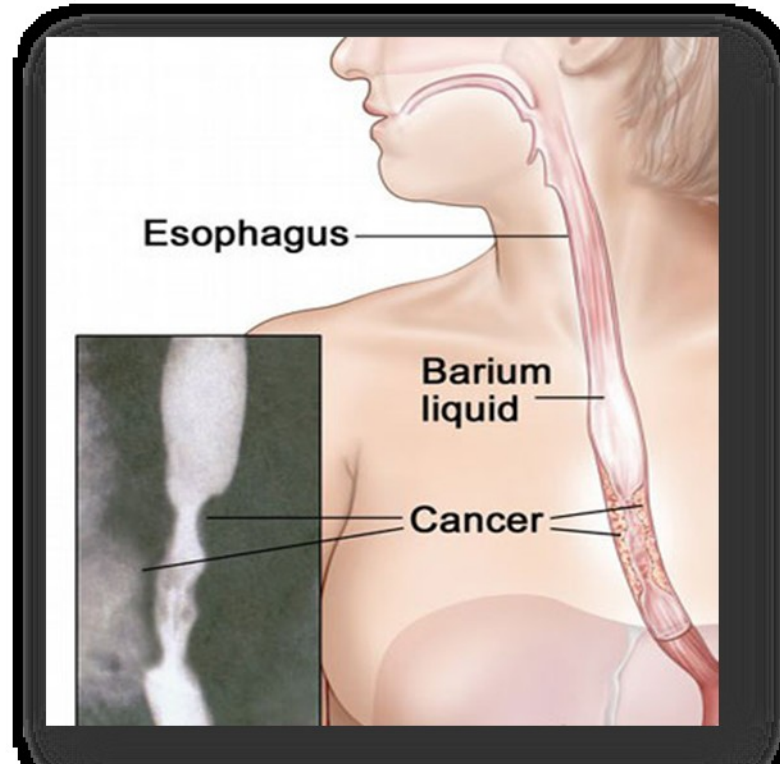


Carcinoma of Esophagus



Clinical Anatomy

Hollow muscular tube 25 cm in length which spans from the **cricopharyngeus** at the **cricoid cartilage** to **gastroesophageal junction** (Extends from C7-T10).

Has 4 constrictions-

- At starting(cricopharyngeal junction)
- crossed by aortic arch(9'inch)
- crossed by left bronchus(11'inch)
- Pierces the diaphragm(15'inch)

Histologically 4 layers:

mucosa, submucosa, muscular & fibrous layer.

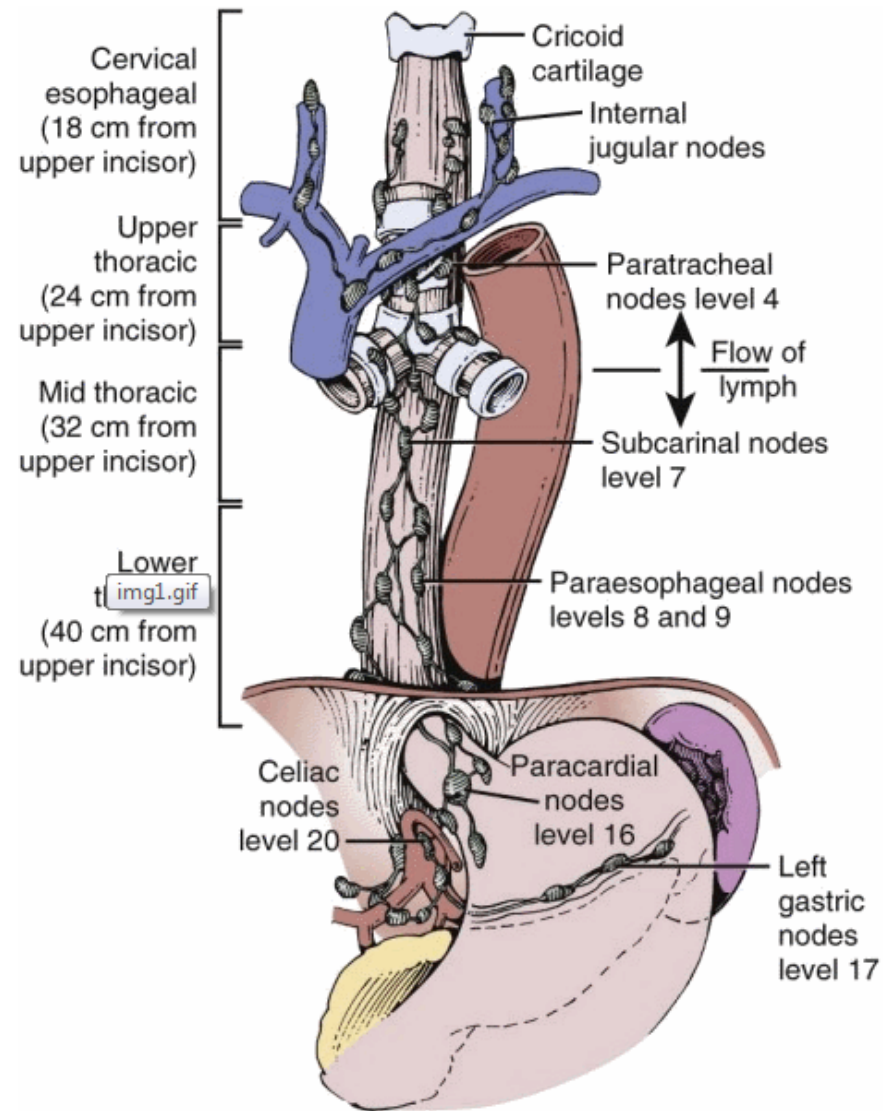


FIGURE Anatomy of the esophagus

Clinical Anatomy

Four regions of the esophagus:

Cervical = cricoid cartilage to thoracic inlet (15–18 cm from the incisor).

