

# Esophageal Cancer

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# The Esophagus

*Food for thought*

- A muscular pump bordered by 2 sphincters
- One function: Transport

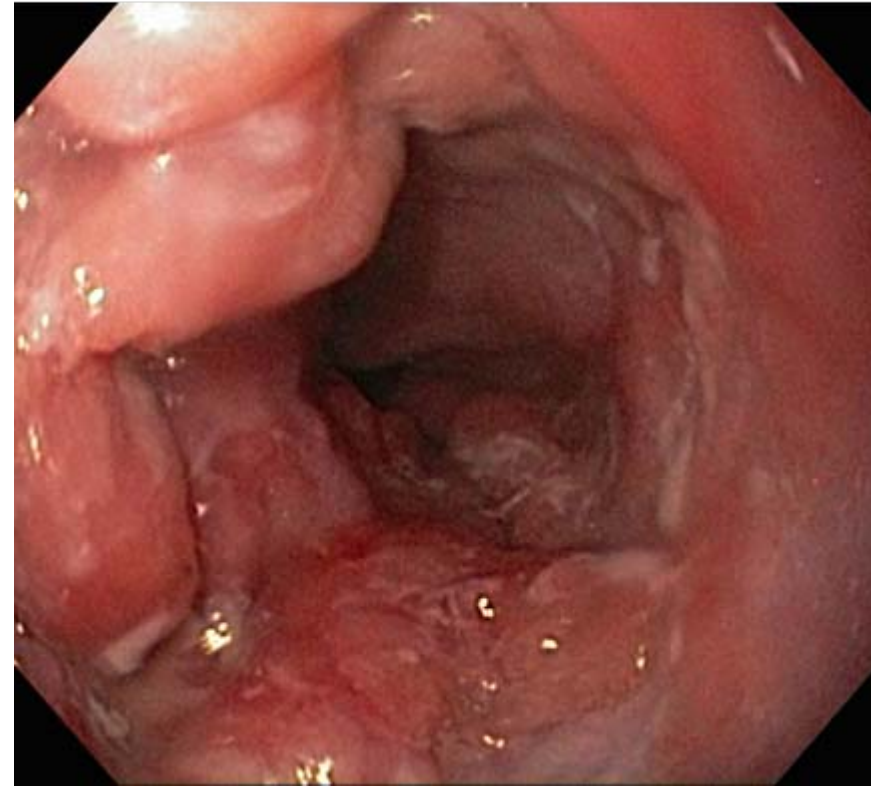
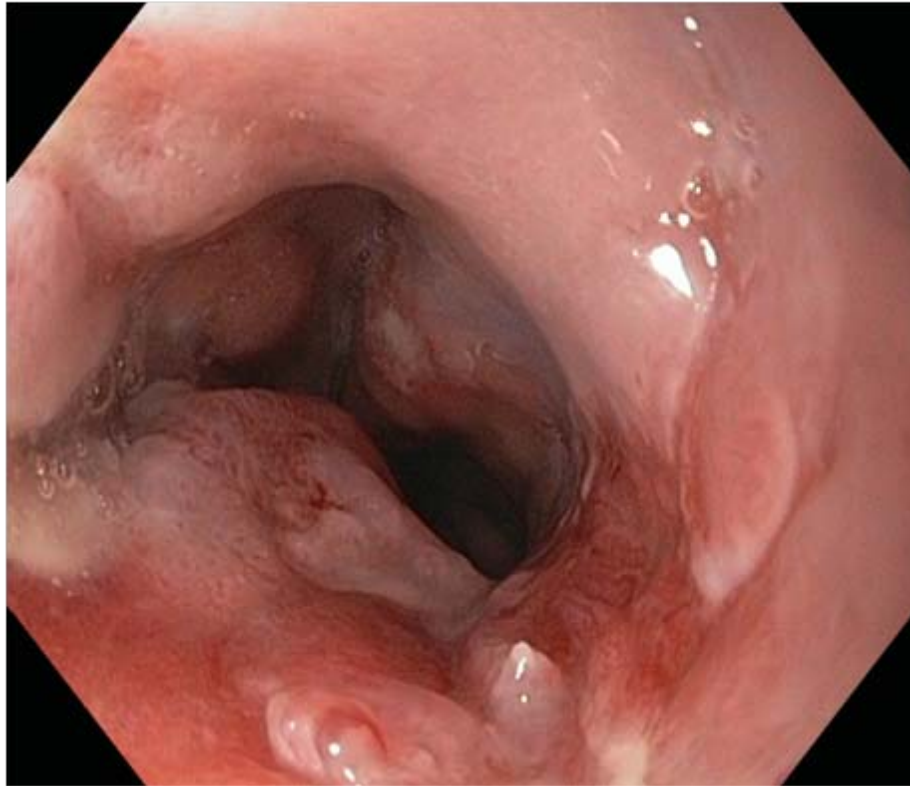
The unidirectional (aboral) movement of food/saliva

- **No** endocrine, exocrine, immunologic, digestive, absorptive or secretory functions

# Presenting Symptoms

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- Dysphagia
- Odynophagia / chest pain
- Weight loss
- Hematemesis
- Others

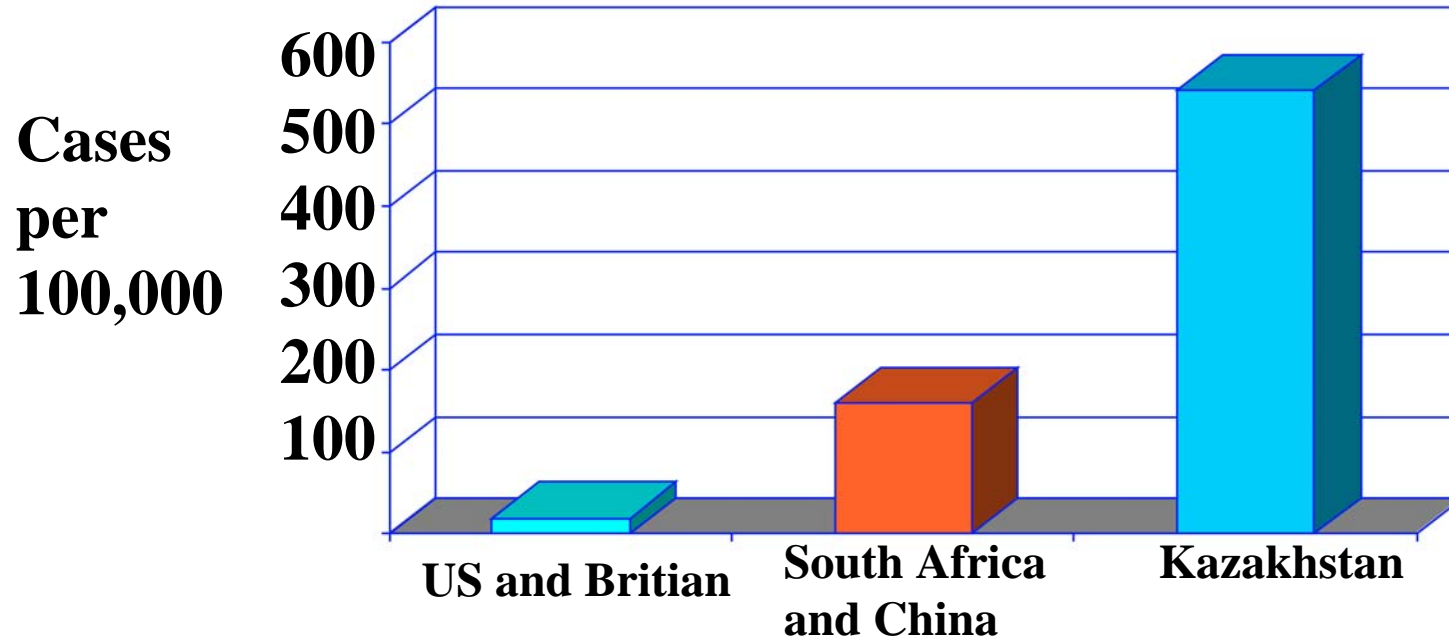


# Overview

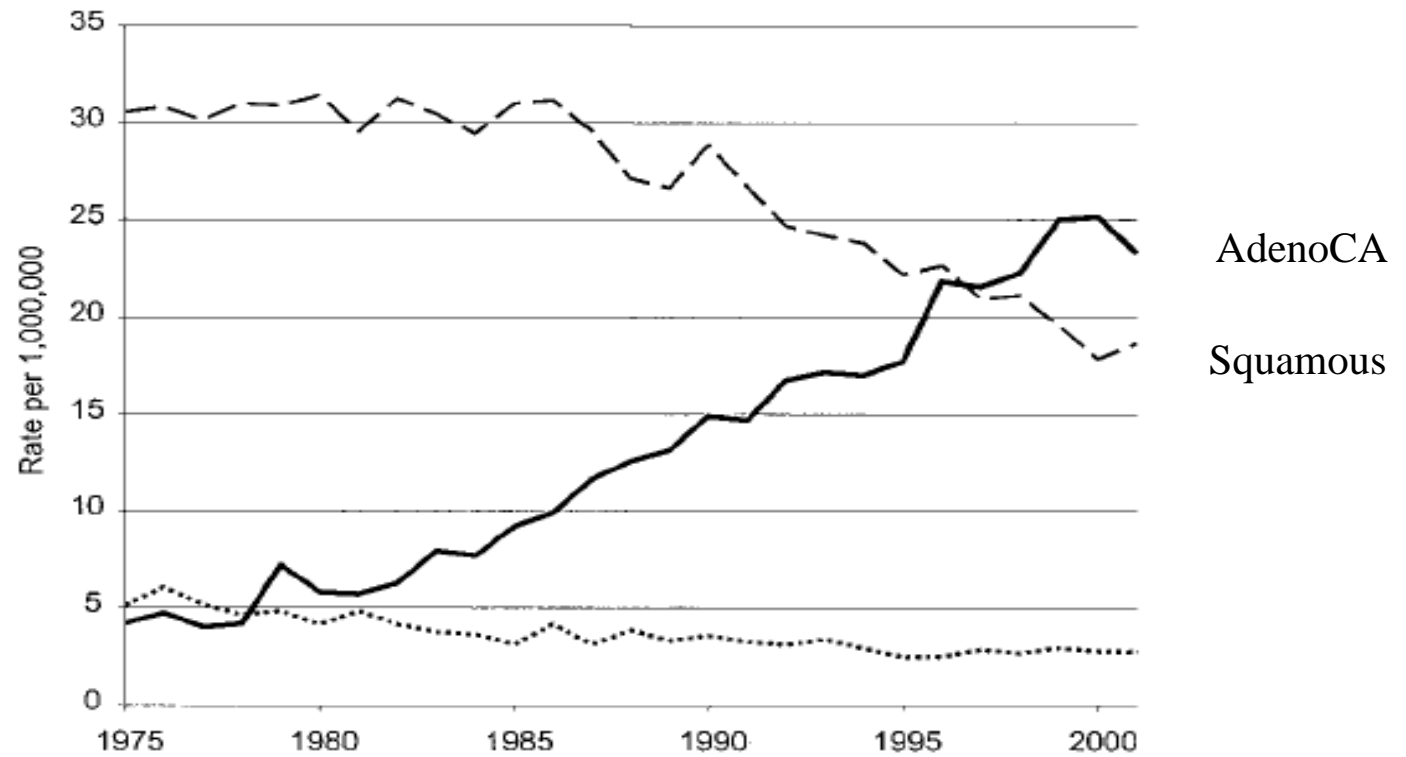
Cell Type	Demo-graphics	Risk Factors	Location	Incidence
Squamous carcinoma	Black Males	Etoh Smoking Diet-nitrosamines	Proximal and Mid Esophagus	Declining
Adenocarcinoma	White Males	Barrett's	Lower esophagus	Increasing

# Squamous Cell Carcinoma

## *Incidence by Geographic Location*

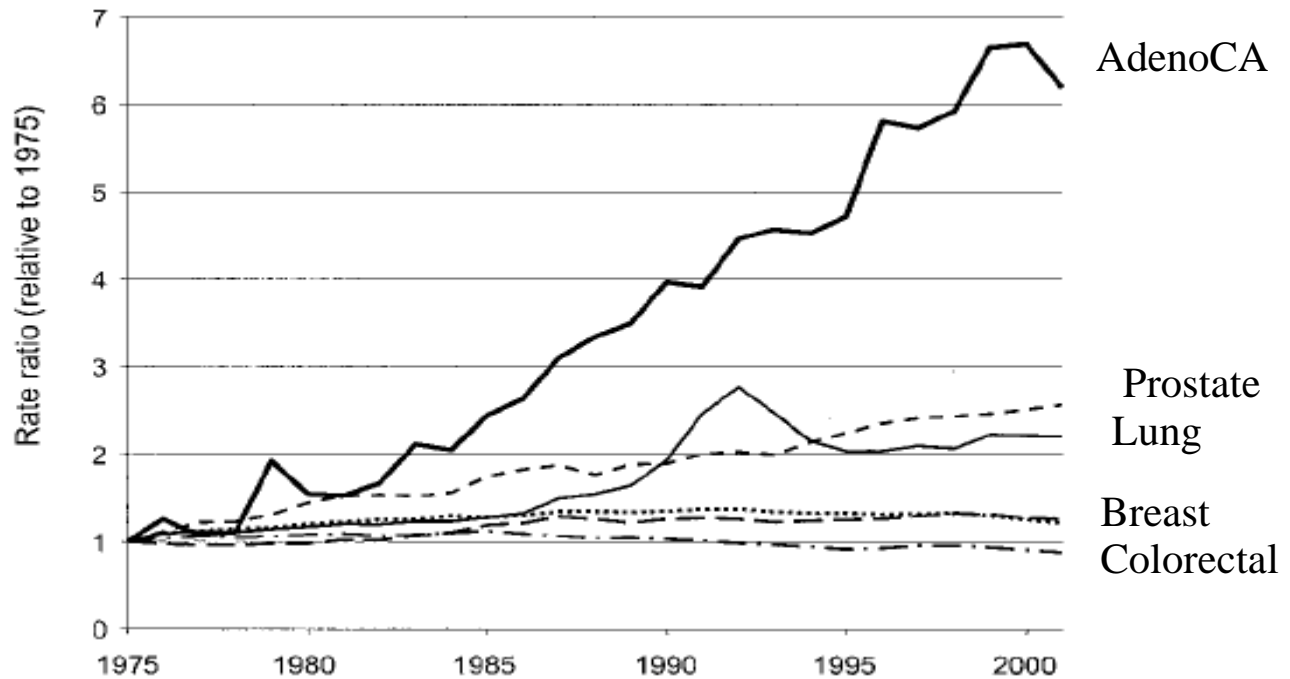


# Histology and Esophageal Cancer Incidence (1975–2001)



Pohl H, Welch HG. J Natl Cancer Inst 2005;97:142–6.

# Relative Change in Incidence of Esophageal Adenocarcinoma and Other Malignancies (1975–2001)



Pohl H, Welch HG. J Natl Cancer Inst 2005;97:142– 6



# Evolution of Esophageal Cancer

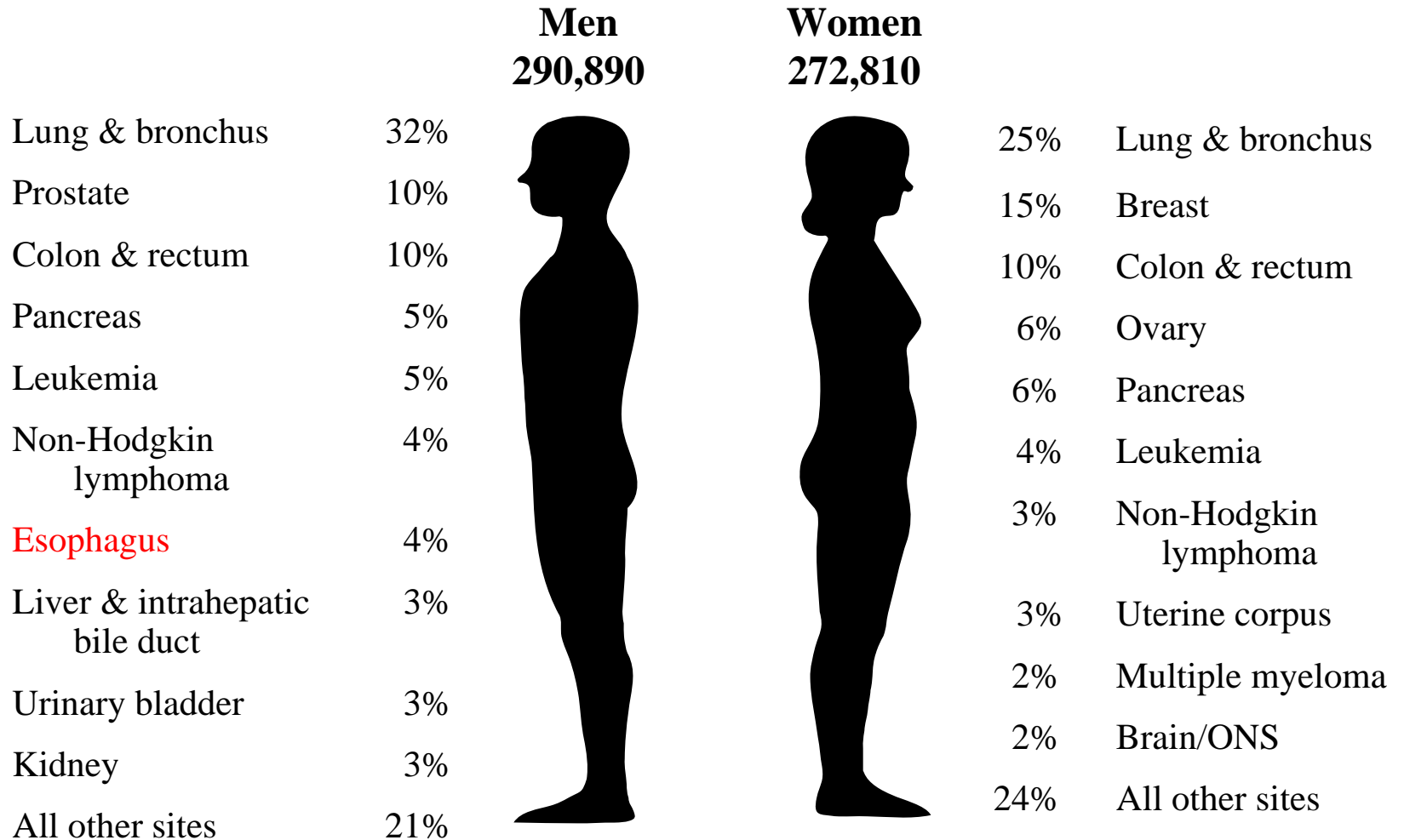
- In the U.S. and western Europe, the incidence of adenocarcinoma of the distal esophagus, GE junction and gastric cardia has increased by approximately **10% / yr** over the past 30 years (now 10x incidence compared to 1976.)
- **70-75%** of all esophageal CA in the U.S. is now adenocarcinoma.

# Esophageal Cancer

## *2010 Estimates*

- 16,640 new cases diagnosed in the U.S.  
~ 70% adenocarcinoma (~11,000+ cases)
- 14,500 deaths
- 5-year relative survival (2001-2007) = 16.8%
- Median age (2004-2008) = 68 years

# Estimated US Cancer Deaths



# Why the Increase in Esophageal Adenocarcinoma?

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- GERD?
- Acid suppression therapy?
- Obesity/diet?
- *Helicobacter pylori* eradication?

# Carcinogenesis Sequence

GERD  
(Reflux of gastric/duodenal contents)

Squamous epithelial injury

Intestinal metaplasia of mucosa  
(Barrett's)

Low-grade dysplasia

**High-grade dysplasia**

**Invasive carcinoma**

Persons with recurrent GERD symptoms have an 8-fold increase in the risk of developing esophageal adenocarcinoma

Lagergren, *et al.* NEJM 1999;340:825-31.

