision</td>
<td>7</td>
<td>12%</td>
</tr>
</tbody>
</table>

Manometry

Normal Swallow

Swallow after SPJ

n = 5

Conclusions

• SPJ can establish nutritional independence in a high-risk patient population when stomach is unavailable

• This is our preferred alternative for reconstruction when stomach is unavailable

How does the SPJ functionally compare to a Gastric Conduit?
Super-Charged Pedicled Jejunal Interposition Performance Compares Favorably to a Gastric Conduit After Esophagectomy

Stephens EH,¹ Gaur P,² Hotze KO,² Correa AM,³ Kim MP,² Blackmon SH⁴

¹Cardiothoracic Surgery, Columbia University, New York; ²Thoracic Surgery, The Methodist Hospital, Houston; ³MD Anderson, Houston; ⁴Thoracic Surgery, Mayo Clinic, Rochester
Background

• Objective
  • Assess the functionality of SPJ in comparison to gastric conduits

Stephens ES, ...Blackmon SH. SPJ Performance compares favorable to a gastric conduit after esophagectomy. Annals of Thoracic Surgery 2015;
Methods

• A conduit functionality questionnaire was developed evaluating:
  • Reflux
  • Dumping
  • Dysphagia
  • Stricture
  • Zubrod score (functional status)
  • Post-op pain
  • Conduit emptying (radiography)

• Preoperative/demographic, intraoperative, and postoperative data were prospectively collected on the 94 living patients who underwent esophageal reconstruction 2009-2013 at HMH.

Methods

• 45 of the 94 (48%) patients answered the questionnaire >1 month after surgery. For patients who completed multiple questionnaires, the worst score for each category was used.

• Statistical analysis was performed using SPSS (SPSS, Chicago, IL) and included Mann-Whitney u-test and Fisher’s Exact Test for cross tabs with statistical significance defined as p<0.05.

Development/Validation of Conduit Assessment Tool

- Tool was developed using three methods to establish content validity:
  - 720 patient encounter records during focus groups held over a 5 year period
  - formal presentations and review in multidisciplinary GI conference
  - formal presentations and review in multidisciplinary esophagus tumor board meetings

Focus Groups
Esophagus Support Group
Methods: Conduit Questionnaire

By: Shanda Blackmon, M.D., M.P.H., FACS

Pt Name: 
Date of last assessment: __/__/__

Date of Surg: Surgical Anatomy:

Meds:

Nutrition Assessment: 
Baseline weight: 
Current weight: 
Prealbumin:  
Albumin:  Lactose-[]n[[]y  
BMI:  ZUBROD:

Date of assessment: __/__/__

Reflux Score
0 1 2 3 4

Dumping Score
0 1 2 3 4

Dysphagia Score
0 1 2 3 4

Stricture Score
0 1 2 3 4

Conduit Emptying Score
0 1 2 3 4

Action Plan:
- [] nutrition counseling
- [] further evaluation/imaging/testing
- [] speech swallow training
- [] surgical correction of problem:

Upper GI date:

Methods: Conduit Questionnaire

- Reflux\(^1\)
  - Mayo Score
- Dumping Score\(^2\)
  - Sigstad’s scoring method
- Dysphagia\(^3\)
  - Mayo Score
- Stricture\(^4\)
  - Blackmon et al. Score
- Zubrod score\(^5\)
  - 0=asymptomatically active
  - 1=restricted in strenuous activity
  - 2=ambulatory, self-care, >50% time out of bed
  - 3=ambulatory, limited self-care, >50% time in bed
  - 4=no self-care, bed-ridden

- Post-op pain (0-10)\(^6\)
- Conduit emptying (radiography)\(^7\)
  - 0=rapid emptying w straight path
  - 1=90% emptying, <2min delay
  - 2=90% emptying, 2-15 min
  - 3=90% emptying, 16-30 min
  - 4=conduit stasis, >30min

### Results

### Patient Characteristics and Operative Data

<table>
<thead>
<tr>
<th></th>
<th>Gastric Conduit (n=31)</th>
<th>SPJ (n=14)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td>23 (74%)</td>
<td>8 (57%)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td>63±10</td>
<td>55±15</td>
<td>0.037</td>
</tr>
<tr>
<td><strong>Underlying Etiology: Cancer</strong></td>
<td>26 (84%)</td>
<td>13 (93%)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Type of Resection:</strong></td>
<td></td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Oncologic Rsxn for Adenoca</td>
<td>20 (65%)</td>
<td>6 (43%)</td>
<td></td>
</tr>
<tr>
<td>Rsxn for Benign Disease</td>
<td>2 (7%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Previous Rsxn</td>
<td>1 (3%)</td>
<td>7 (50%)</td>
<td></td>
</tr>
</tbody>
</table>