Upper thoracic = thoracic inlet to tracheal bifurcation (18–24 cm).

Midthoracic = tracheal bifurcation to just above the GE junction (24–32 cm).

Lower thoracic = GE junction (32–40 cm).

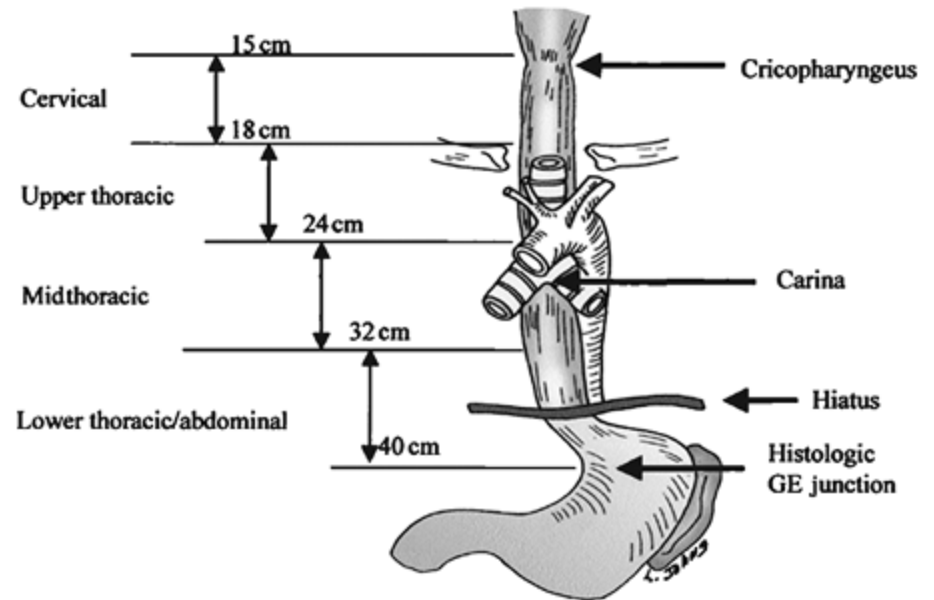


Figure Anatomy of the esophagus with landmarks and recorded distance from the incisors used to divide the esophagus into topographic compartments. GE, gastroesophageal.

Lymphatic Drainage

Rich mucosal and submucosal lymphatic system.

The submucosal lymphatics may extend long distances (proximal and distal margins used for RTP have traditionally been a minimum of 5 cm).

The submucosal plexus drains into the regional lymph nodes in the cervical, mediastinal, paraesophageal, left gastric, and celiac axis regions