# Barrett's Esophagus

## *Definition*

- Defined as any length of endoscopically visible columnar mucosa extending onto the esophagus
- PLUS ***intestinal metaplasia*** on histologic examination
  - Short-segment: < 3cm
  - Long-segment: ≥ 3cm

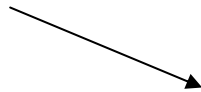
# Barrett's Esophagus



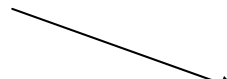
# Barrett's Esophagus

## *Carcinogenesis Sequence*

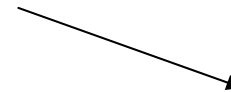
**No dysplasia**



**Low-grade dysplasia**



**High-grade dysplasia**

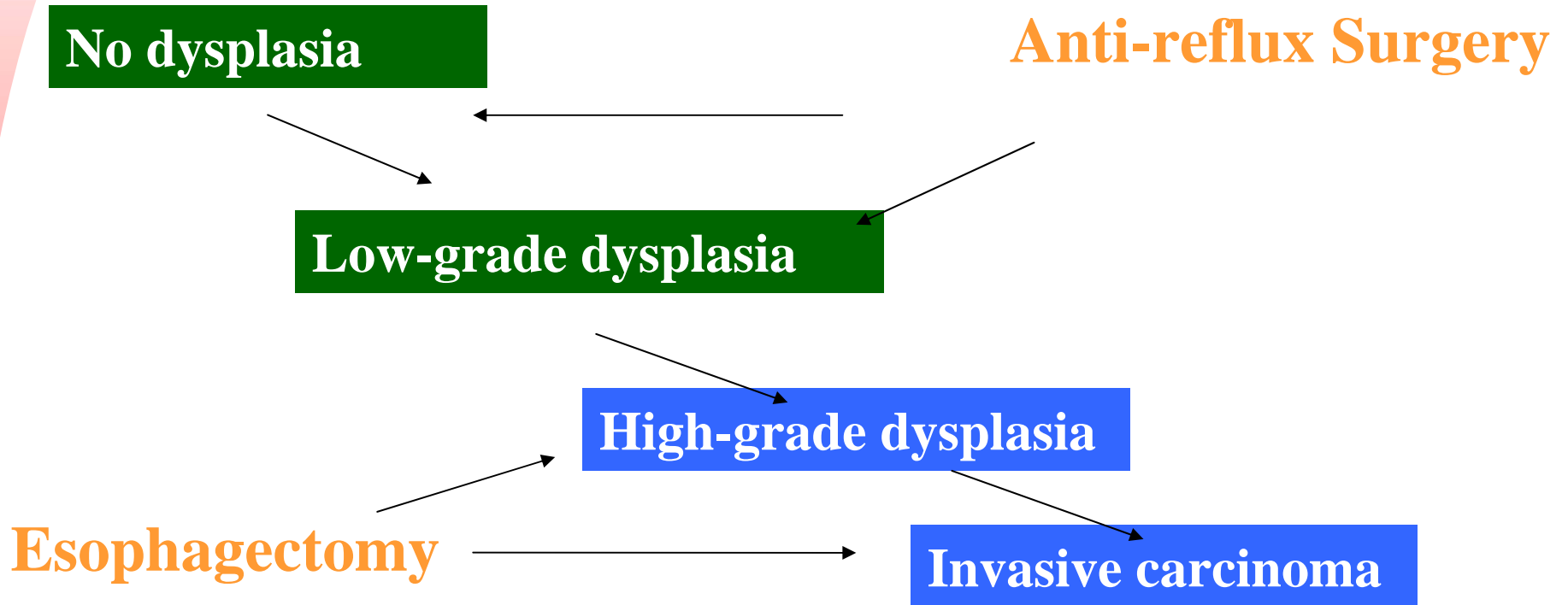


**Invasive carcinoma**



# Barrett's Esophagus

## *Surgical Considerations*



# Barrett's Esophagus

## *Management Controversies*

- Screening
  - Baseline endoscopy on patients with GERD
    - When?
    - How often?
- Surveillance
  - Serial endoscopies on patients with known BE to R/O progression to dysplasia/CA
    - How often?
    - Are lives saved?
- Ablation

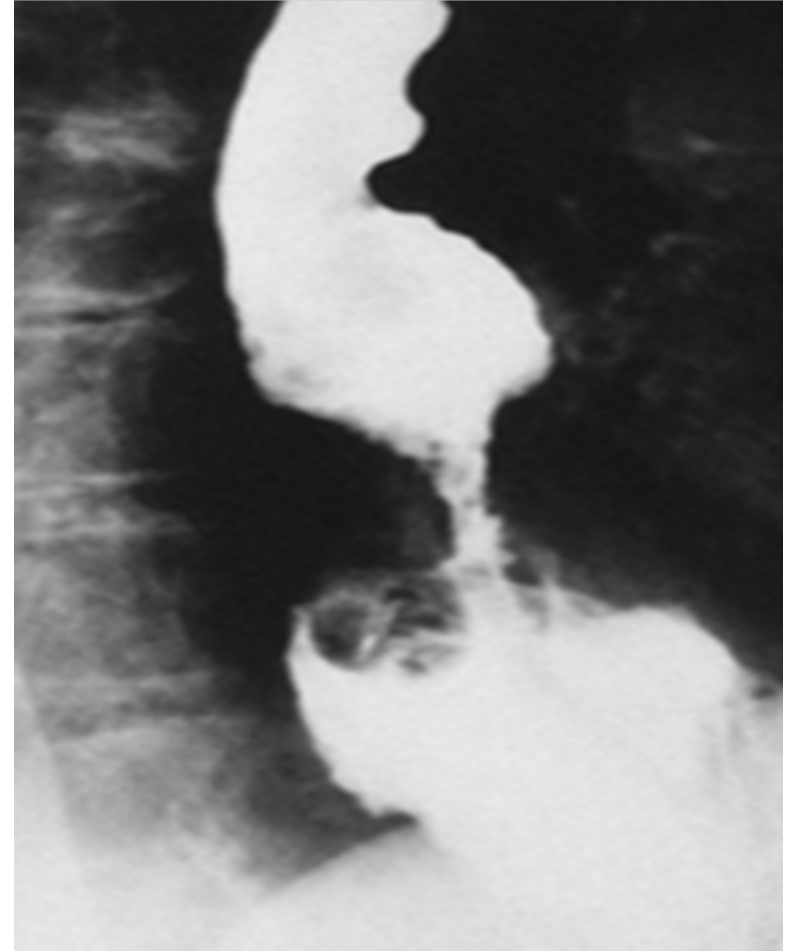
# Pre-Operative Investigations for Esophageal Carcinoma

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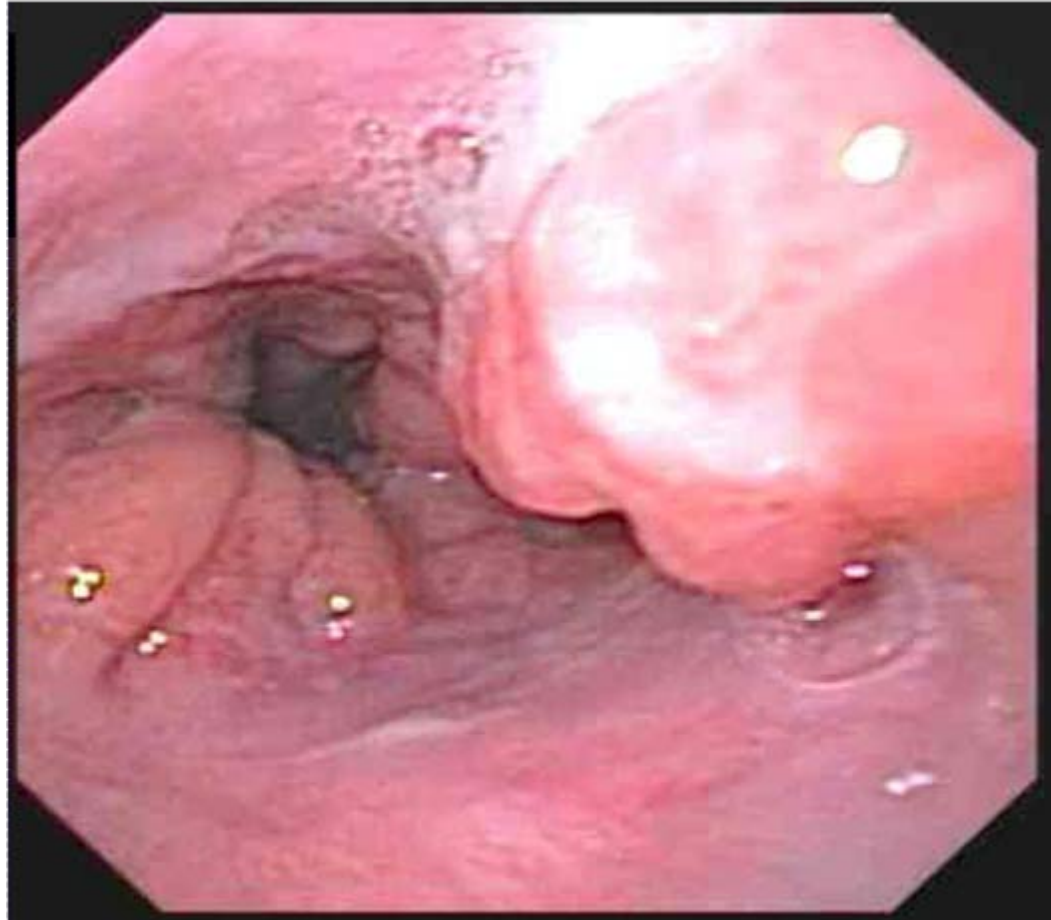
- Flexible upper endoscopy with biopsies
- Barium UGI
- Computed tomography (CT)
- Endoscopic ultrasound (EUS)
- PET

# Diagnosis & Staging

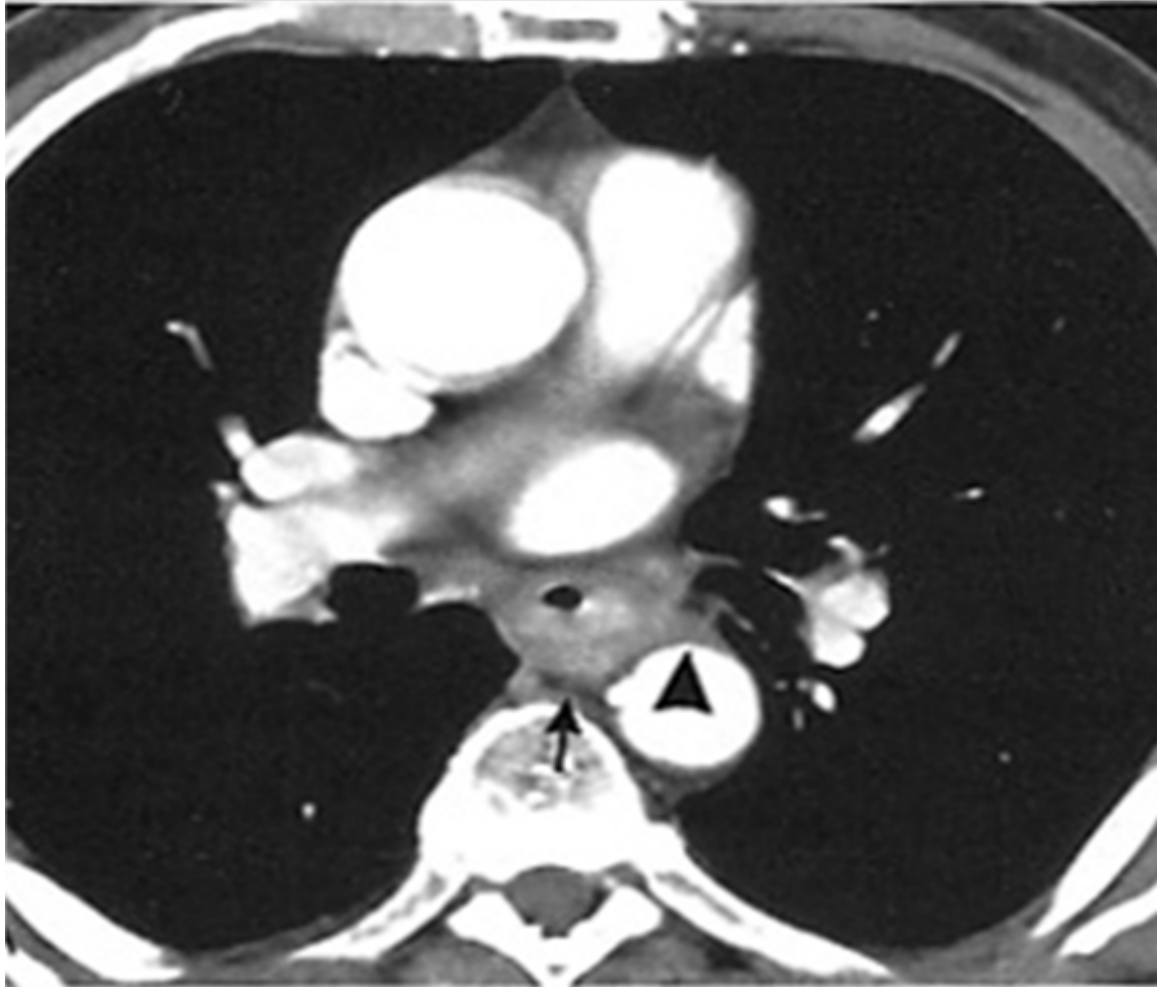
- 50 y/o male
- Dysphagia



# EGD with biopsy

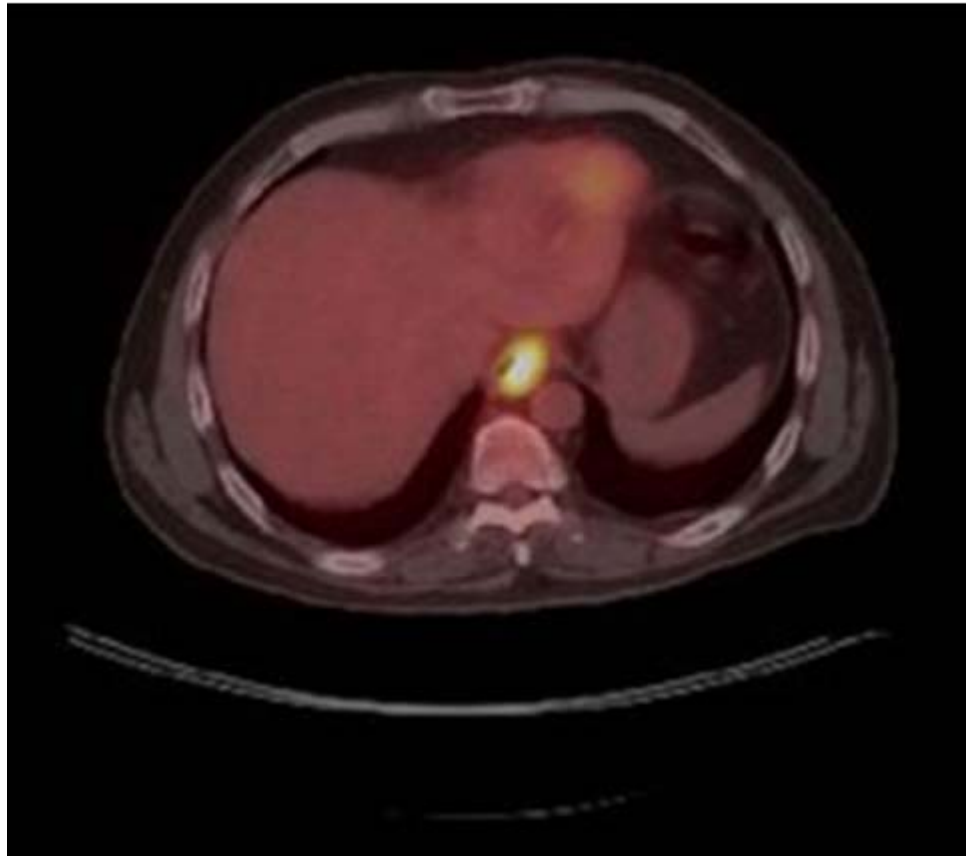


# Chest/Abdominal CT



- Evaluate for T4 disease and metastasis

# PET/ CT Scan



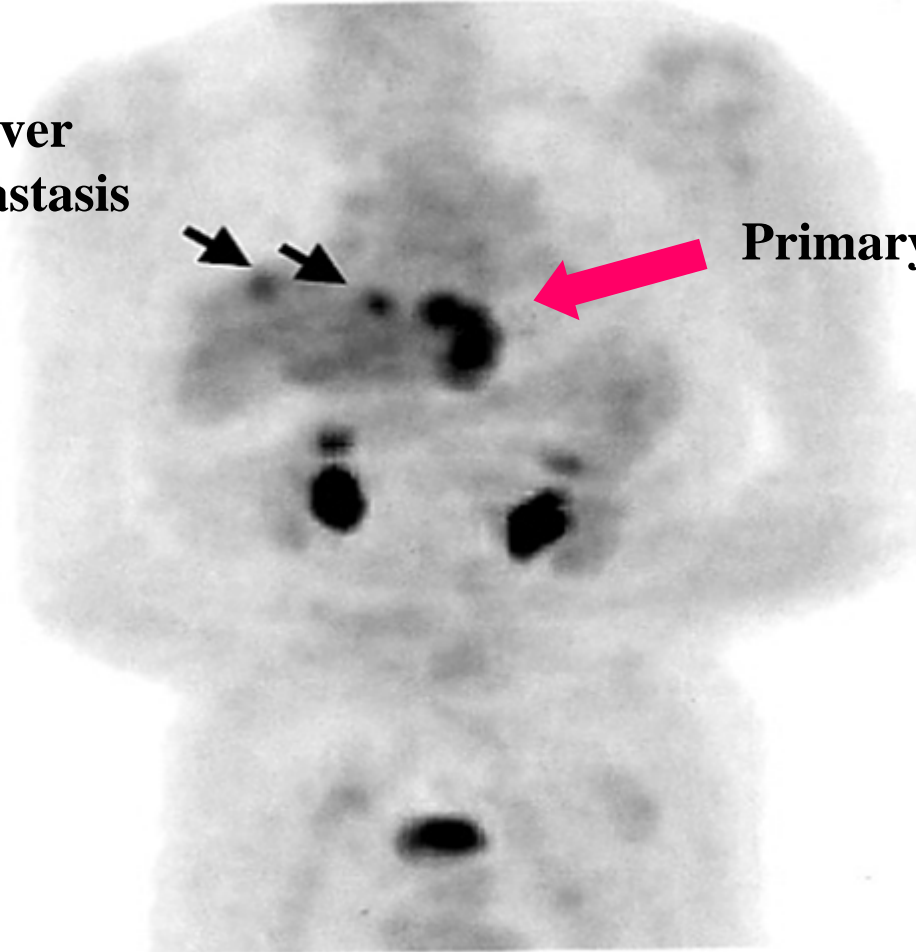
- Radioactive sugar – (fluorodeoxyglucose ) is injected into the blood
- Uptaken by rapidly growing and active cells absorb large