Stephens ES, ...Blackmon SH. SPJ Performance compares favorable to a gastric conduit after esophagectomy. Annals of Thoracic Surgery 2015;
### Results

**Patient Characteristics and Operative Data**

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<th>SPJ (n=14)</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of Anastomosis:</strong></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neck</td>
<td>7 (23%)</td>
<td>14 (100%)</td>
<td></td>
</tr>
<tr>
<td>Intrathoracic</td>
<td>24 (77%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Anastomosis Technique:</strong></td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Hand sewn anastomosis</td>
<td>1 (3%)</td>
<td>2 (14%)</td>
<td></td>
</tr>
<tr>
<td>Stapled side-to-side anastomosis</td>
<td>13 (42%)</td>
<td>12 (86%)</td>
<td></td>
</tr>
<tr>
<td>Circular stapled anastomosis</td>
<td>17 (55%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
</tbody>
</table>

Stephens ES, ...Blackmon SH. SPJ Performance compares favorable to a gastric conduit after esophagectomy. *Annals of Thoracic Surgery* 2015;
## Results
### Post-Operative Complications

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<th>SPJ (n=14)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surgical Complications:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>15 (48%)</td>
<td>7 (50%)</td>
<td>NS</td>
</tr>
<tr>
<td>Afib</td>
<td>7 (23%)</td>
<td>3 (21%)</td>
<td></td>
</tr>
<tr>
<td>Renal failure</td>
<td>4 (13%)</td>
<td>1 (7%)</td>
<td></td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>1 (3%)</td>
<td>1 (7%)</td>
<td></td>
</tr>
<tr>
<td>UTI</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>DVT</td>
<td>1 (3%)</td>
<td>1 (7%)</td>
<td></td>
</tr>
</tbody>
</table>

Afib = atrial fibrillation, NS = not statistically significant, UTI = urinary tract infection, DVT = deep vein thrombosis.

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### Results

#### Post-Operative Complications

<table>
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<th>SPJ (n=14)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of stay (days)</strong></td>
<td>10±4</td>
<td>17±15</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>30 day mortality</strong></td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Leak within 60 days</strong></td>
<td>7 (23%)</td>
<td>4 (29%)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Reoperation</strong></td>
<td>3 (10%)</td>
<td>1 (7%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Results: Clinical Follow-Up

<table>
<thead>
<tr>
<th></th>
<th>Gastric Conduit (n=31)</th>
<th>SPJ (n=14)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death at last follow-up</td>
<td>2 (7%)</td>
<td>2 (14%)</td>
<td>NS</td>
</tr>
<tr>
<td>Length of follow-up</td>
<td>14±11</td>
<td>22±14</td>
<td>NS</td>
</tr>
</tbody>
</table>

Results: Conduit Function

P=0.04

Discussion

• SPJ compares favorably to gastric conduit for esophageal reconstruction in terms of functionality.

• The groups differed significantly with SPJ patients more likely to have had prior resection.

• Operative outcomes and peri-operative complications were not significantly different between groups except longer length of stay for SPJ patients and more post-operative pain.

Discussion

• The conduit assessment is a useful tool to compare reconstruction techniques, as well as assess patients’ recovery and need for further interventions.

Current Mayo Experience

- Alternative conduits 1/1985 to 12/2015:
  - Cervical replacement w skin = 17
  - Colon Interpositions = 141
  - Jejunal Interpositions = 45
  - Other = 60
  - Gastrectomy
    - jejunum = 236
More Mayo data here***
Discussion

- Future studies involve:
  - Validation of the conduit assessment tool at other institutions and in more patients
  - Application of the tool to compare the outcomes of other reconstruction techniques
  - Establish expected ranges at each post-operative time point for a given surgery, enabling identification of patients and cut-points where deviation may trigger further intervention
Esophageal Replacement

• The future may hold many other options:
  • Tissue-engineered 3-dimensional scaffolds repopulated with stem cells have already been used to replace the trachea
  • Esophageal stents have now given us the ability to bridge a disconnected segment of bowel and allow for regrowth of tissue and establish new continuity
It Takes Teamwork
If we have time, cases;;;
Questions?