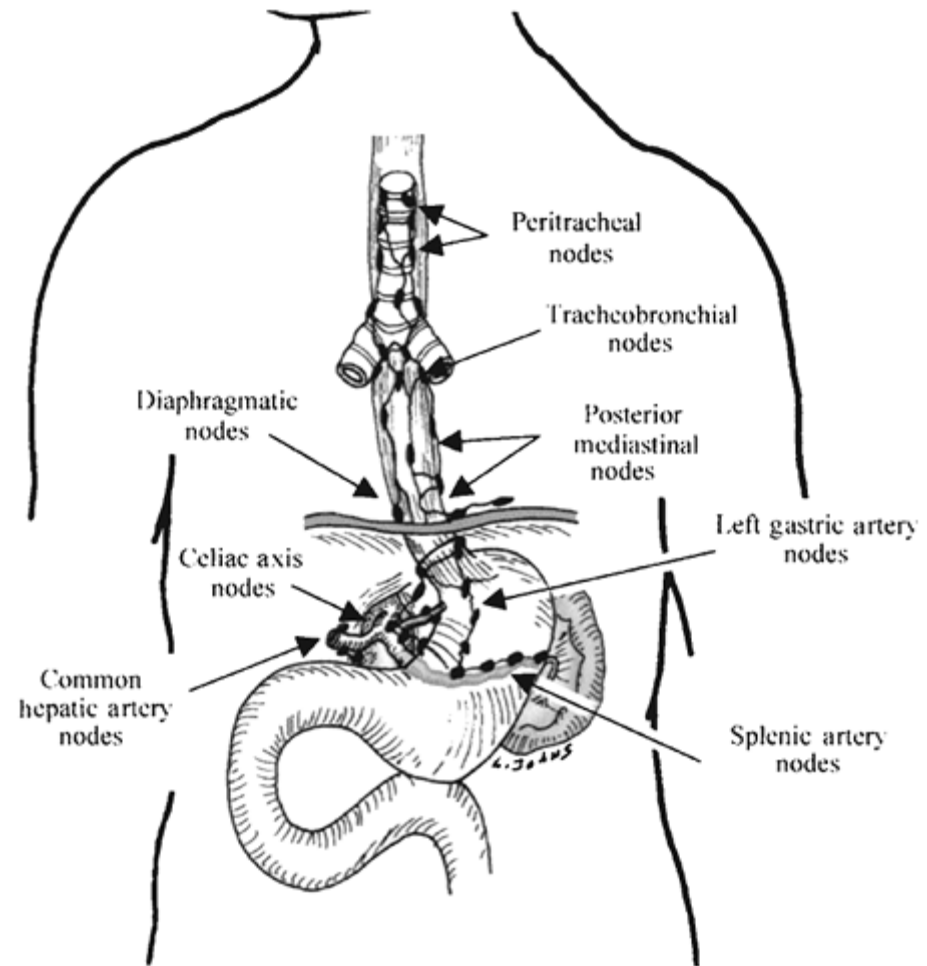


Figure Lymphatic drainage of the esophagus with anatomically defined lymph node basins

Epidemiology

Esophageal cancer is the 7th leading cause of cancer deaths.

accounts for 1% of all malignancy & 6% of all GI malignancy.

Most common in China, Iran, South Africa, India and the former Soviet Union.

The incidence rises steadily with age, reaching a peak in the 6th to 7th decade of life.

Male : Female = 3.5 : 1

African-American males : White males = 5:1

Epidemiology

Worldwide SCC responsible for most of the cases.

Adenocarcinoma now accounts for over 50% of esophageal cancer in the USA, due to association with GERD , Barretts's esophagus & obesity.

SCC usually occurs in the middle 3rd of the esophagus (the ratio of upper : middle : lower is **15 : 50 : 35**).

Adenocarcinoma is most common in the lower 3rd of the esophagus, accounting for over 65% of cases.

Risk Factors : Squamous Cell Carcinoma

Smoking and alcohol (80% - 90%)

Dietary factors

- N-nitroso compounds (animal carcinogens)
- Pickled vegetables and other food-products
- Toxin-producing fungi
- Betel nut chewing
- Ingestion of very hot foods and beverages (such as tea)



Underlying esophageal disease (such as **achalasia** and caustic strictures, Tylosis)

Genetic abnormalities:

- p53 mutation, loss of 3p and 9q alleli...

Risk Factors: Adenocarcinoma

- z Associated with **Barrett's esophagus, GERD & hiatal hernia.**
- z Obesity (3 to 4 fold risk)
- z Smoking (2 to 3 fold risk)
- z Increased esophageal acid exposure such as Zollinger-Ellison syndrome.

Barrett's esophagus is a

metaplasia of the esophageal epithelial lining. The squamous epithelium is replaced by columnar epithelium, with 0.5% annual rate of neoplastic transformation.

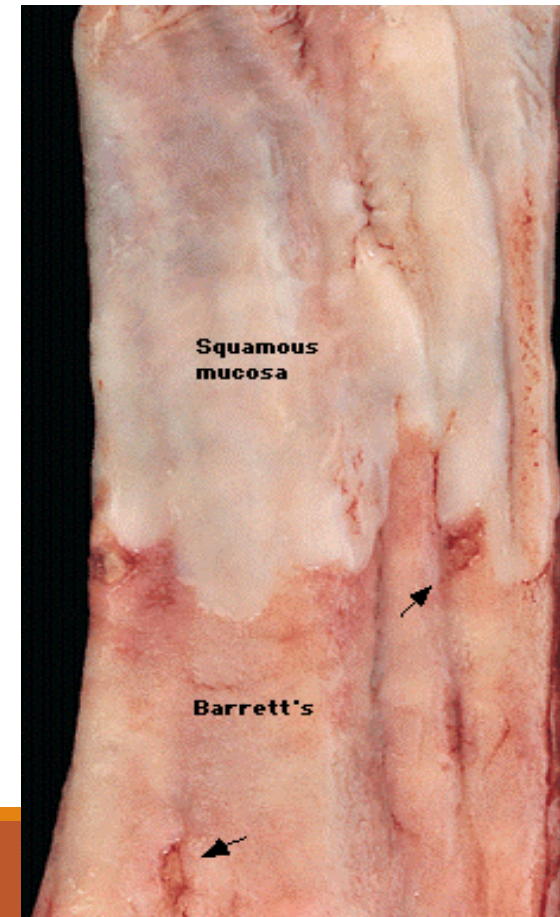
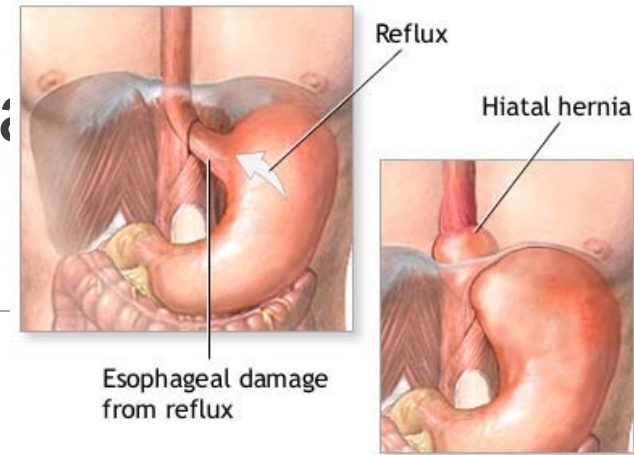


Fig. Barrett's esophagus

Pattern of spread

No serosal covering, direct invasion of contiguous structures occurs early.