# PET Scan

**Liver  
Metastasis**



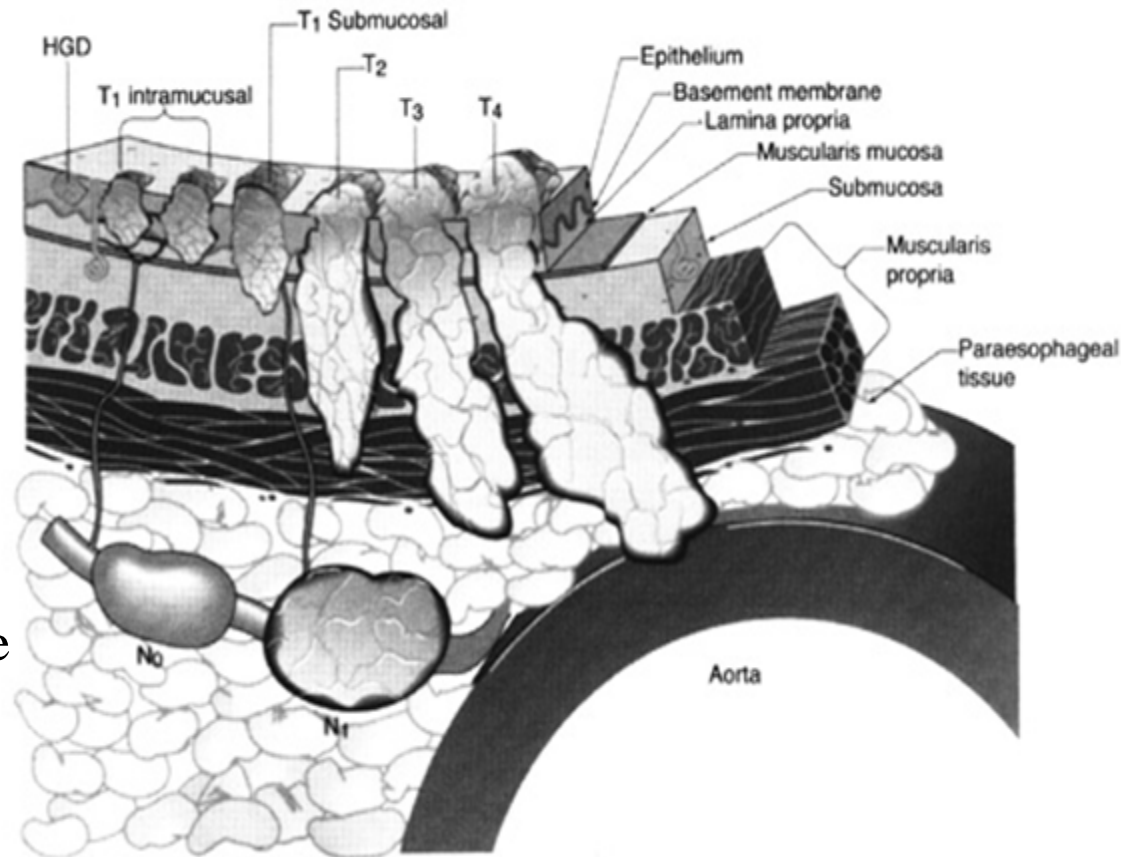
**Primary tumor**



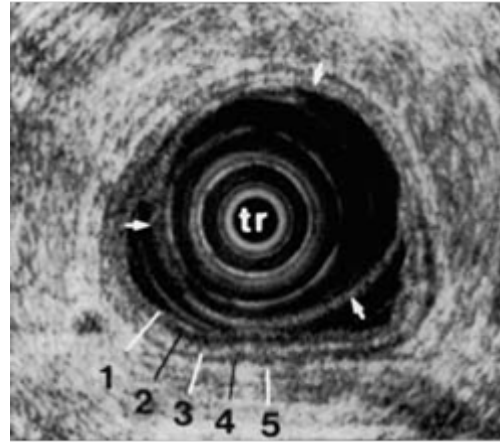


# T-stage/Depth of invasion

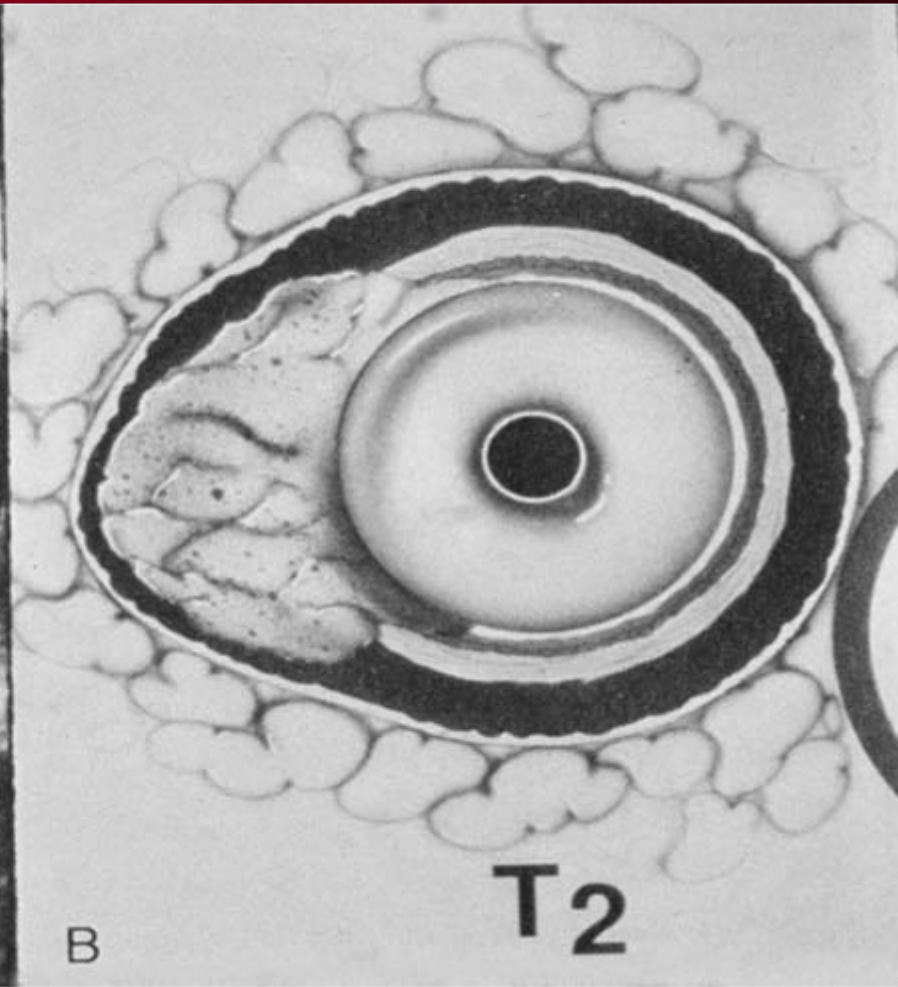
- T<sub>is</sub> Intraepithelial
- T<sub>1</sub> Invades submucosa
- T<sub>2</sub> Invades muscularis propria
- T<sub>3</sub> Invades paraesophageal tissue
- T<sub>4</sub> Invades adjacent organ



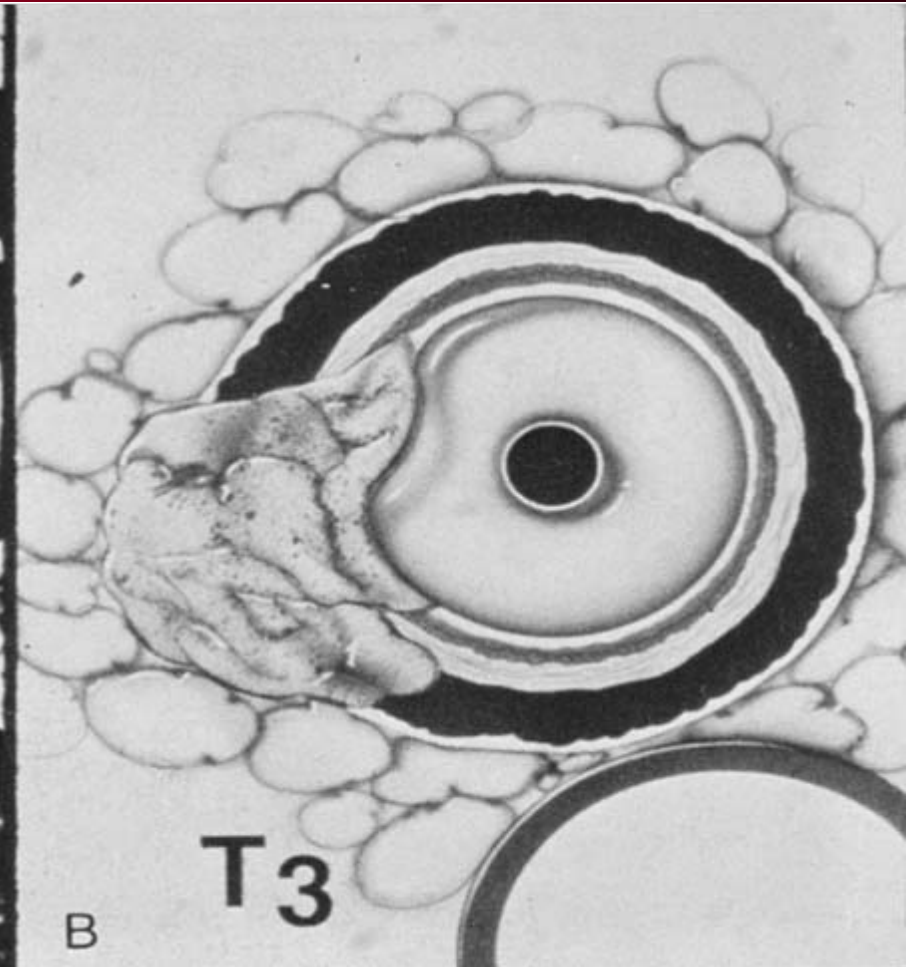
# Endoscopic Ultrasonography (EUS)



# EUS

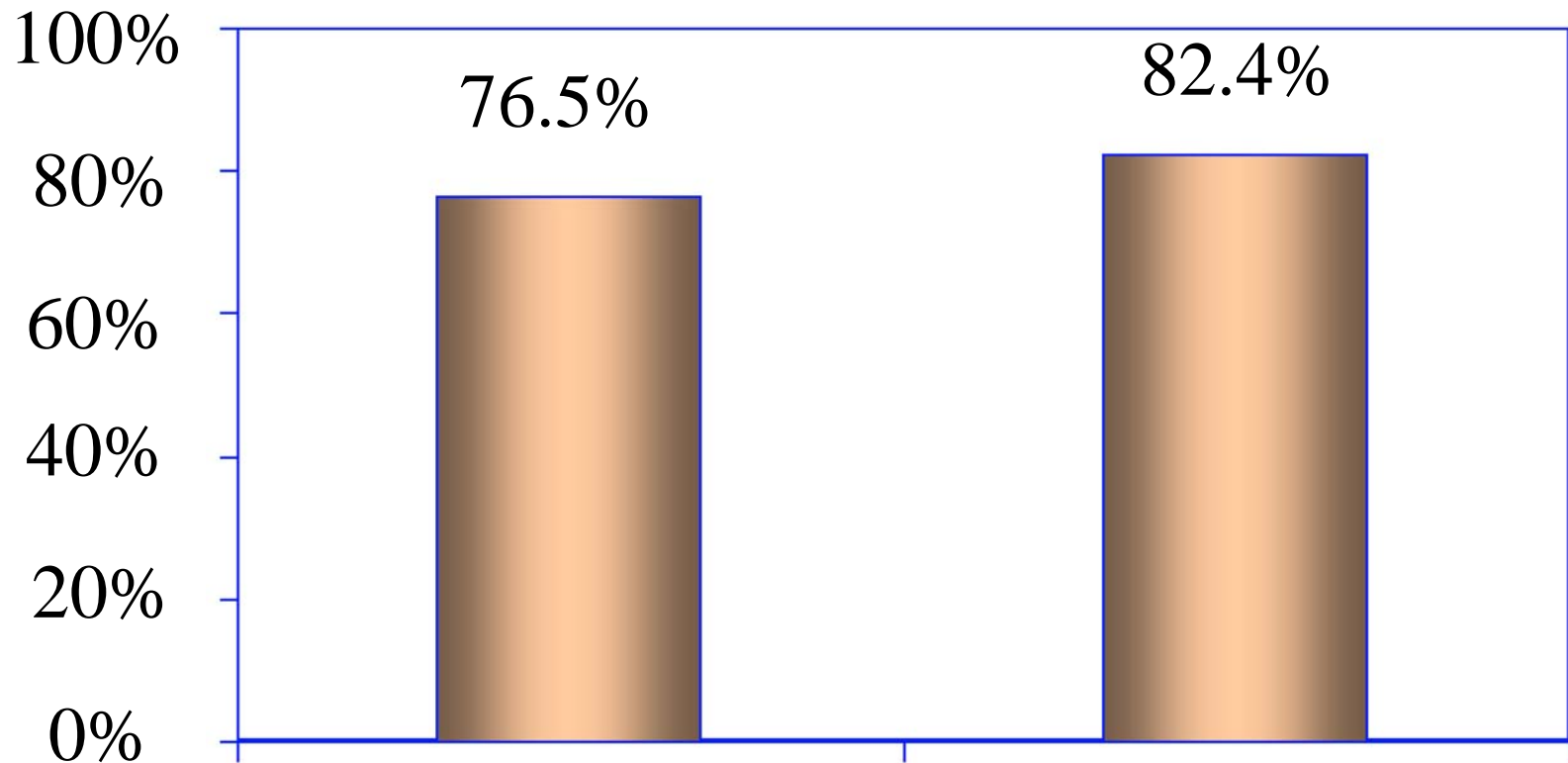


# EUS



# Comparison EUS vs Pathology

Proportion Correctly Predicted by EUS



# Critical Barriers

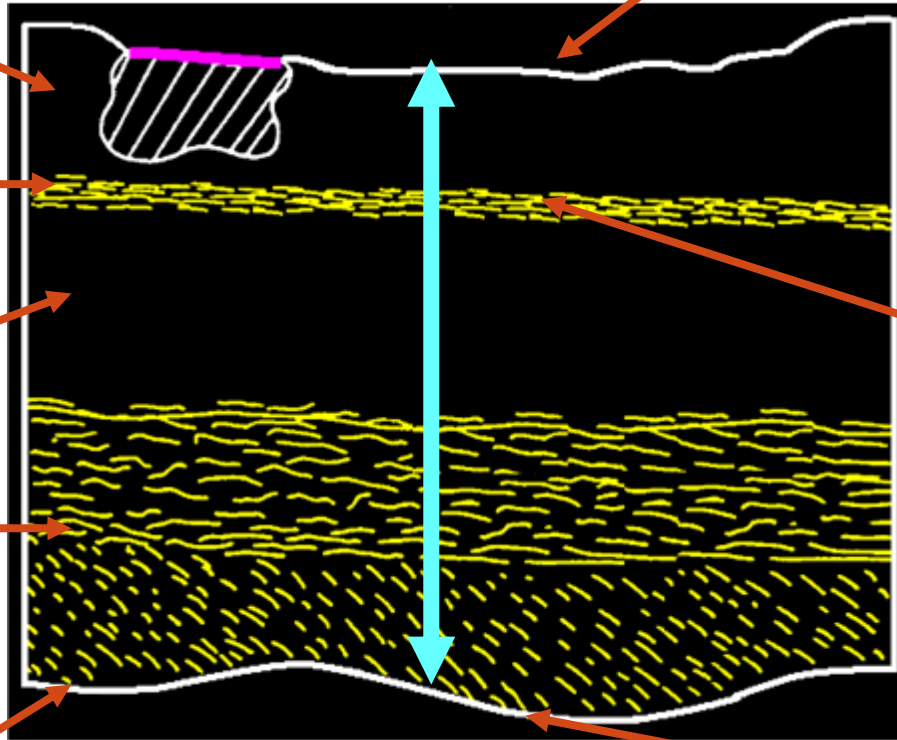
Lamina Propria

Muscularis  
Mucosa

Submucosa

Muscularis  
Propria

Adventitia



0.5-1cm

## Basement Membrane Barrier

Invasive cancer  
Node rarely involved  
Systemic disease rare (< 2%)  
5yr. Survival = 90%

## Muscularis Mucosa Barrier

Nodes likely involved (25%)  
Few in number (0-5)  
Systemic disease possible (17-25%)  
5yr. Survival = 75%

## Adventitial Barrier

Nodes commonly involved (85%)  
Many in number (3-14)  
Systemic disease common (60- 75%)  
5yr. Survival = 30%

## N Stage

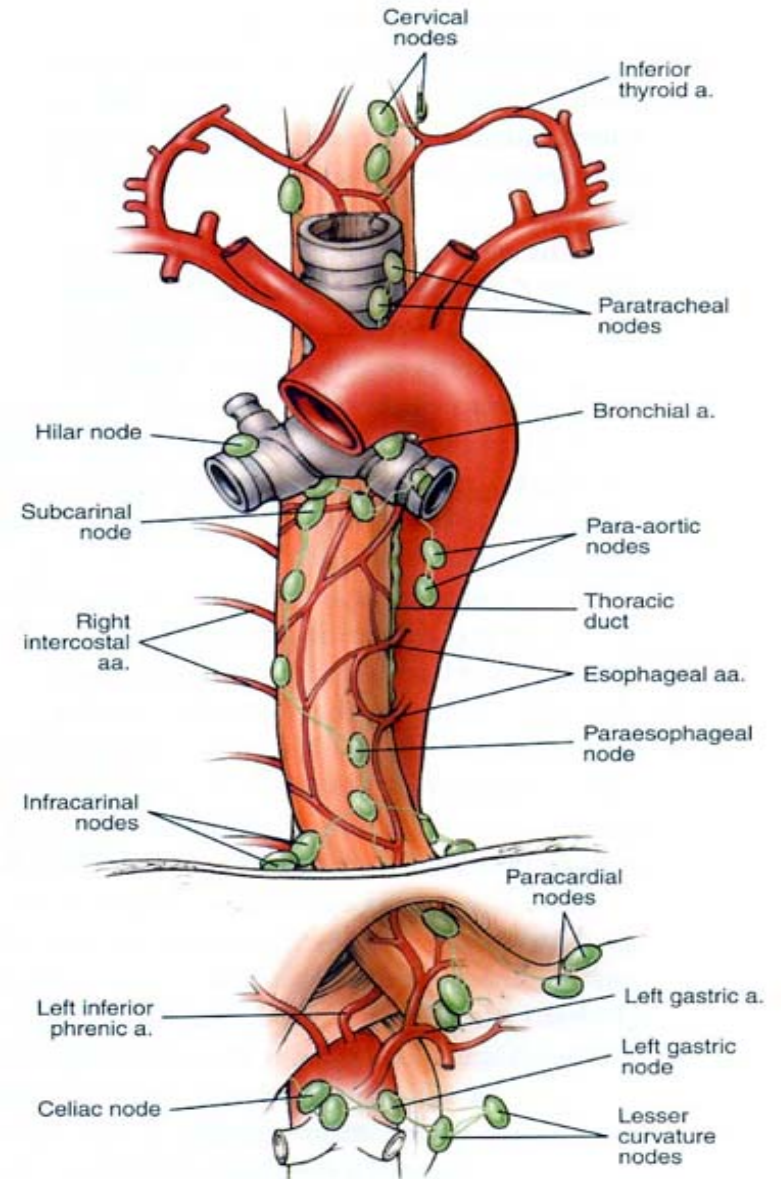
N0 no lymph nodes

N1 1-2 lymph nodes

N2 3-6 lymph nodes

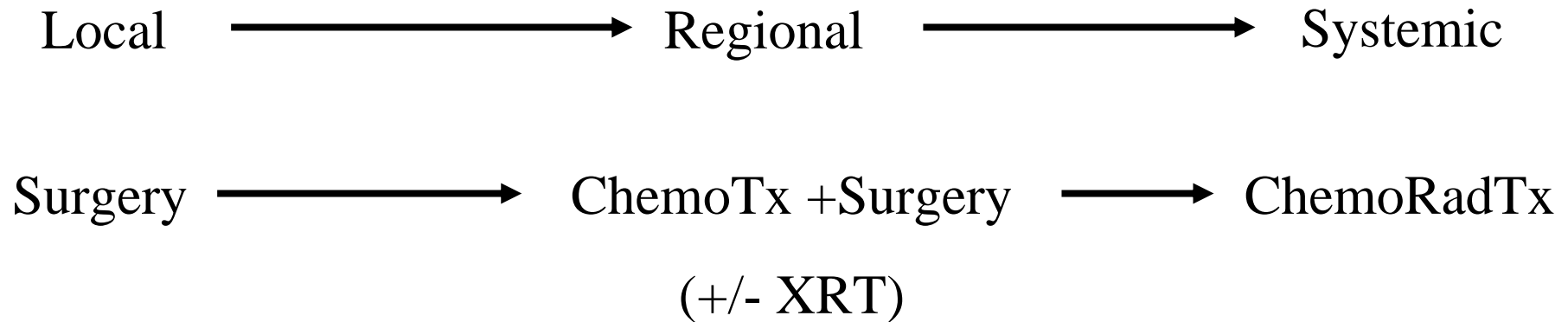
N3 7 or more lymph nodes

## Lymphatic Drainage



# Progression of Carcinoma

## *Implications for Therapy*





# 1913 1<sup>st</sup> Successful Esophagectomy

by Franz John A. Torek



- Transthoracic esophagectomy
- 67-year-old woman who presented with progressive dysphagia and weight loss.