Commonly spread by lymphatics (70%)

Lymph node involvement increases with T stage.

- T1 – 14 to 21%
- T2 – 38 to 60%

25% - 30% hematogenous metastases at time of presentation.

Most common site of metastases are

- lung, liver, pleura, bone, kidney & adrenal gland

Median survival with distant metastases – 6 to 12 months

Pathological Classification

Preinvasive Neoplasia

- Esophageal intraepithelial neoplasia
- Glandular epithelial dysplasia/adenocarcinoma in situ in Barrett's mucosa

Invasive Malignant Neoplasia

- Squamous cell carcinoma
 - Adenocarcinoma,
 - Adenoid cystic carcinoma
 - Mucoepidermoid carcinoma
 - Adenosquamous carcinoma
 - Small cell carcinoma
 - Carcinoid tumor
 - Malignant melanoma
 - Sarcomas
- } 95%

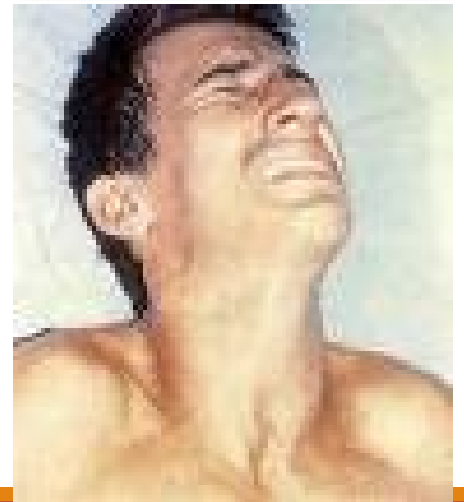
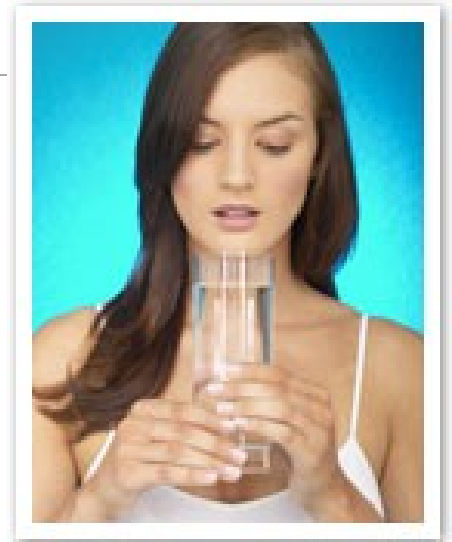
Clinical Features

It is commonly associated with the symptoms of dysphagia, wt. loss, pain, anorexia, and vomiting

Symptoms often start 3 to 4 months before diagnosis

Dysphagia - in more than 90% pt. Odynophagia - in 50% of pt.

Wt. loss – more than 5 % of total body wt. in 40 – 70% pt. associated with worst prognosis.



Contd...

Complications:

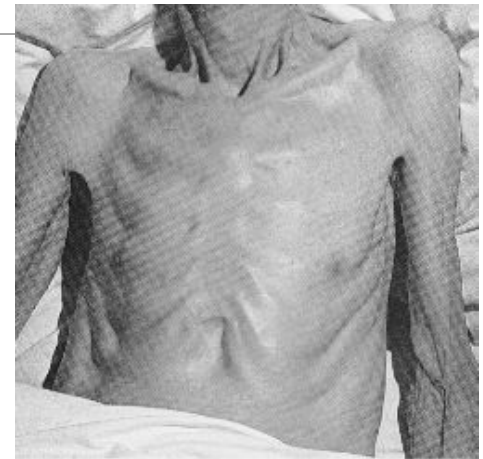
Cachexia, Malnutrition, dehydration, anaemia,.

Aspiration pneumonia.

Distant metastasis.

Invasion of near by structures: e.g.

- Recurrent laryngeal nerve → Hoarseness of voice
- Trachea → Stridor & TOF → cough, choking & cyanosis
- Perforation into the pleural cavity → Empyema
- back pain in celiac axis node involvement