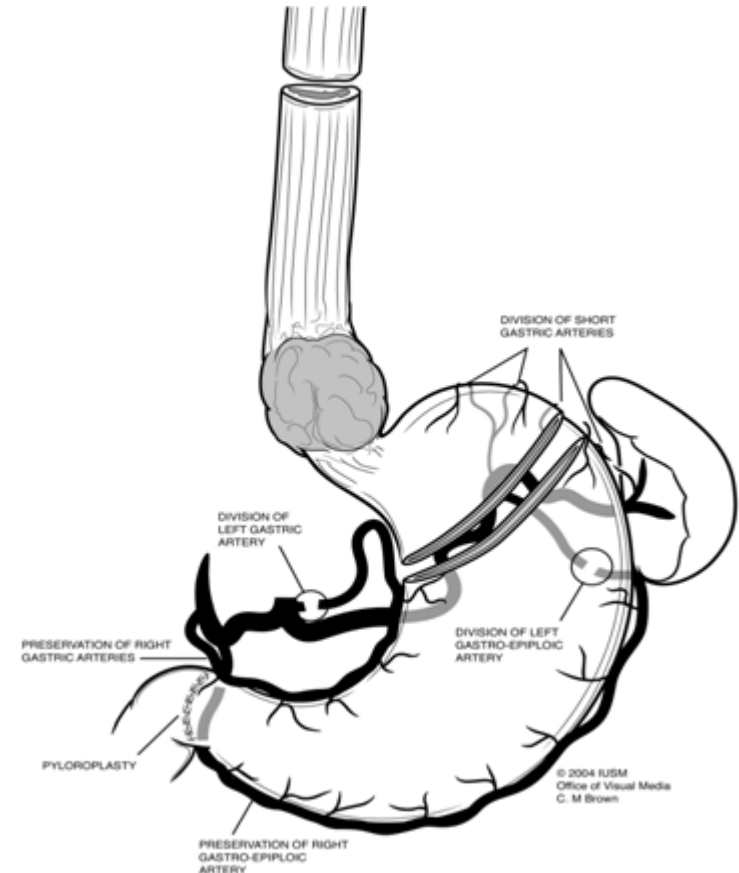
# 1913 1<sup>st</sup> Successful Esophagectomy



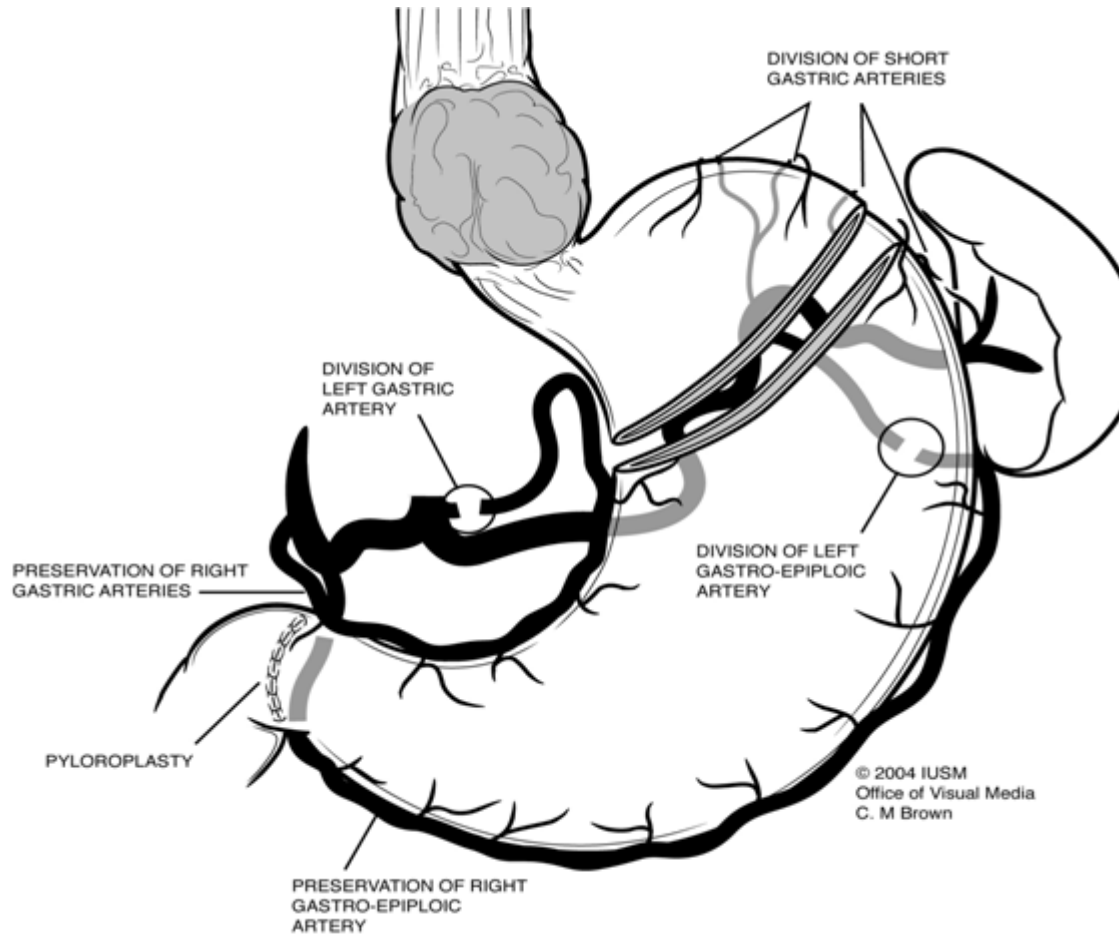
- Patient was fed through the gastrostomy tube for the first 8 post-op days
- Later received nutrition orally.
- Meal passed from the proximal esophageal stoma through an external tube to the gastrostomy
- Patient survived for 12 years

# Surgical Resection

- Prepare conduit - stomach
- Mobilize esophagus
- Divide esophagus proximally and stomach distally
- 5cm margins
- Anastomosis between esophagus and stomach
- Pyloroplasty



# Anatomy/Vascular supply



# Esophagectomy Options

*Less  
invasive*



*More  
Invasive*

- “Minimally invasive” esophagectomy
- Transhiatal esophagectomy
- Ivor Lewis Esophagectomy  
Right thoracotomy, laparotomy, intrathoracic esophagogastrostomy
- 3 hole esophagectomy  
Right thoracotomy, laparotomy, cervical esophagogastrostomy
- Radical (en bloc) esophagectomy
  - with 2-field lymphadenectomy
  - with 3-field lymphadenectomy

# Transhiatal Esophagectomy

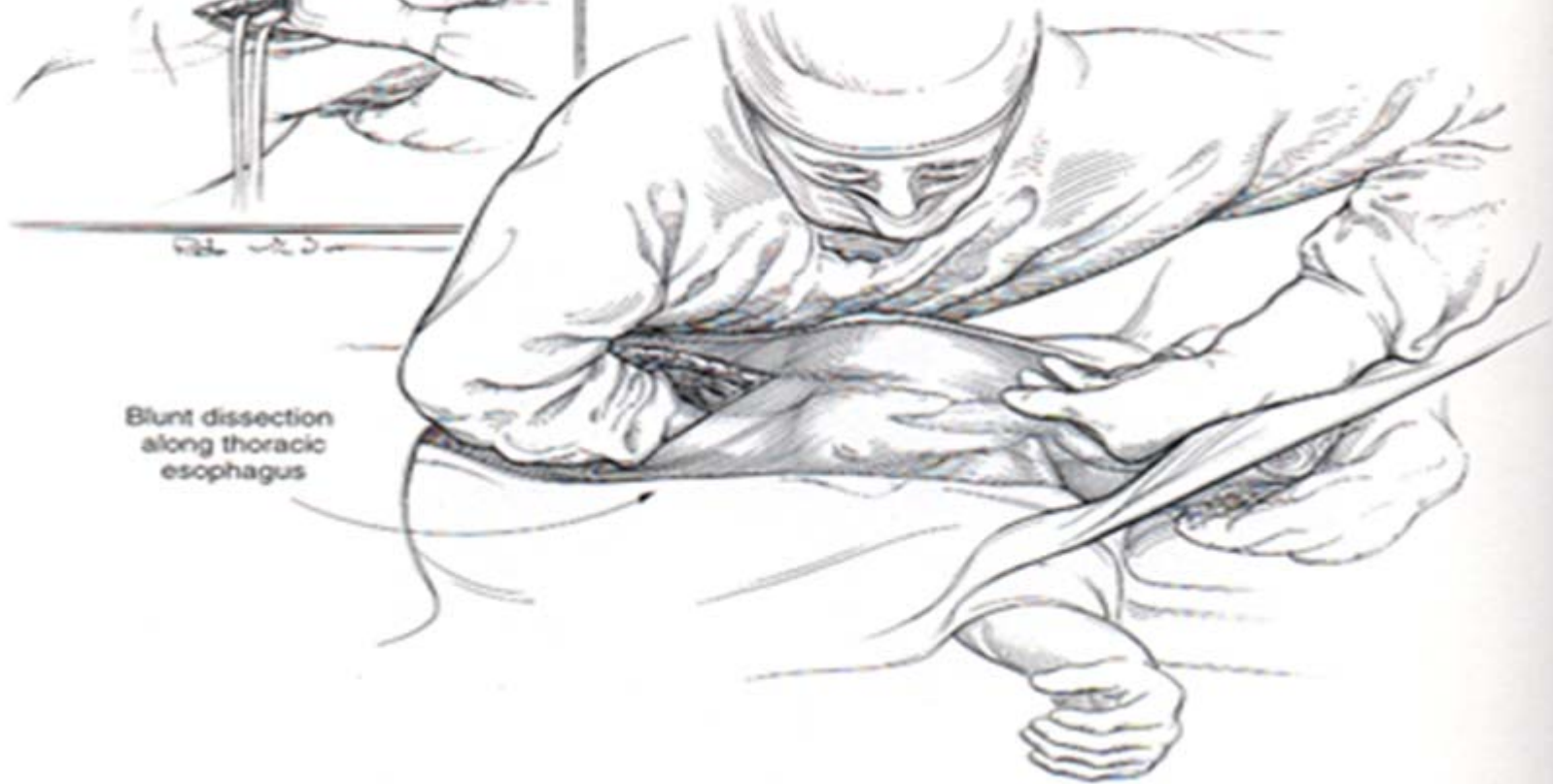


# Transhiatal Esophagectomy

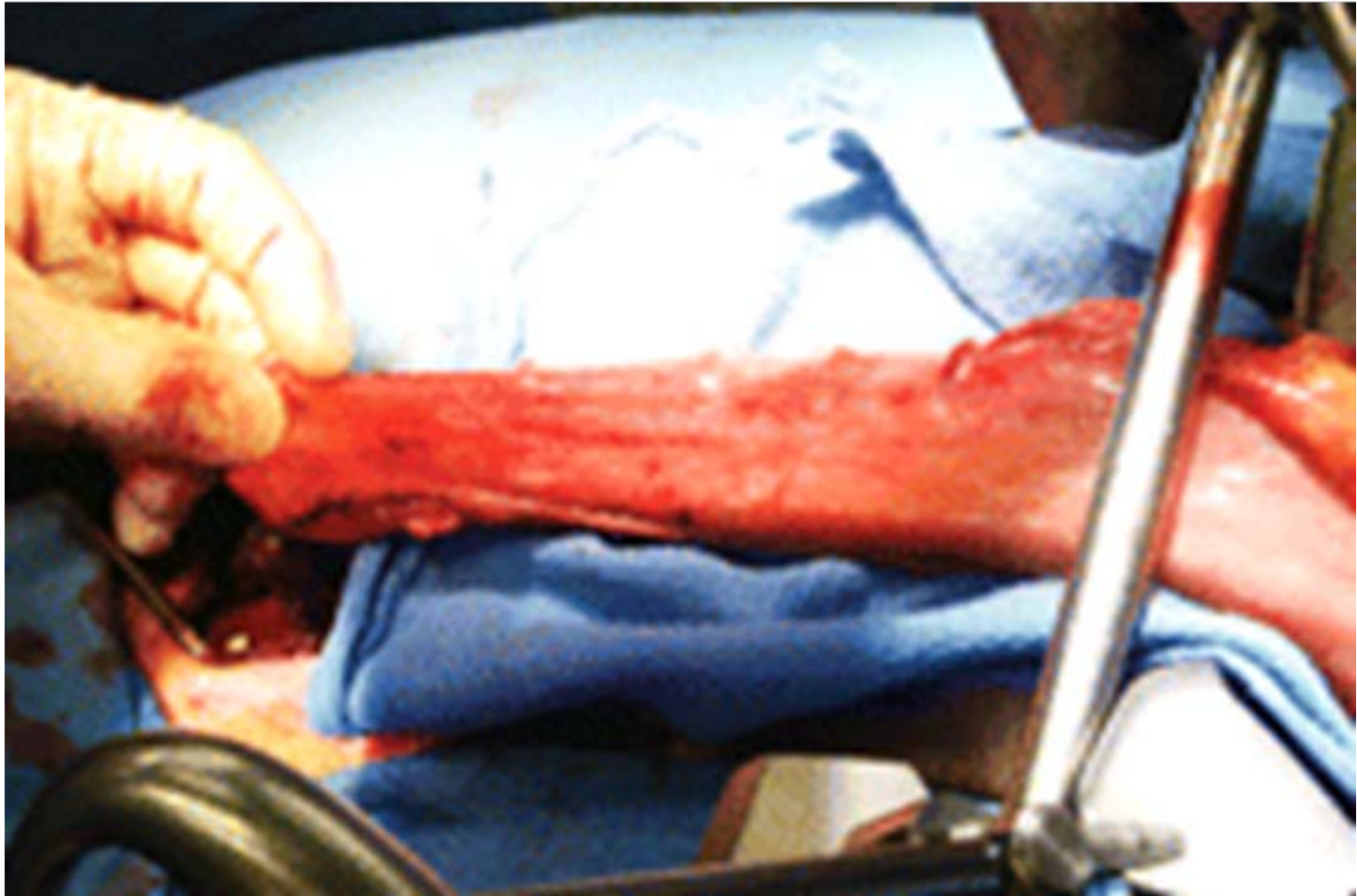
Blunt dissection around cervical esophagus



Blunt dissection along thoracic esophagus



# Gastric conduit





# Transhiatal Esophagectomy

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- Advantages
  - Avoid thoracotomy
  - Cervical anastomosis
- Disadvantages
  - Blind mediastinal dissection
  - Less accurate staging
  - Inferior treatment/less lymphadenectomy

# Ivor Lewis Esophagectomy



# Transthoracic (Ivor Lewis)

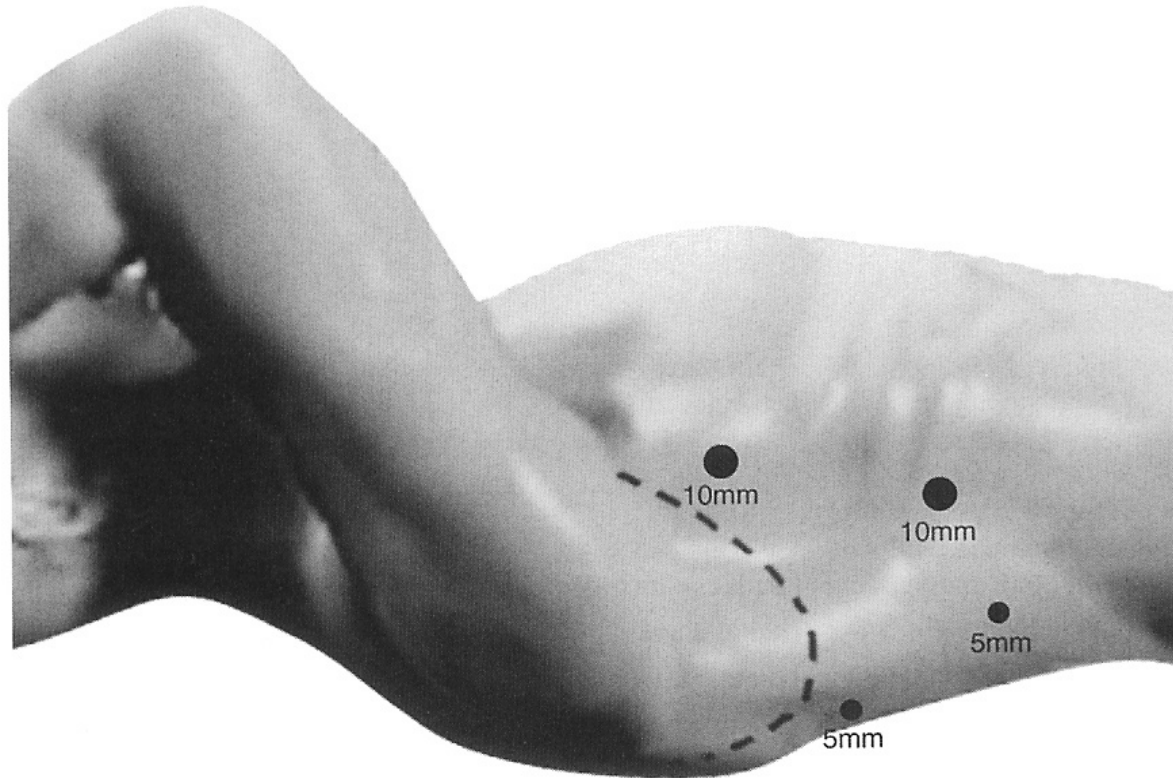
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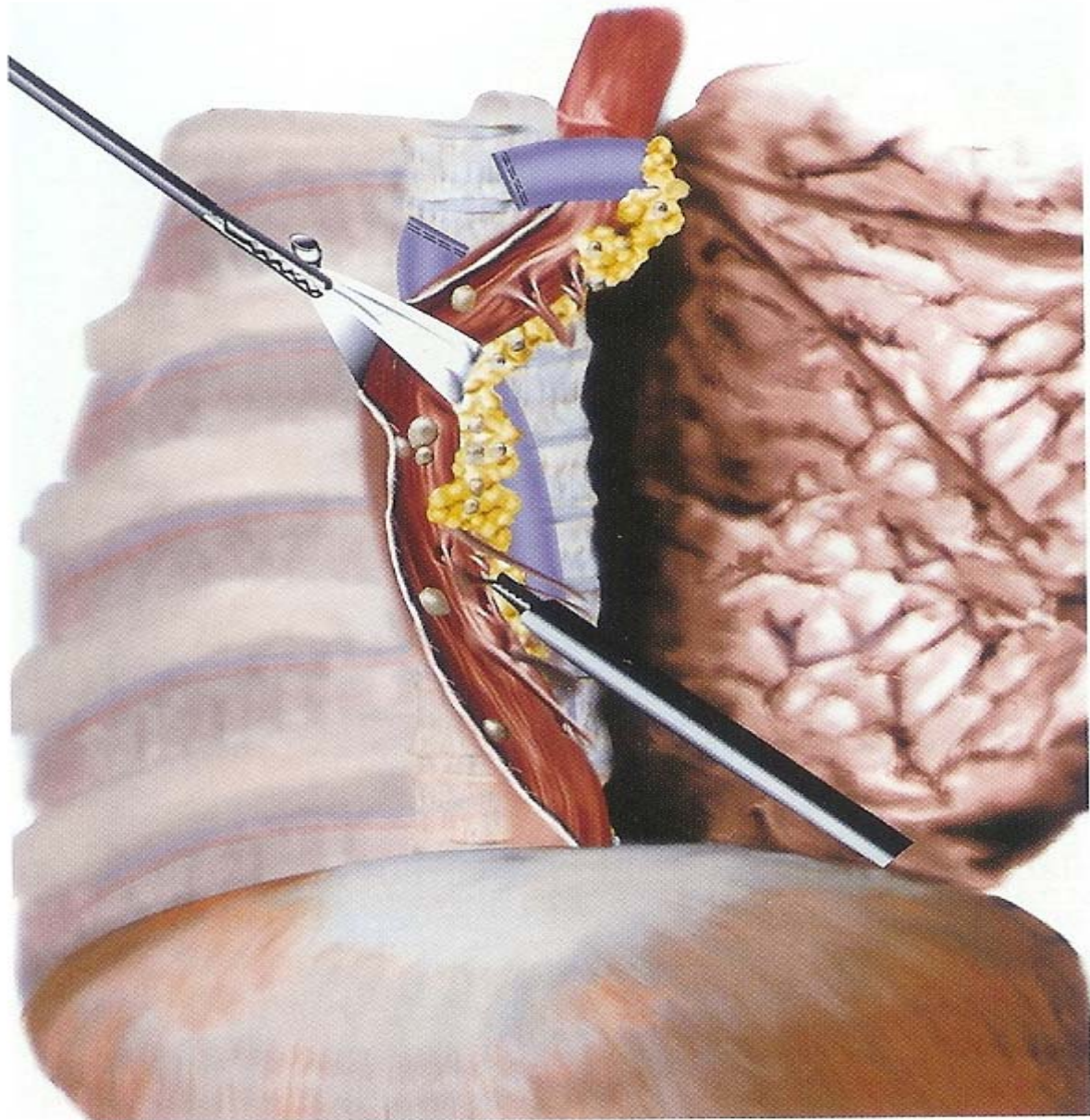
- Advantages
  - Complete 2 – field lymphadenectomy
  - Less risk of blind mediastinal dissection
- Disadvantages
  - Increased morbidity of thoracotomy
  - Intrathoracic leak has higher morbidity

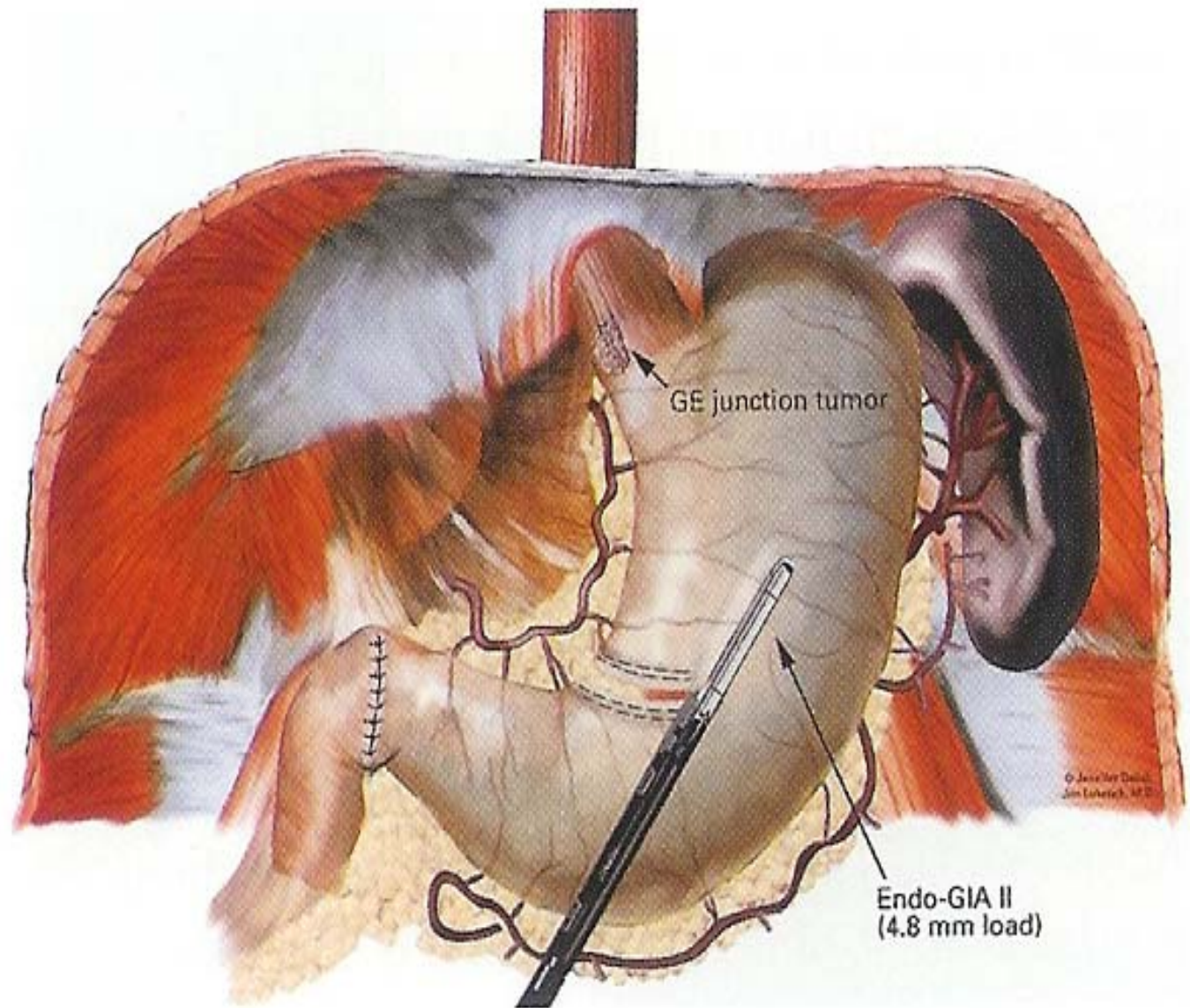
# 3-hole Esophagectomy

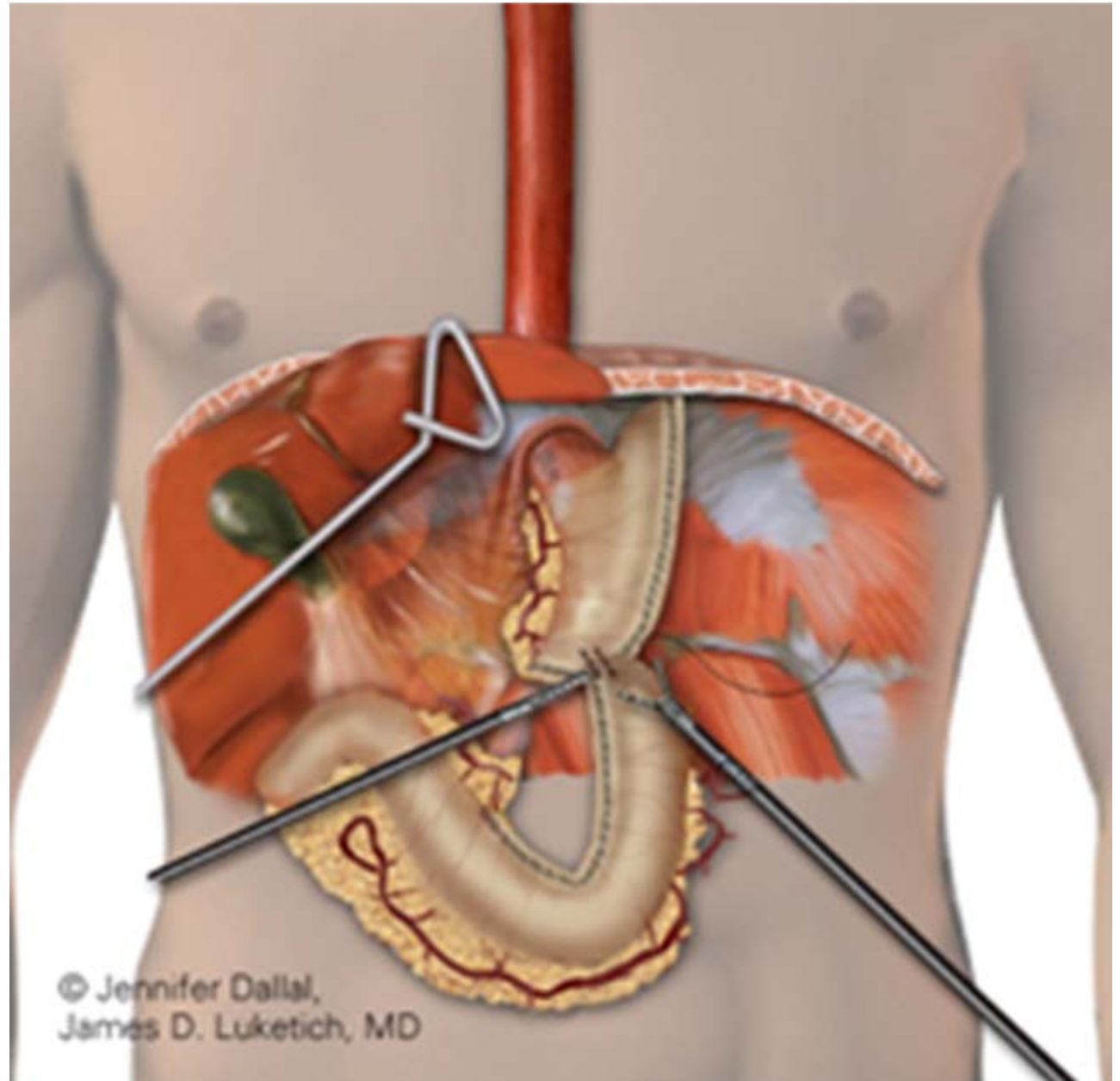


# MIE





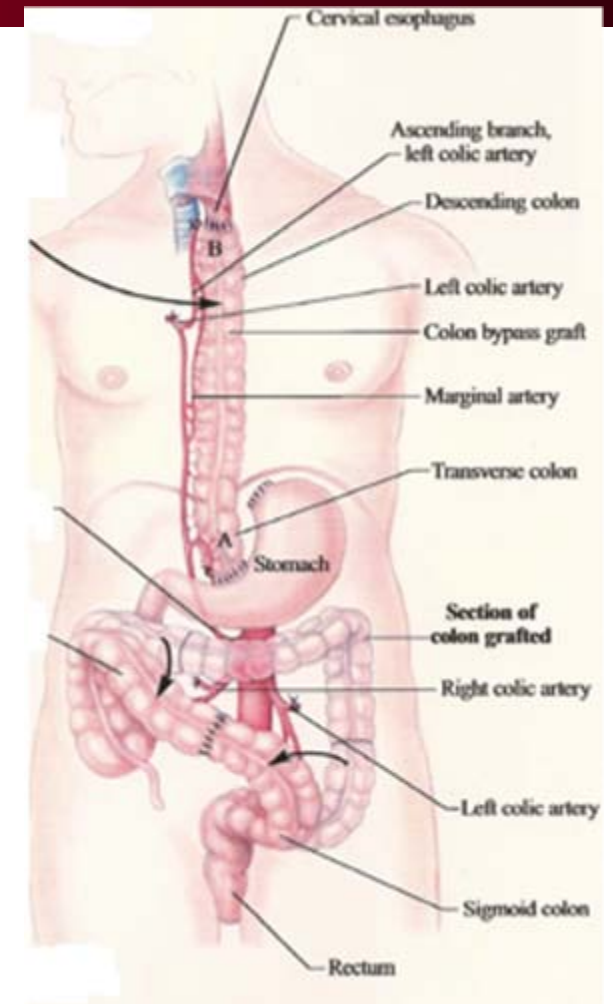
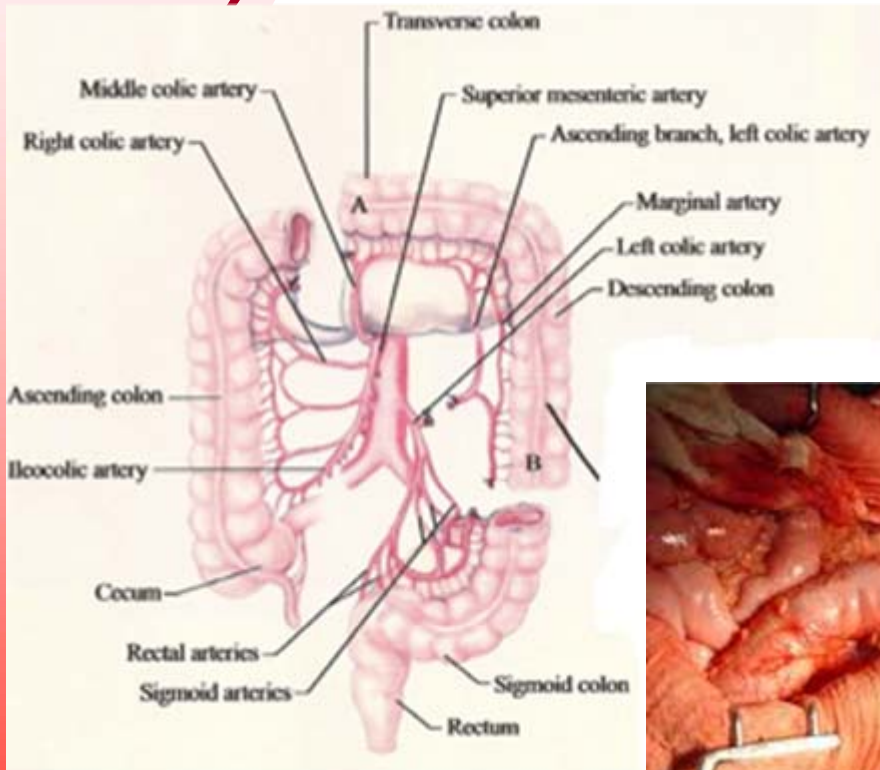








# Colon interposition



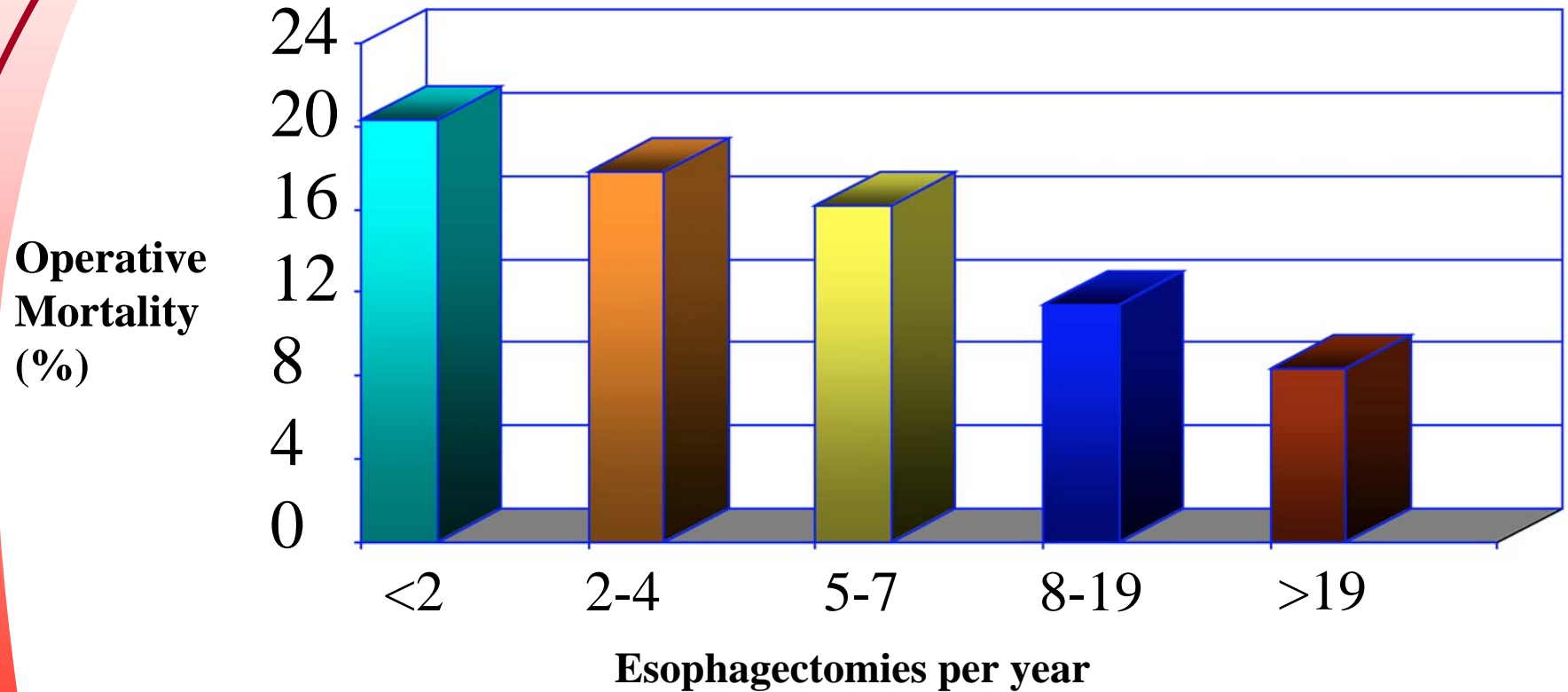
# Surgical Resection Complications

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- Anastomotic leak
- Pulmonary complications
- Chylothorax
- Recurrent laryngeal nerve injury
- Airway injury

# Esophagectomy Mortality Based on Hospital Volume

*Medicare Data, 1994-1999*



Birkmeyer JD, *et al.* NEJM 2002;346:1128-1137.