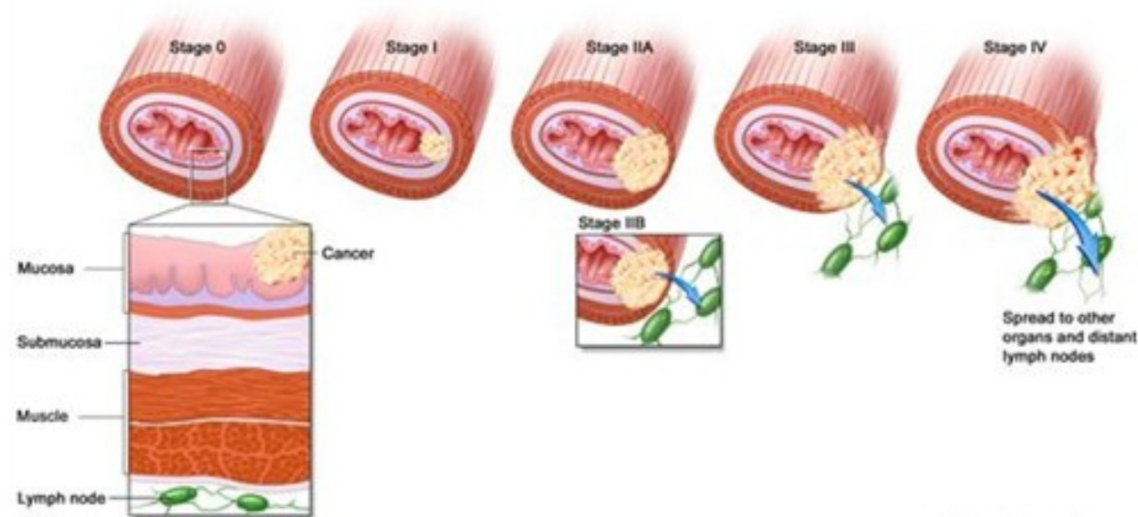


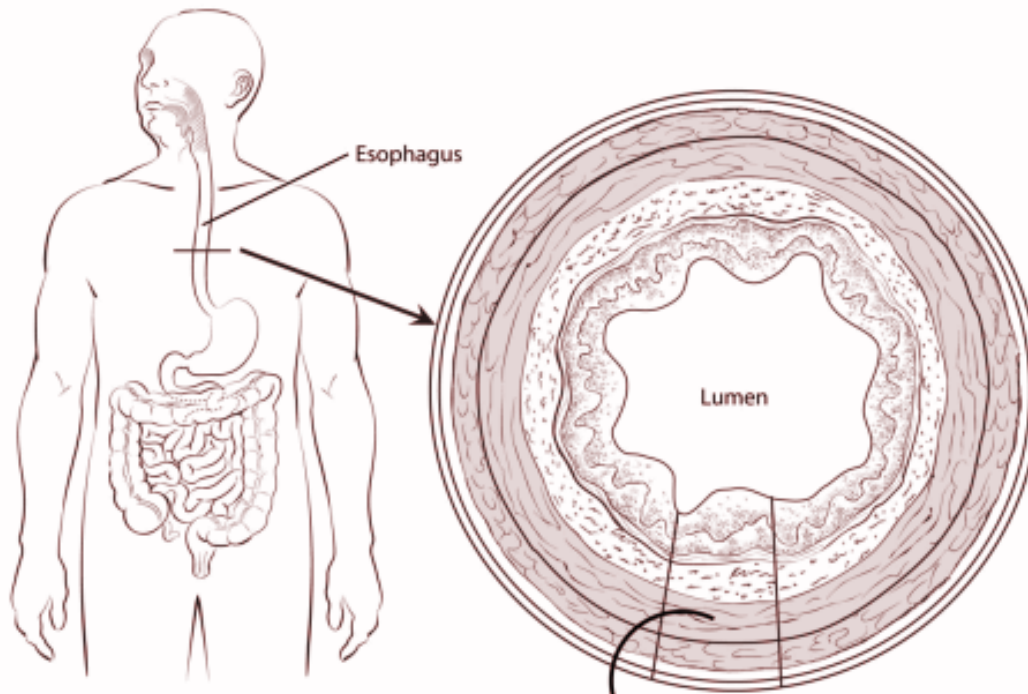
Staging System: T N M

T = depth of the **tumor** into the wall of the esophagus

N = number of lymph **nodes** spread

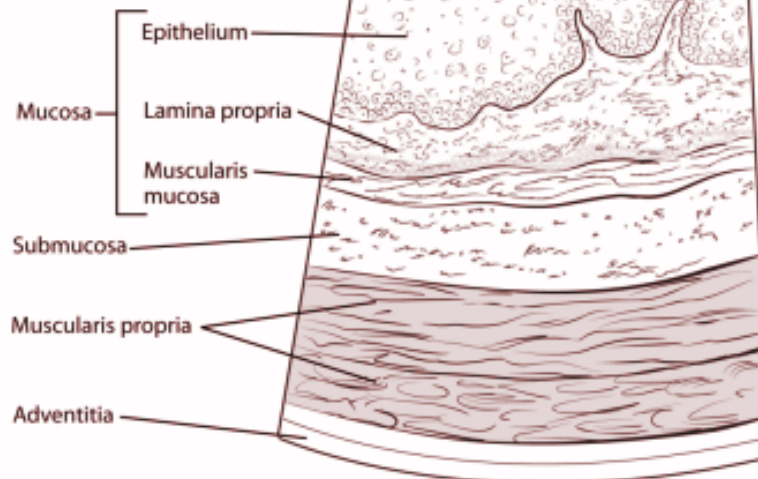
M = distant **metastases** (spread to other parts of the body)