# Mortality After Esophagectomy for Cancer at U.S. Specialty Centers

<b>Institution</b>	<b>Resection Type*</b>	<b>Year</b>	<b>N</b>	<b>Mortality (%)</b>
<b>Brigham</b>	<b>TTE</b>	<b>2001</b>	<b>250</b>	<b>3.6</b>
<b>Cornell</b>	<b>3-field en bloc</b>	<b>2002</b>	<b>80</b>	<b>5</b>
<b>USC</b>	<b>THE/TTE/en bloc</b>	<b>2004</b>	<b>263</b>	<b>4.5</b>
<b>University of Rochester</b>	<b>THE/TTE</b>	<b>2008</b>	<b>258</b>	<b>2.7</b>

\*THE-Transhiatal esophagectomy; TTE-Transthoracic esophagectomy;

# Mortality following esophagectomy

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- The perception: **High**
- The reality: **Not in experienced hands**  
**Not in the right patient population**

# Evolution in Resection for Early Esophageal Neoplasia

*Emphasis on Decreased Morbidity and Improved Quality of Life*

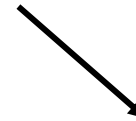
Transthoracic esophagectomy (TTE)



Transhiatal esophagectomy (THE)



Minimally invasive  
esophagectomy (MIE)



Endoscopic resection (ER)

(and ablation)

# Methods to Eliminate Esophageal Mucosa

“Burn it”

- Thermal
  - MPEC
  - APC
  - Nd:YAG laser
  - RF ablation (BarrX)

“Freeze it”

- Cryotherapy

“Laser it”

- PDT (photodynamic therapy)

“Resect it”

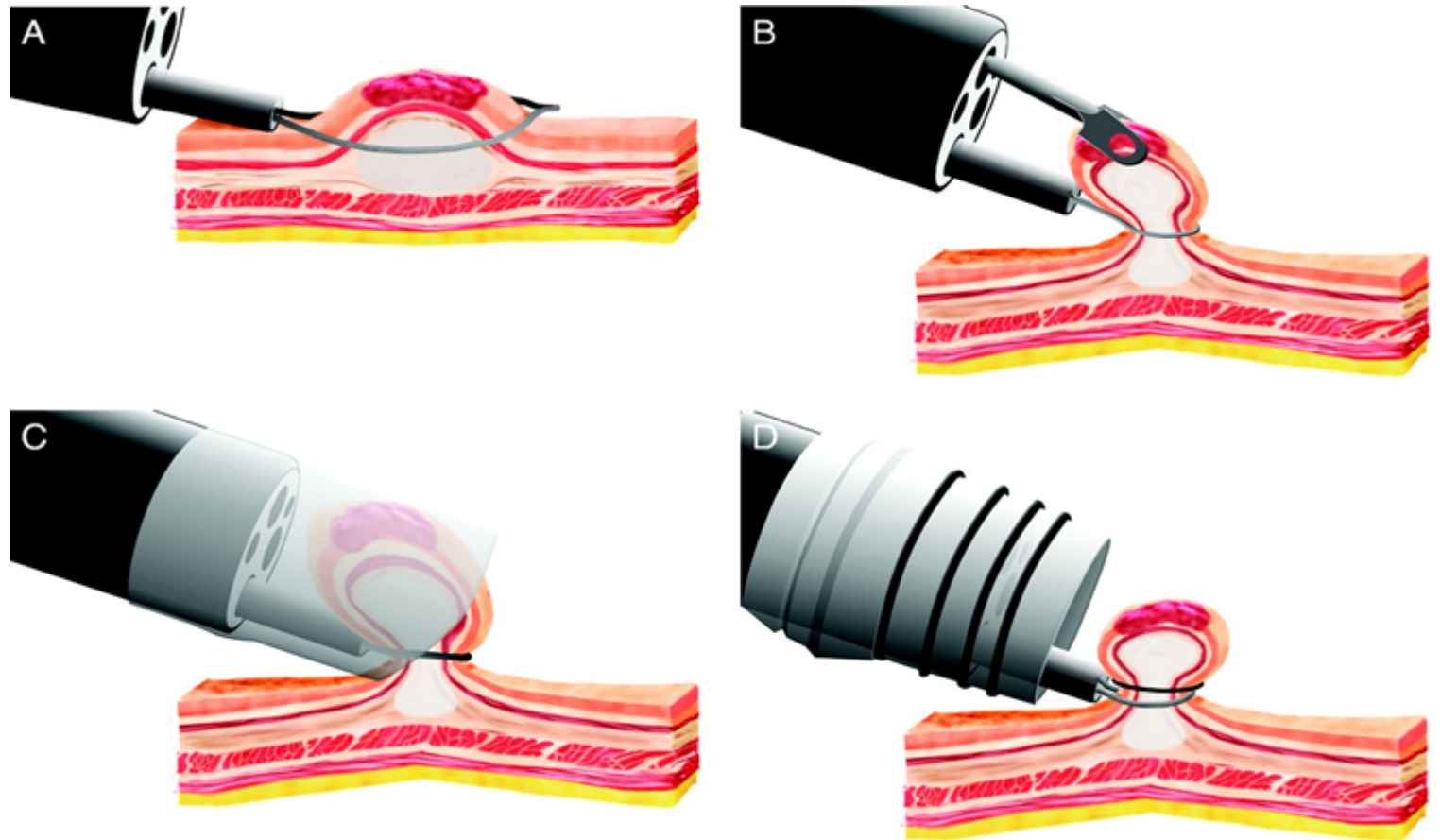
- Mucosectomy
  - Endoscopic
  - Surgical

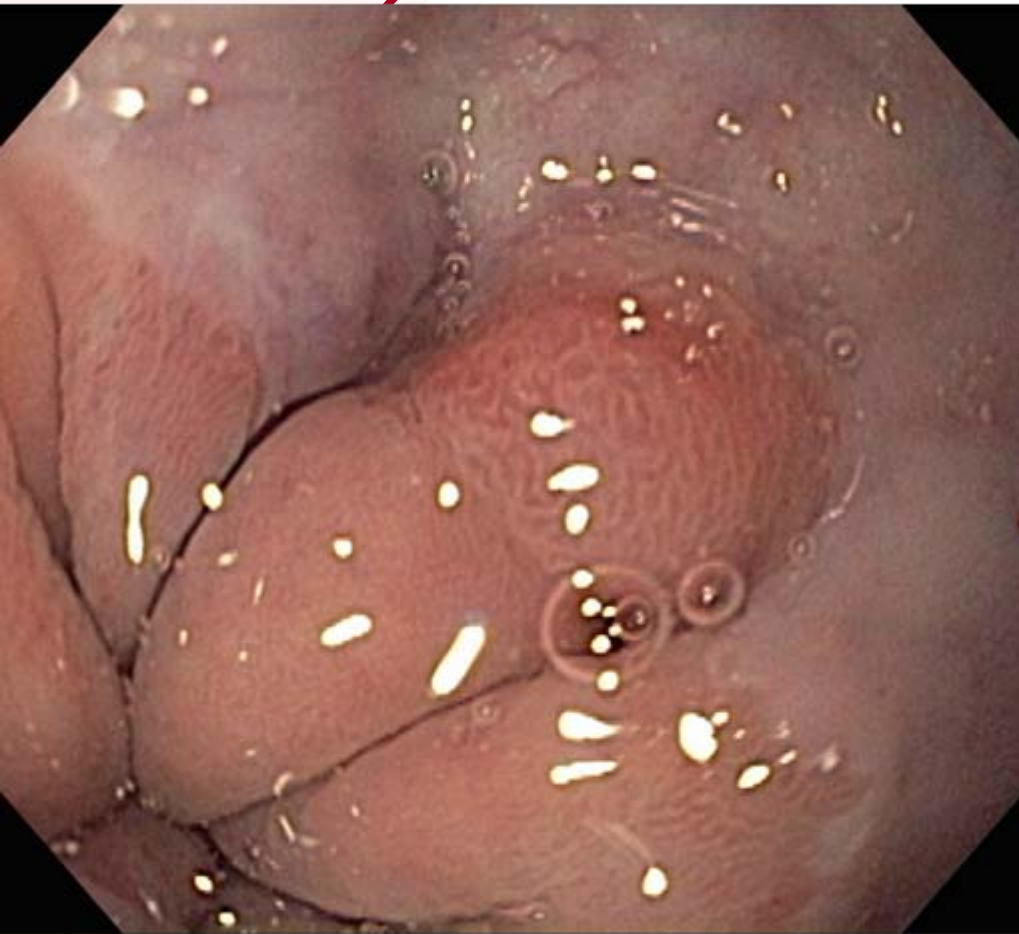


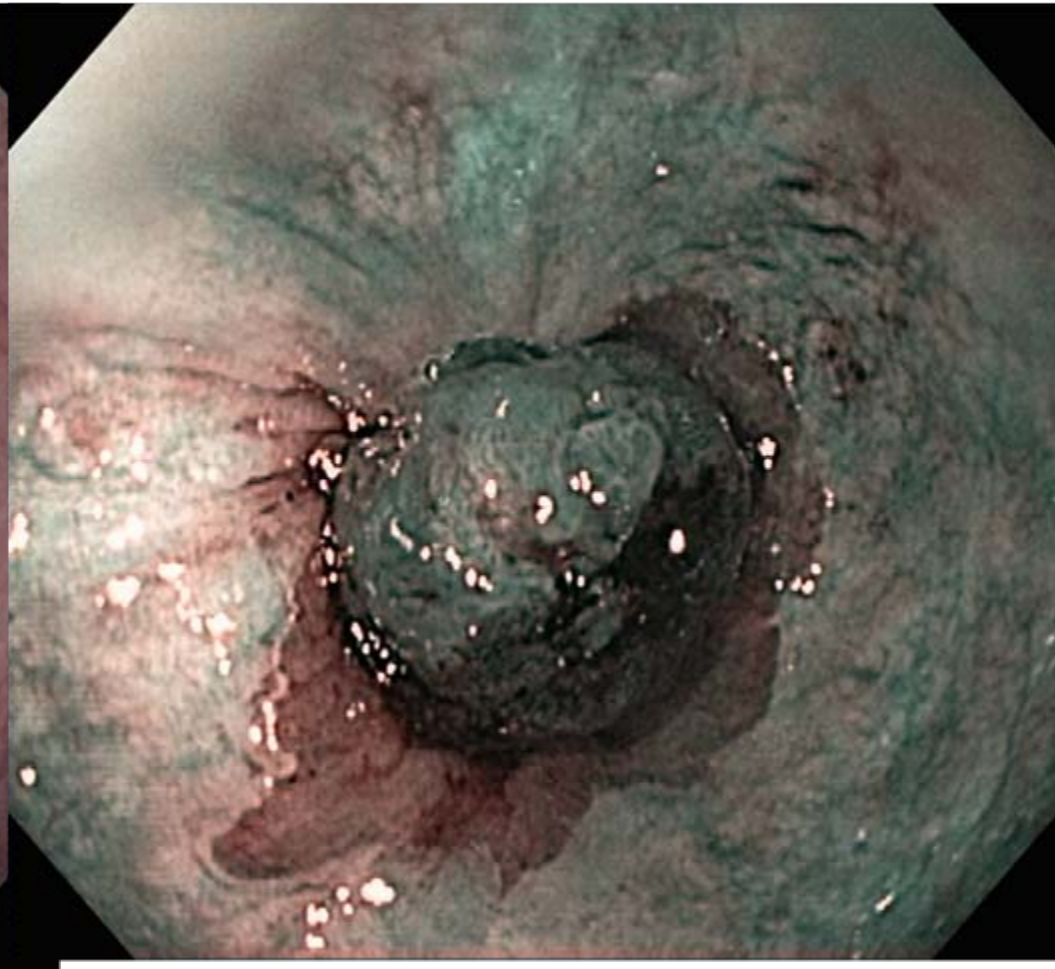
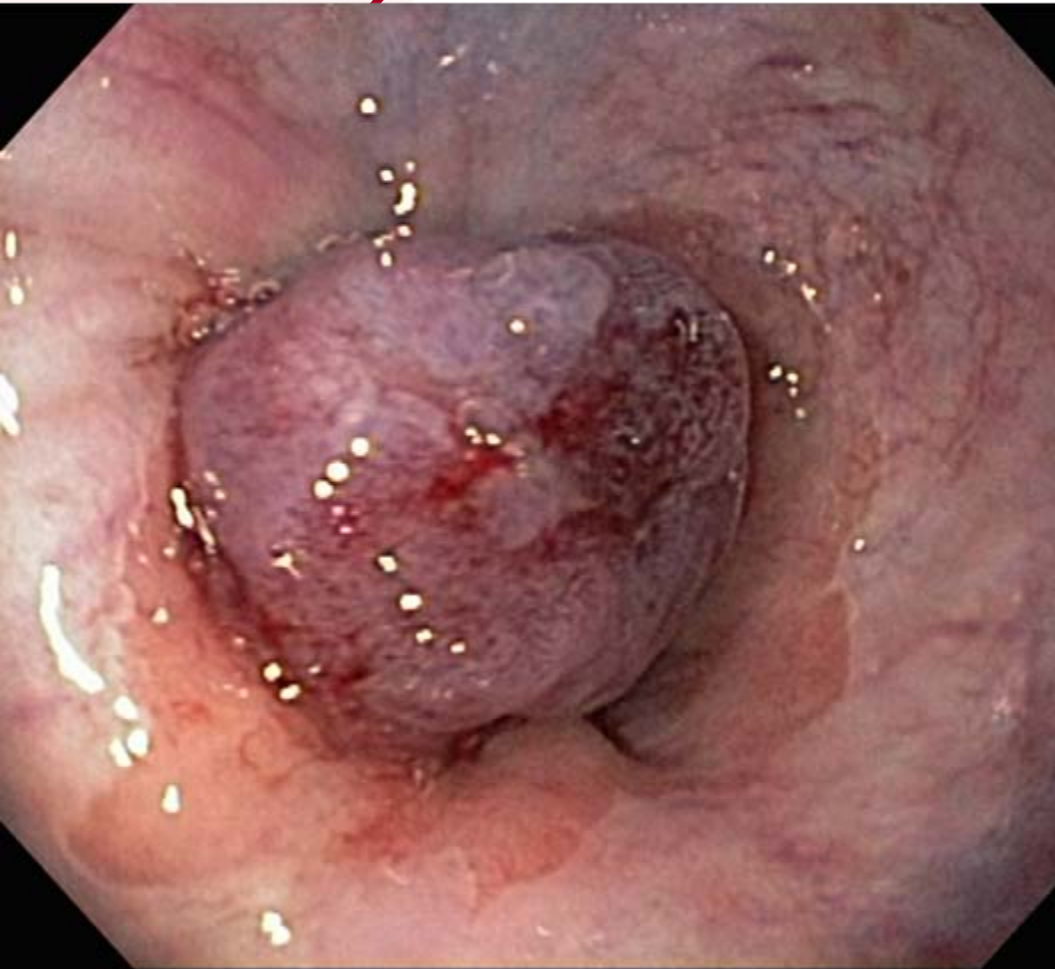
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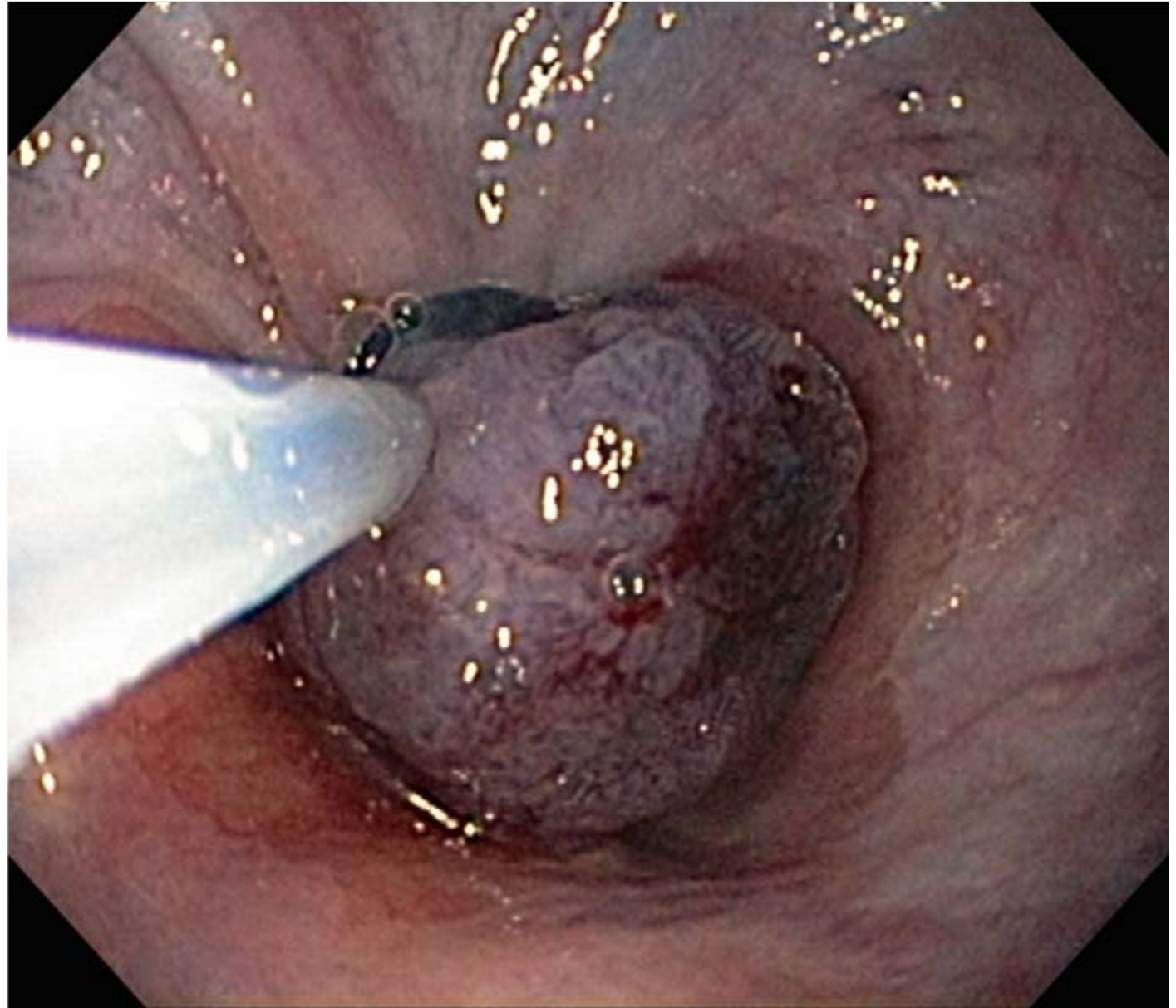
# I. Endoscopic Mucosal Resection (EMR)