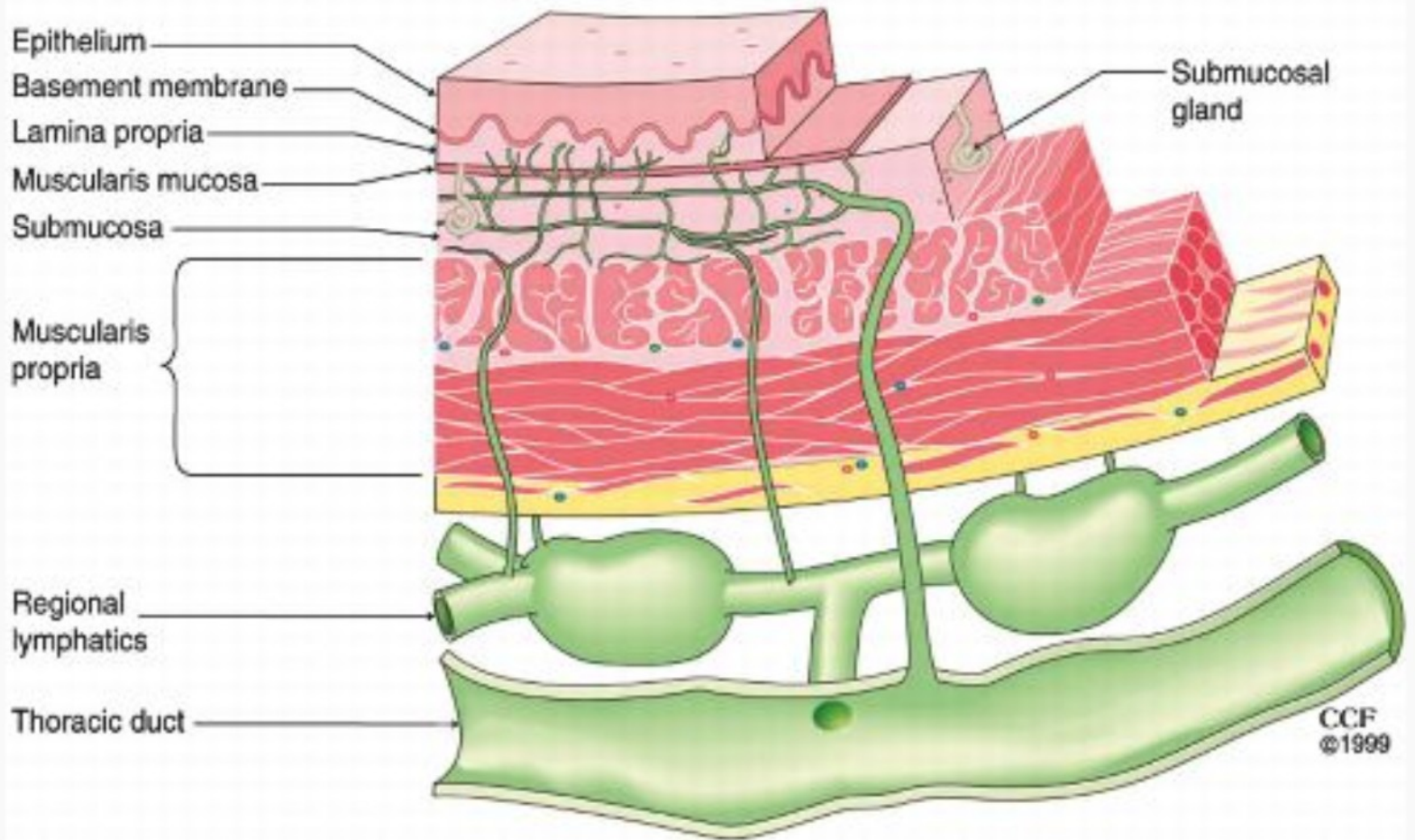


Layers of the Esophagus

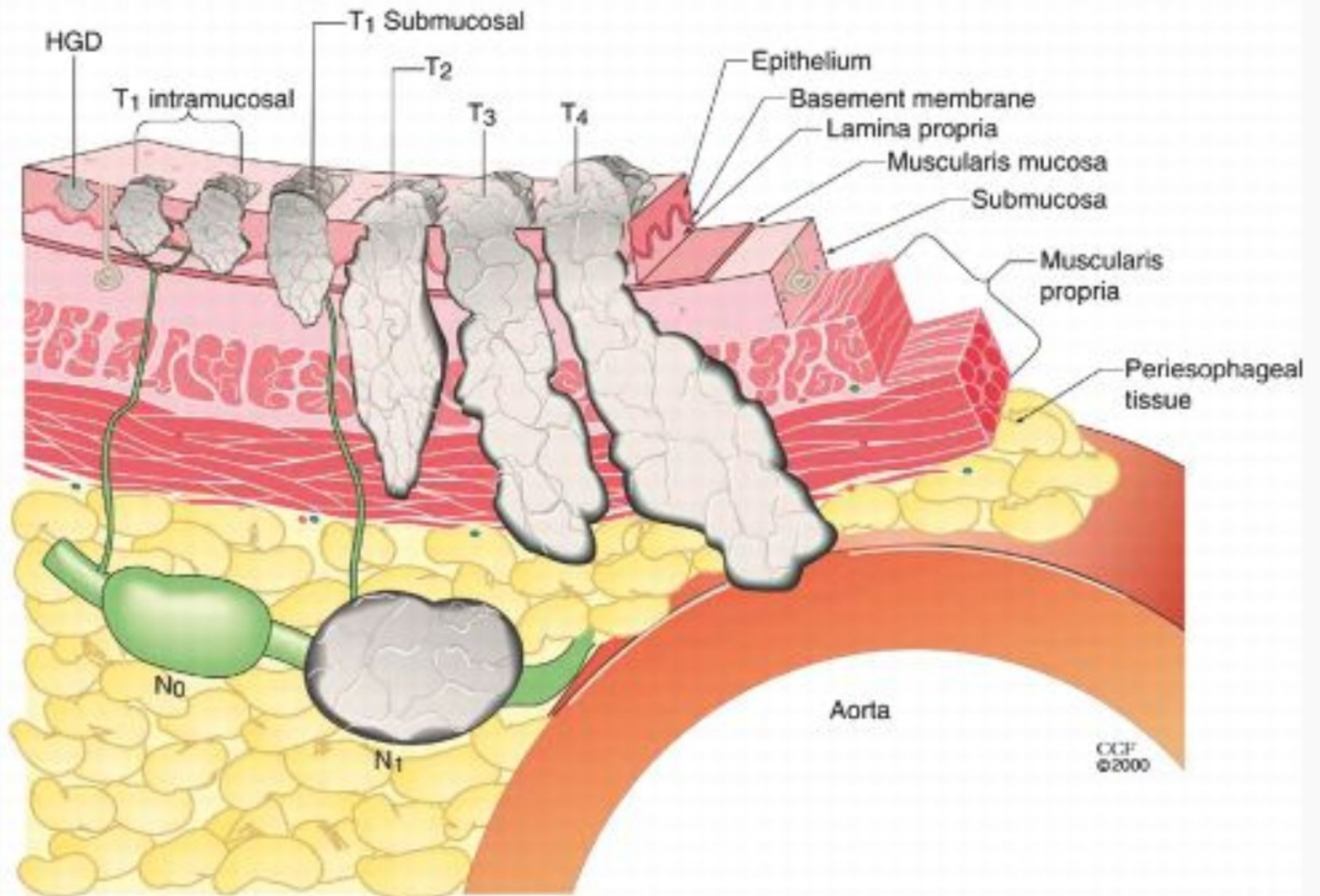
Layers of the Esophagus



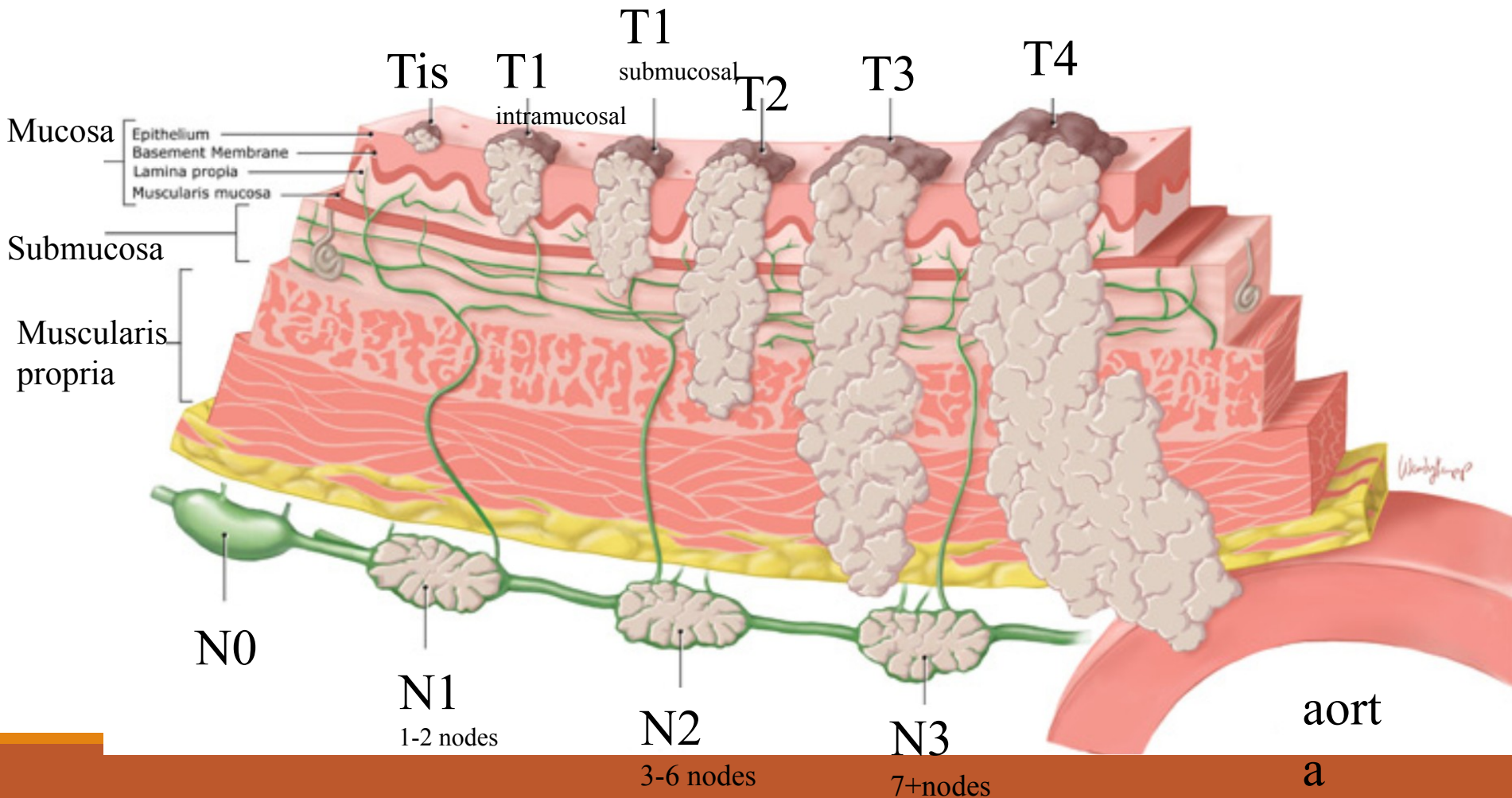
The Esophageal Wall



T and N



Staging System, T and N for Esophagus Cancer



AJCC TNM classification

Stage	Description
Primary tumor (T)	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	High-grade dysplasia and carcinoma in situ (CIS)
T1a	Lamina propria and muscularis mucosae involvement
T1b	Submucosa involvement
T2	Invasion of muscularis propria
T3	Invasion of adventitia
T4a	Pleura, pericardial, or diaphragm involvement
T4b	Other organs (aorta, vertebral body, trachea)
Regional lymph nodes (N)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	1–2 regional lymph node metastasis/es ^a