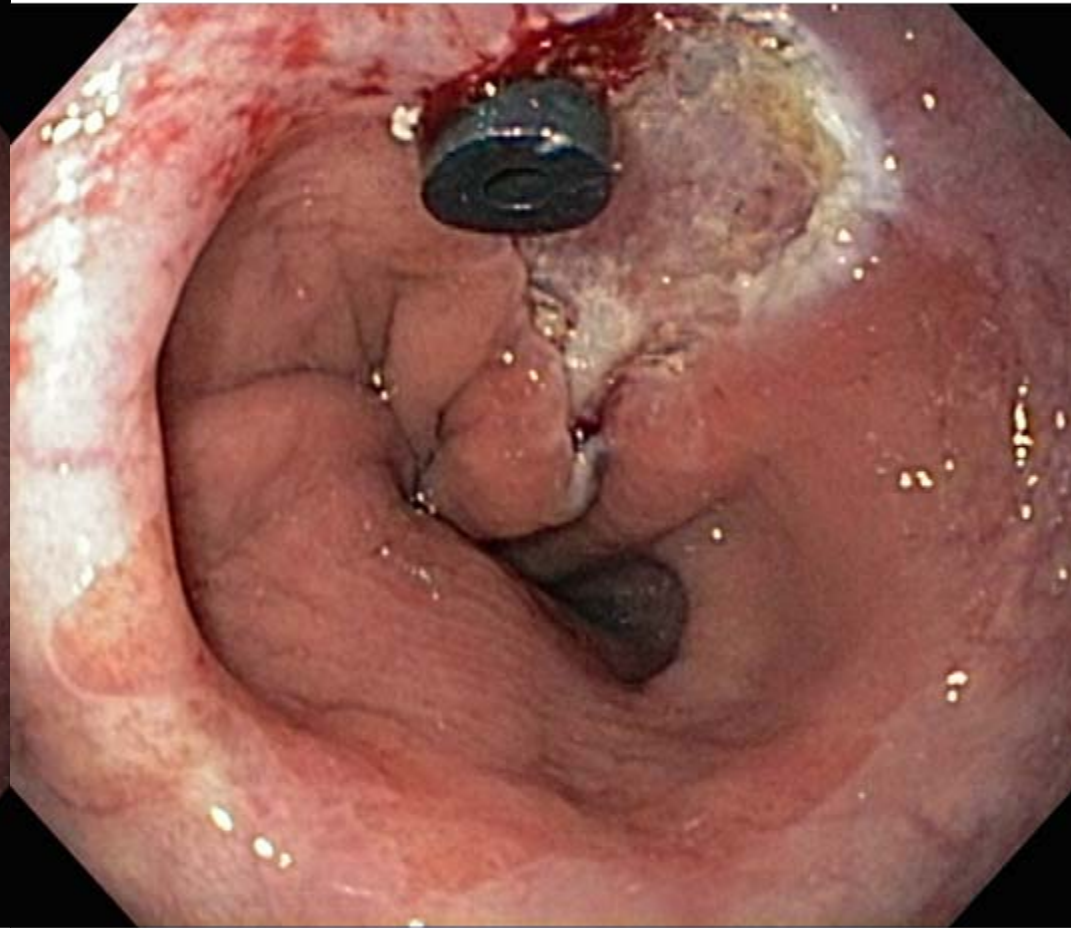
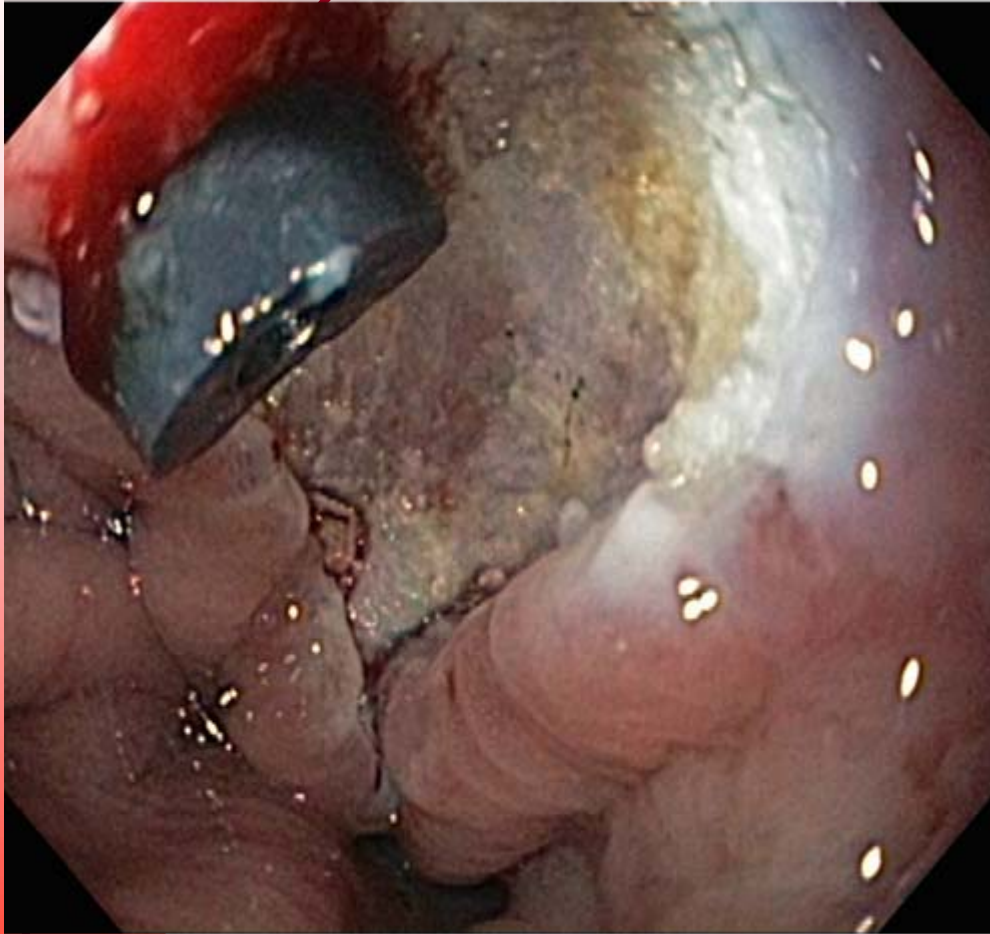
# Techniques of EMR











# Risks of EMR

- 1) **Procedural Complications**
  - Perforation
  - Stricture
  - Bleeding
- 2) **Inadequate Treatment**
  - Positive margins (deep or lateral)
  - Untreated synchronous lesions
  - Associated nodal disease

## II. Radiofrequency Ablation of Barrett's Esophagus

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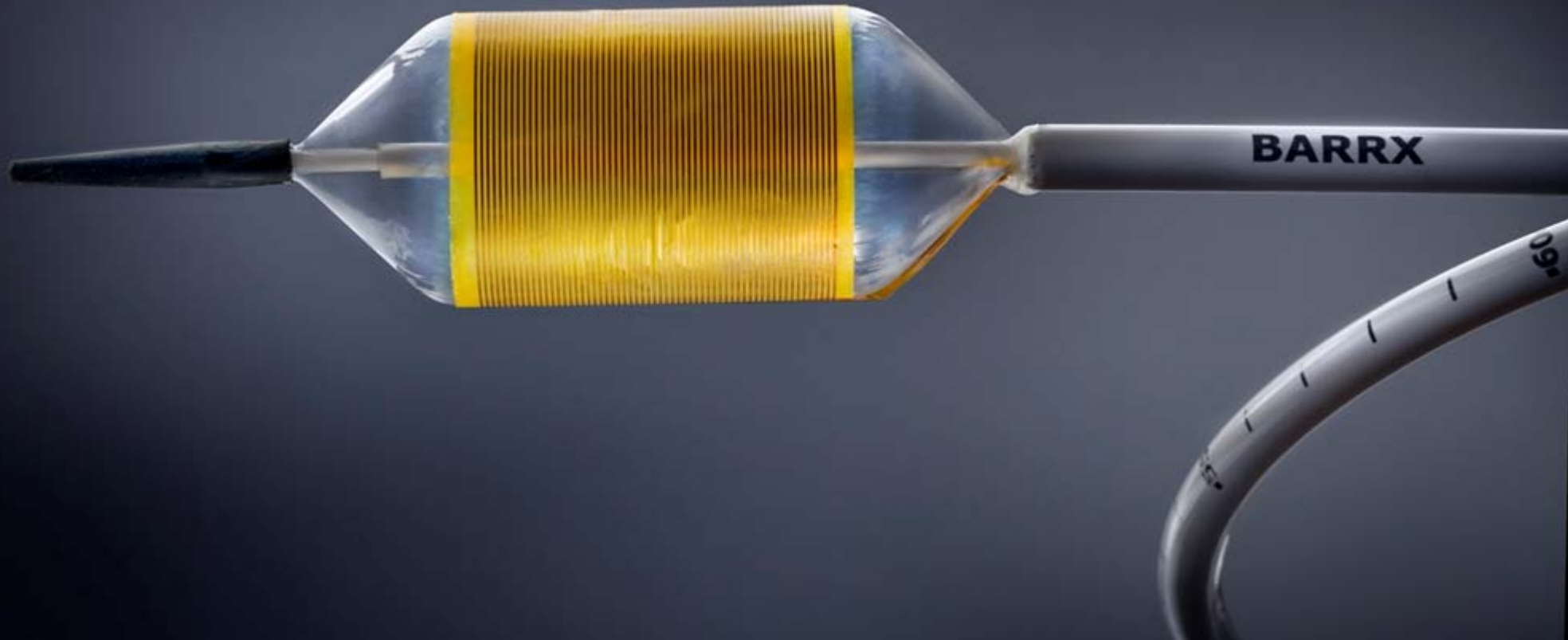
- HALO<sup>360</sup> and HALO<sup>90</sup> systems  
(BÂRRX Medical)



# HALO RF Energy Generator



# HALO<sup>360</sup> Ablation Catheter



# HALO<sup>90</sup>

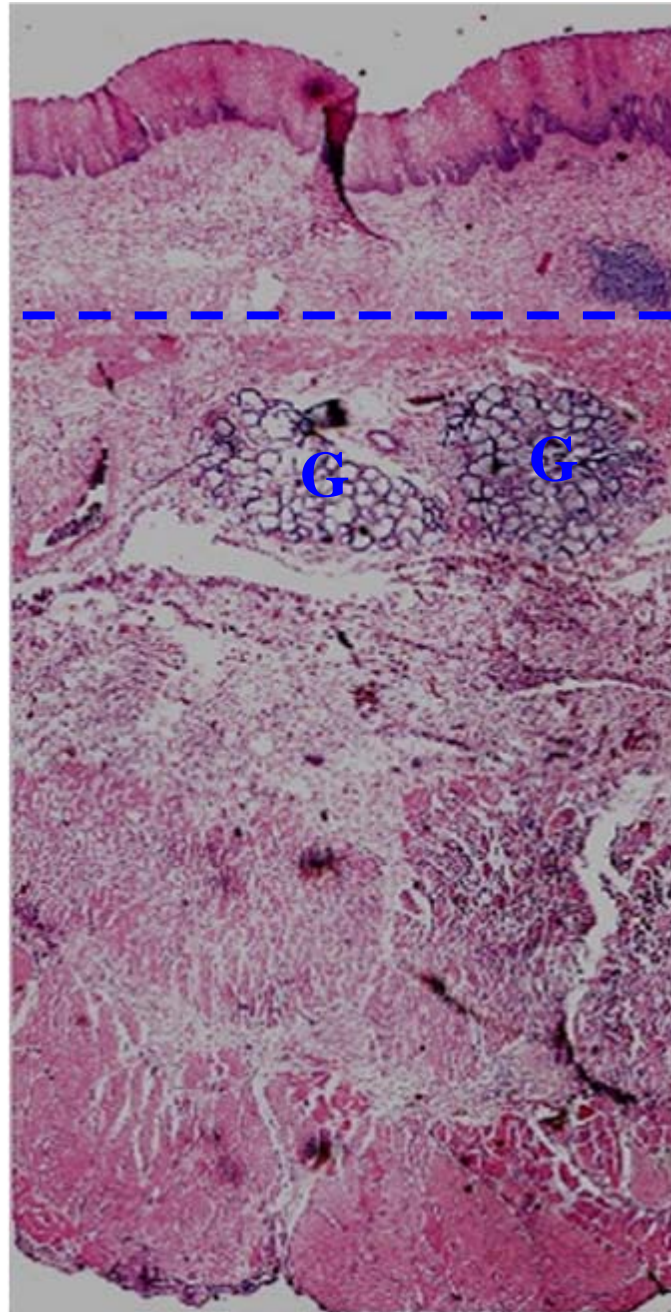


**Ablation Target**

**Muscularis mucosae  
(Ablation Target Depth)**

**Submucosa with  
esophageal glands**

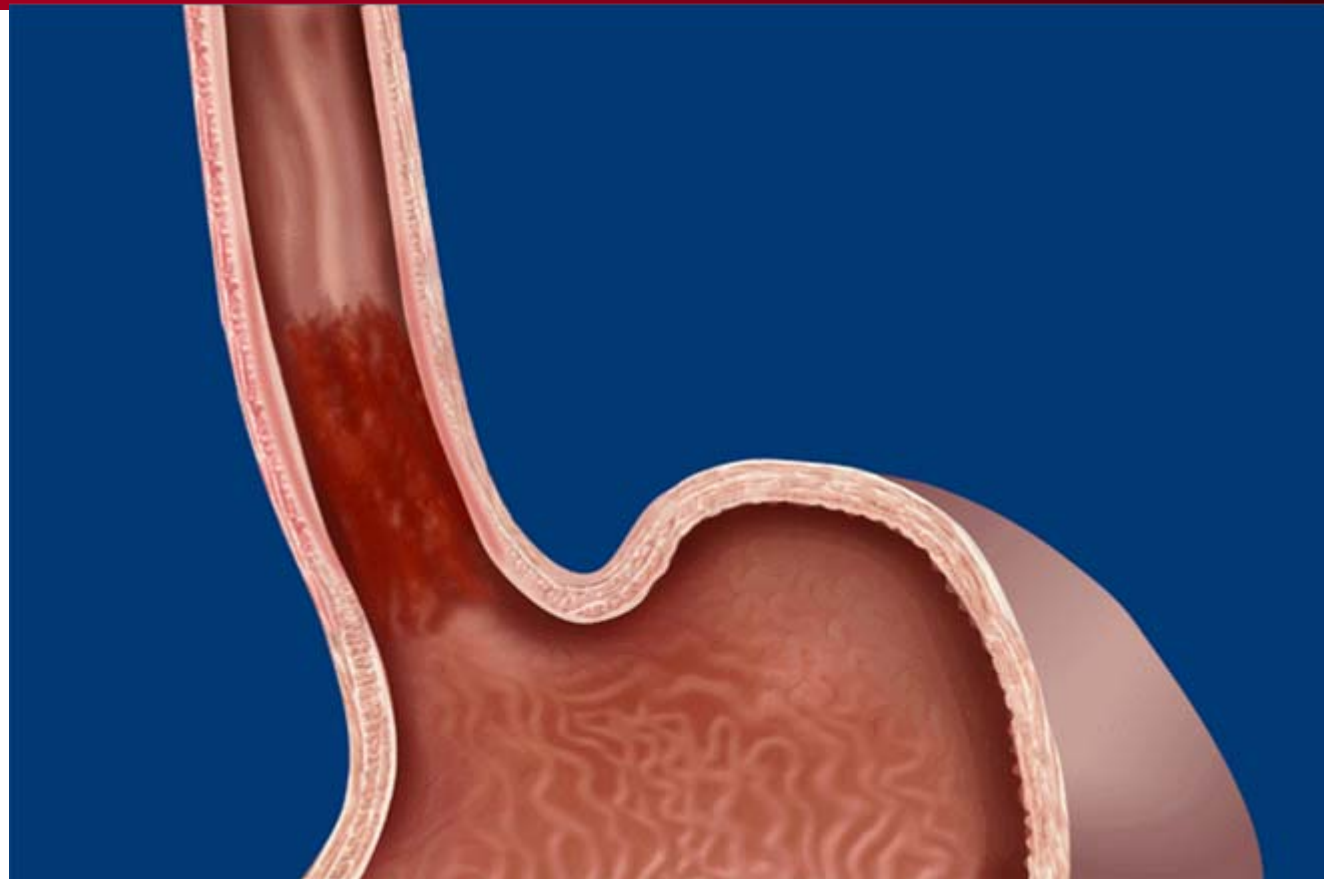
**Muscularis propria**

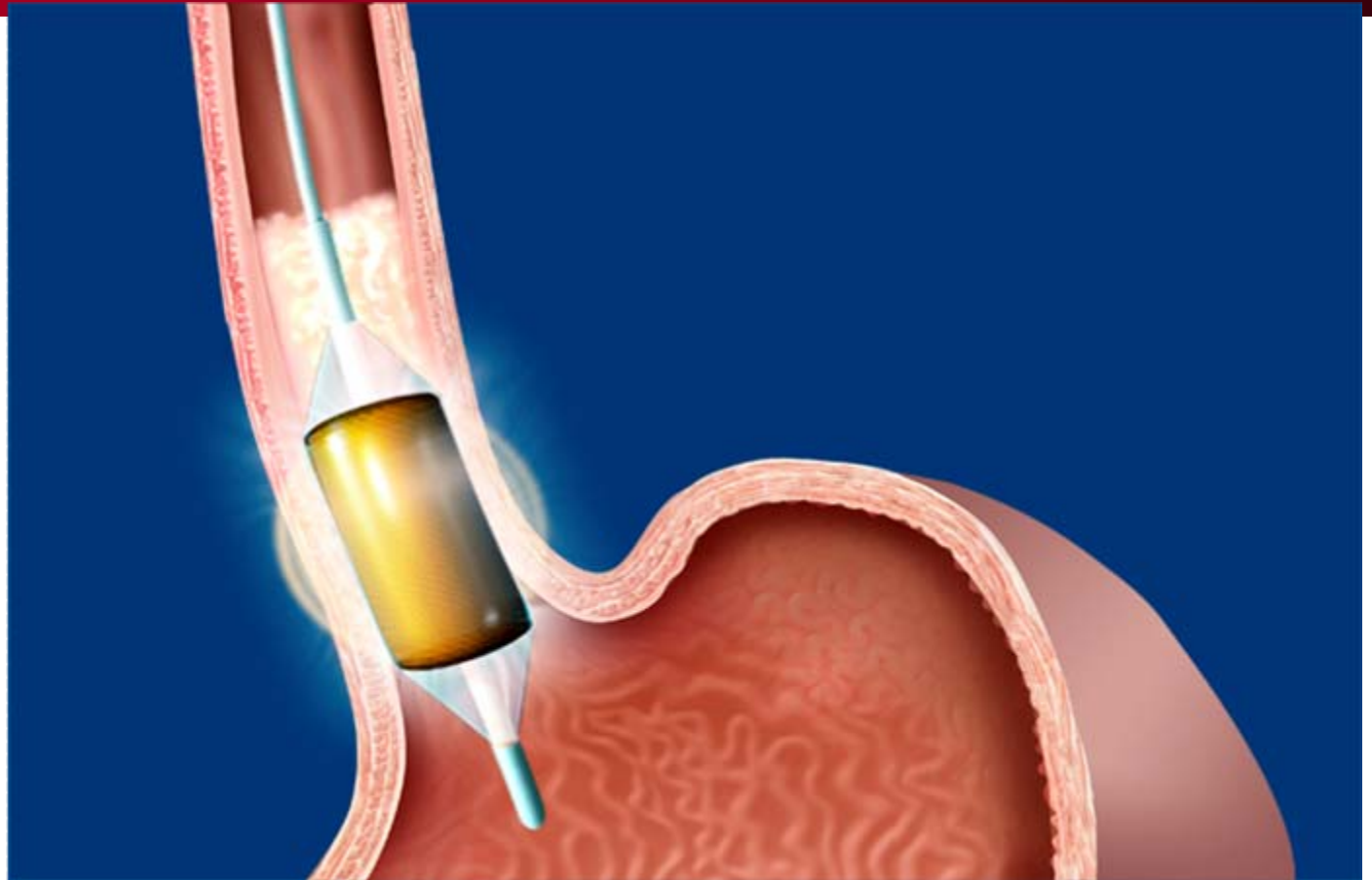


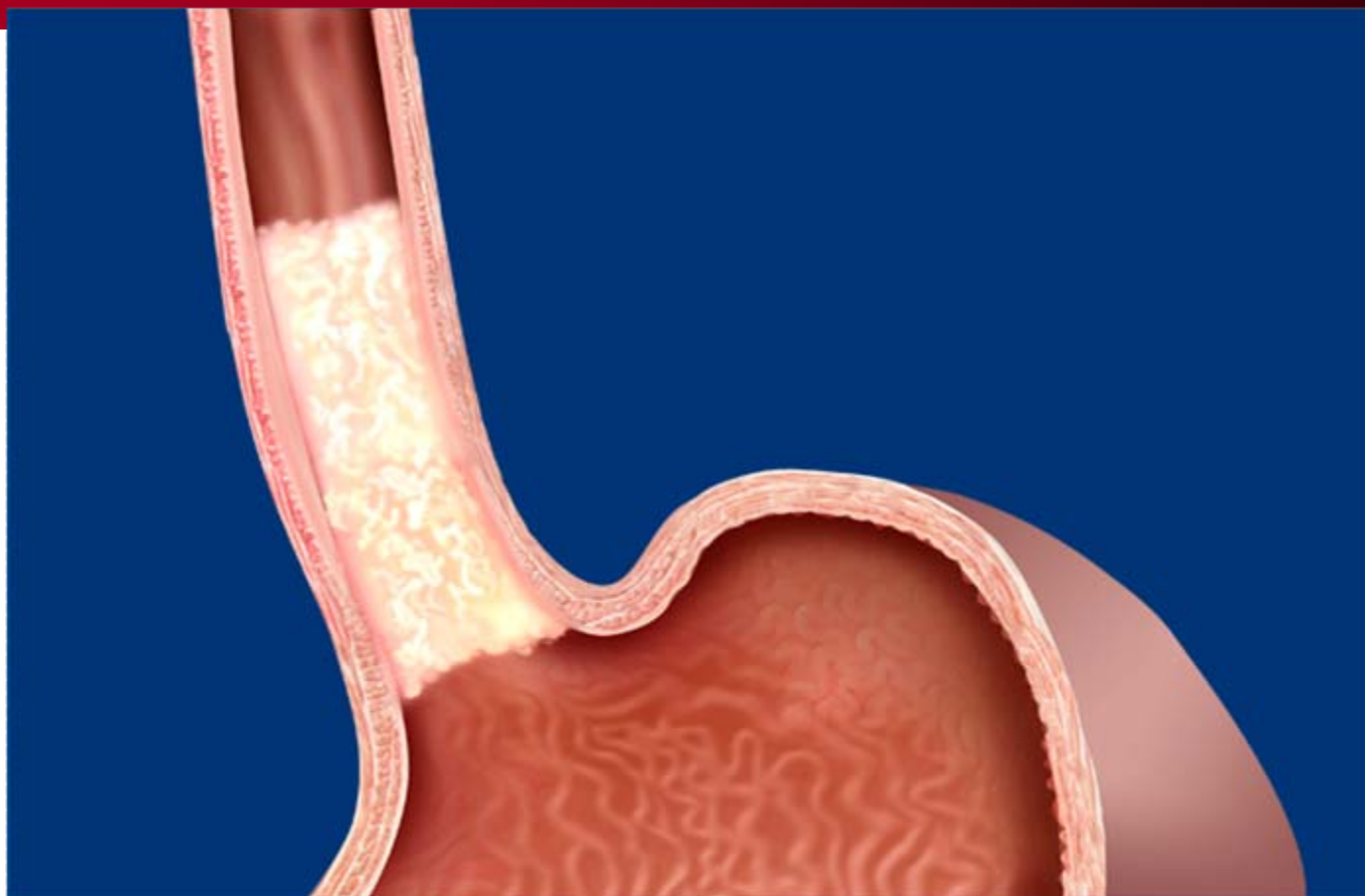
**RF ablation  
depth (avoids  
stricture)**

**EMR and  
PDT Depth**

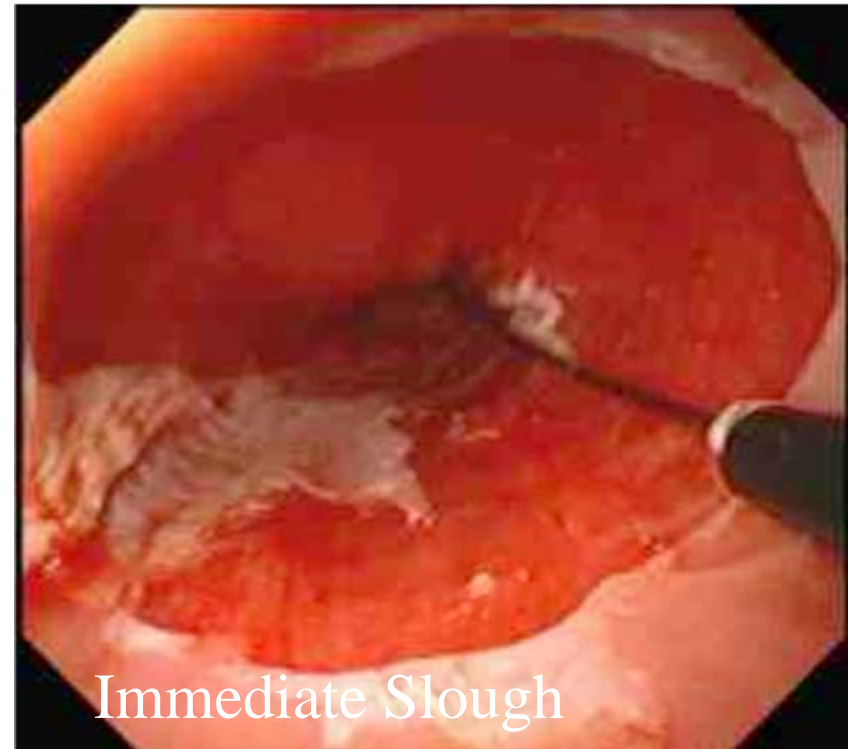
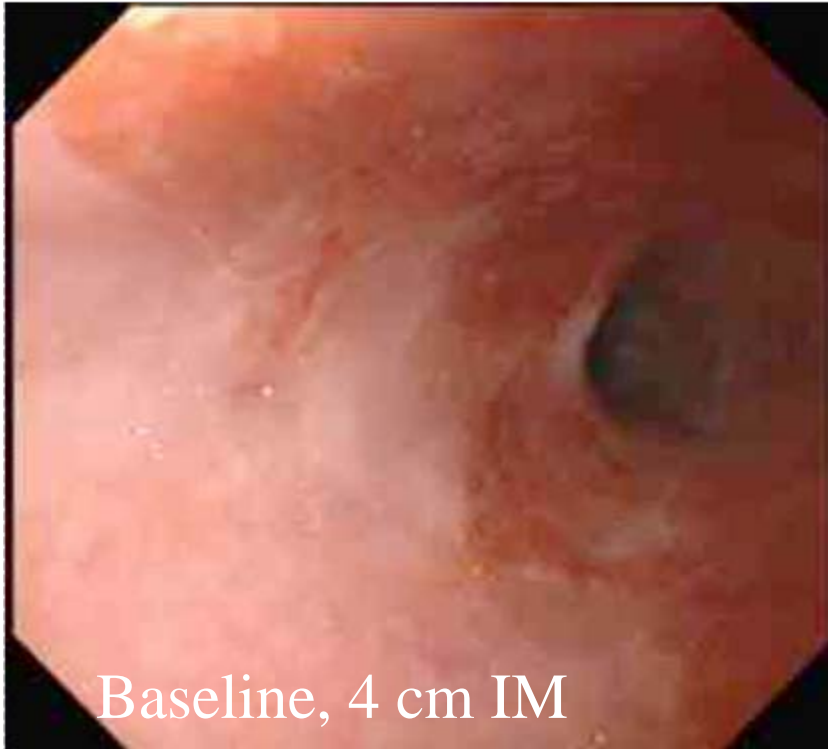
**Surgical  
Depth**





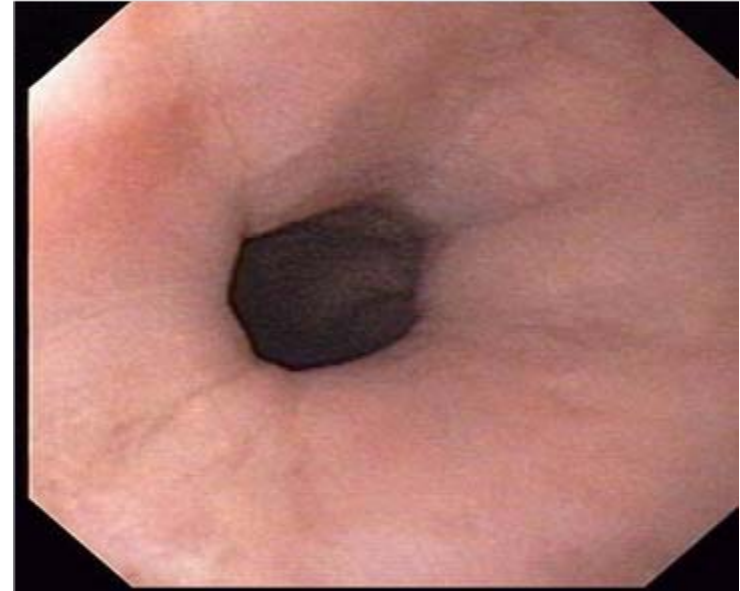


# Endoscopic Appearance





# Effect of RF Ablation



# Potentially Curative Endoscopic Therapies for Early Esophageal Neoplasia

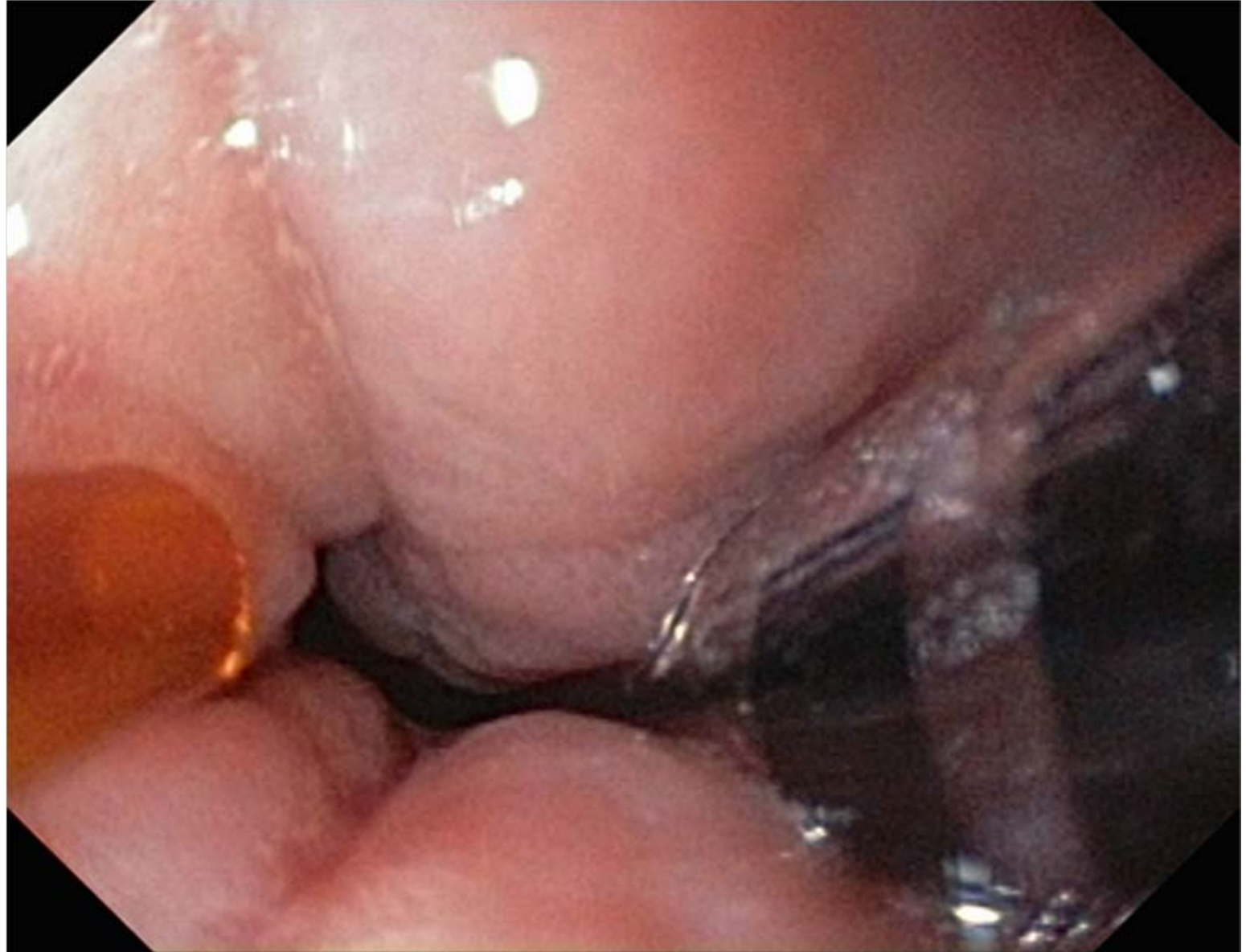
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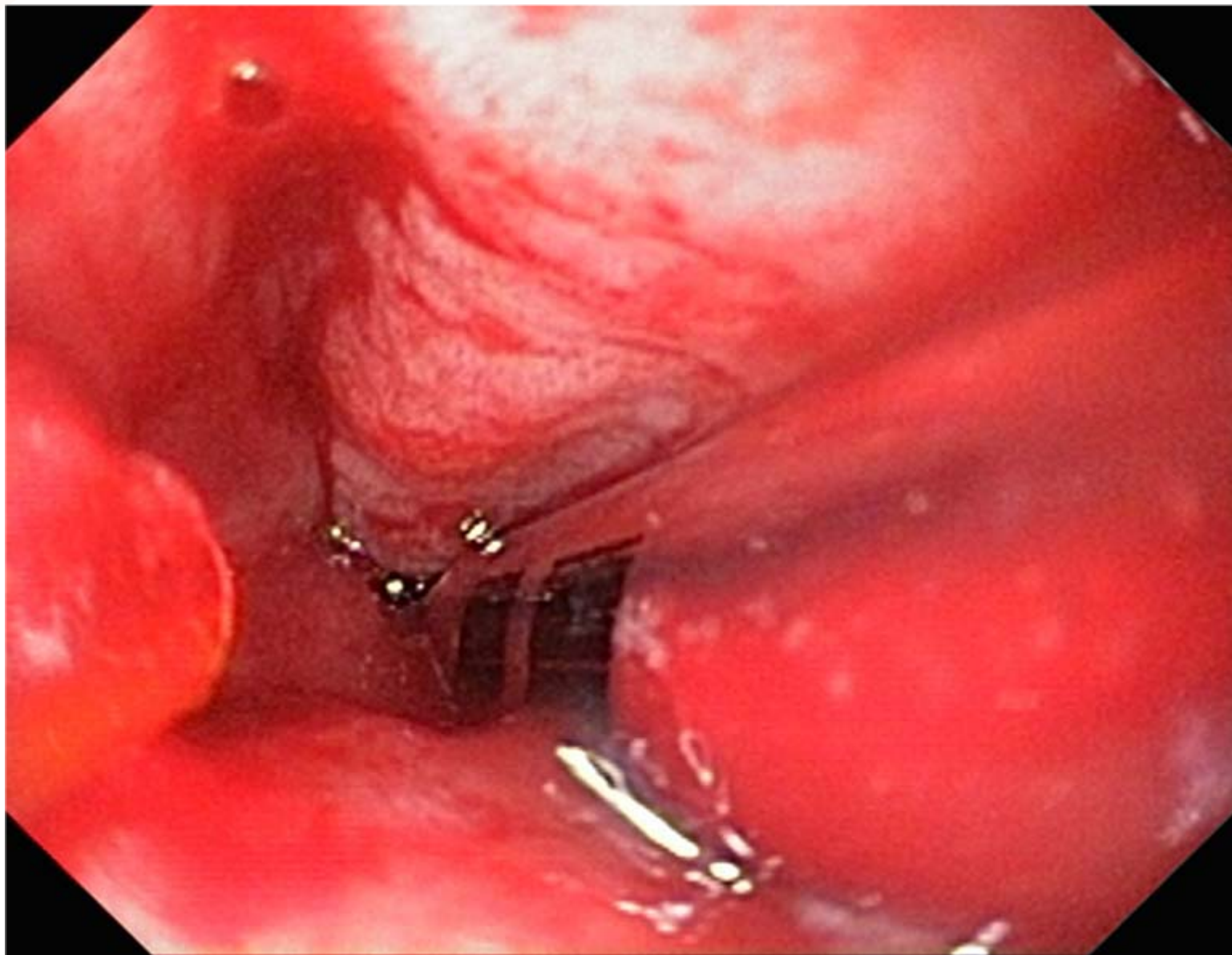
## III. Cryotherapy

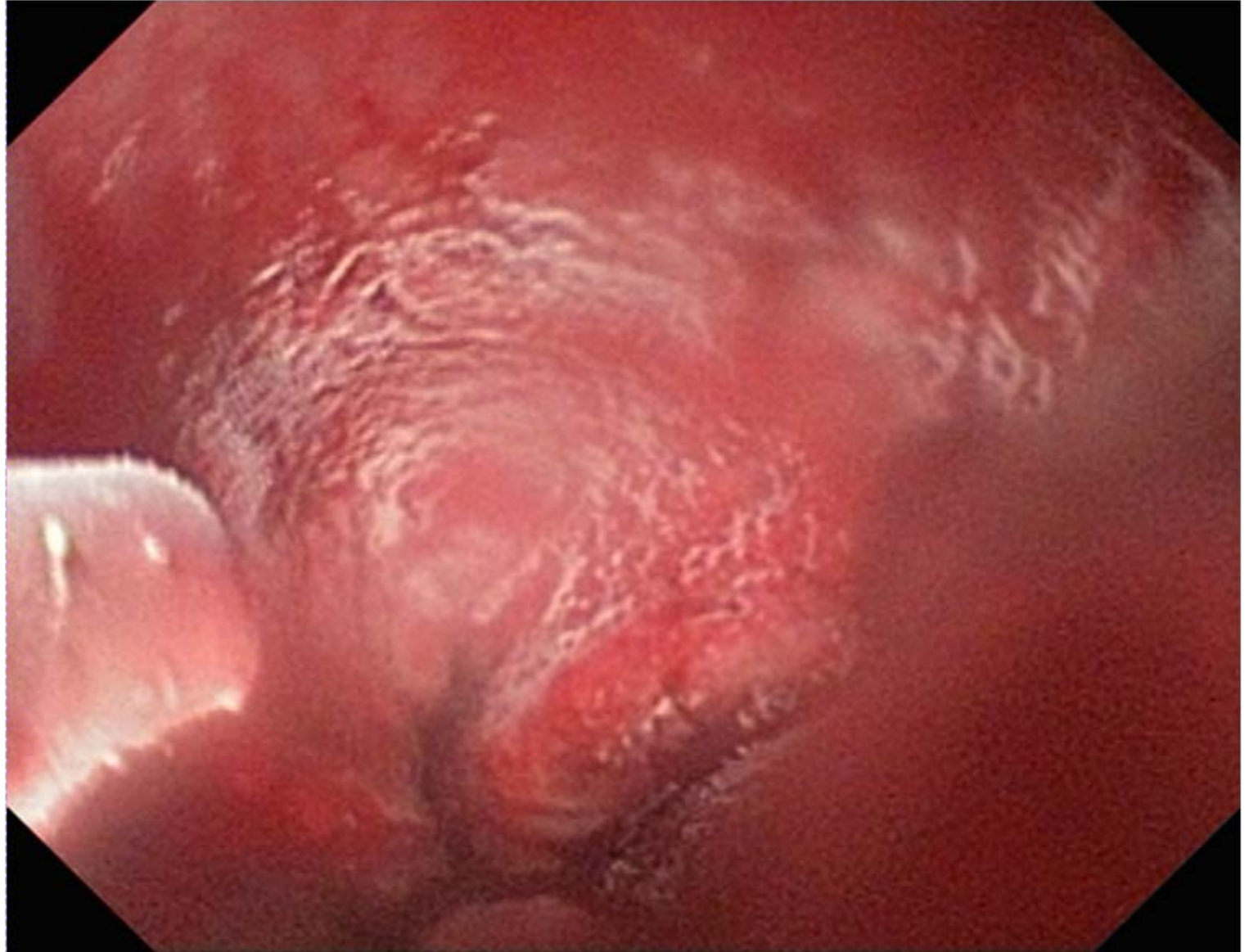
# CryoSpray Ablation™















# Surgery For Esophageal Cancer

- The incidence of esophageal adenocarcinoma continues to rise at an alarming rate!
- Esophageal adenocarcinoma is related to Barrett's esophagus which, in turn, is related to GERD.
- "Improvements" in the medical therapy for GERD have done nothing to halt the progression of esophageal CA.

# Surgery For Esophageal Cancer

- In experienced hands, esophagectomy can be performed safely and with good quality of life.
- Esophagectomy, alone or in combination with chemoTx/XRT, remains the gold standard of treatment for potentially curable disease.
- Endoscopic therapies are evolving as curative therapy for early esophageal cancer when the potential for nodal metastasis is low

# Treatment of Esophageal Cancer

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## *The Future*

- Improved prognosis will depend upon:
  - Improved prevention (control of GERD)
  - Improved screening, earlier detection
  - Improved systemic therapies!

# Treatment of Esophageal Cancer

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## *The Future*

- Improved chemotherapy, immunotherapy or cytologic regimens
- Tumor markers to predict potential for nodal/systemic spread, prognosis and the response to chemotherapy

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# The End