N2	3–6 regional lymph nodes metastases ^a
N3	≥7 Regional lymph nodes metastases ^a
Distant metastasis (M)^b	
M0	No distant metastasis
M1	Metastasis to distant organs (retroperitoneal, paraaortic nodes, lung, liver, bone)

a: Includes nodes previously labeled as “M1a”

b : “M1a” designation is no longer recognized in the 7th edn. of the AJCC system

Staging : Squamous cell carcinoma

Stage	TNM and grade criteria	Location
IA	T1 N0 M0 G1	Any
IB	T1 N0 M0 G2-3	Any
	T2-3 N0 M0 G1	Lower
IIA	T2-3 N0 M0 G1	Upper/middle
	T2-3 N0 M0 G2-3	Lower
IIB	T1-2 N1 M0 any G	Any
	T2-3 N0 M0 G2-3	Upper/middle
IIIA-IV	Same as adenocarcinoma	

Staging : Adenocarcinoma

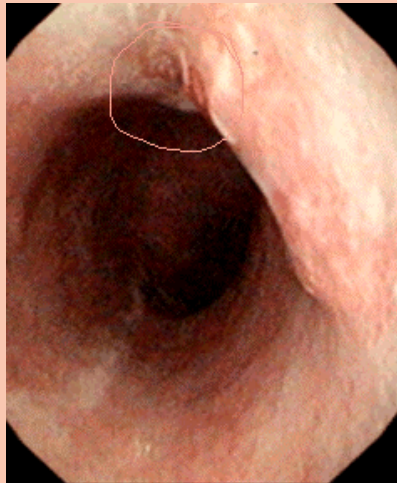
Group	T	N	M	Grade
0	Tis (HGD)			1, X
IA	T1	N0	M0	1-2, X
IB	T1			3
	T2			1-2, X
IIA	T2			3
IIB	T3	N1		Any
	T1-2			
IIIA	T1-2	N2		
	T3	N1		
	T4a	N0		
IIIB	T3	N2		
IIIC	T4a	N1-2		
	T4b	Any		
	Any	N3		
IV	Any	Any	M1	

Diagnostic Workup

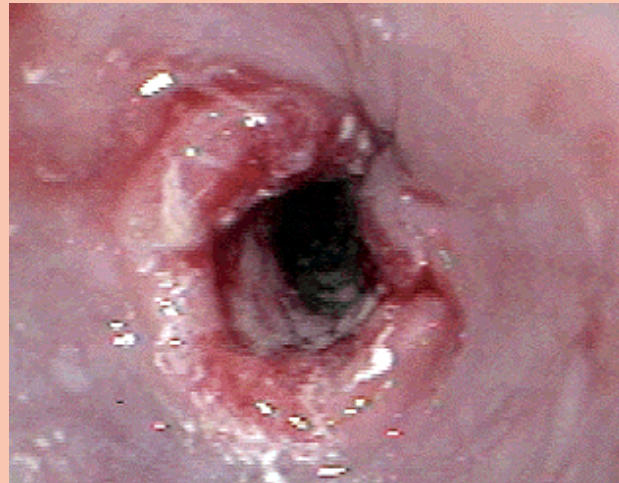
Detailed history & Physical examination: Dysphagia, odynophagia, hoarseness, wt. loss, use of tobacco, nitrosamines, history of GERD. Examine for cervical or supraclavicular adenopathy.

Confirmation of diagnosis:

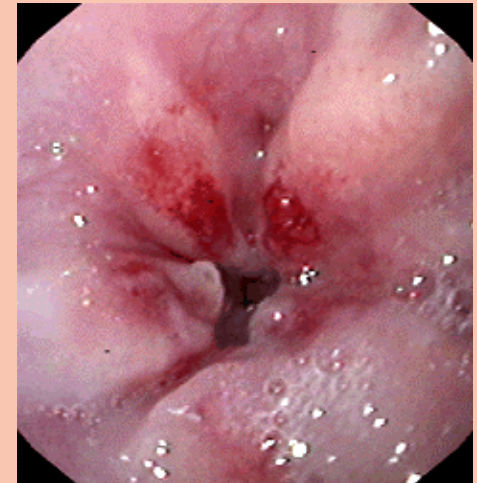
- EGD: allow direct visualization and biopsy, measure proximal & distal distance of tumor from incisor, presence of Barrett's esophagus.



Early, superficial cancer

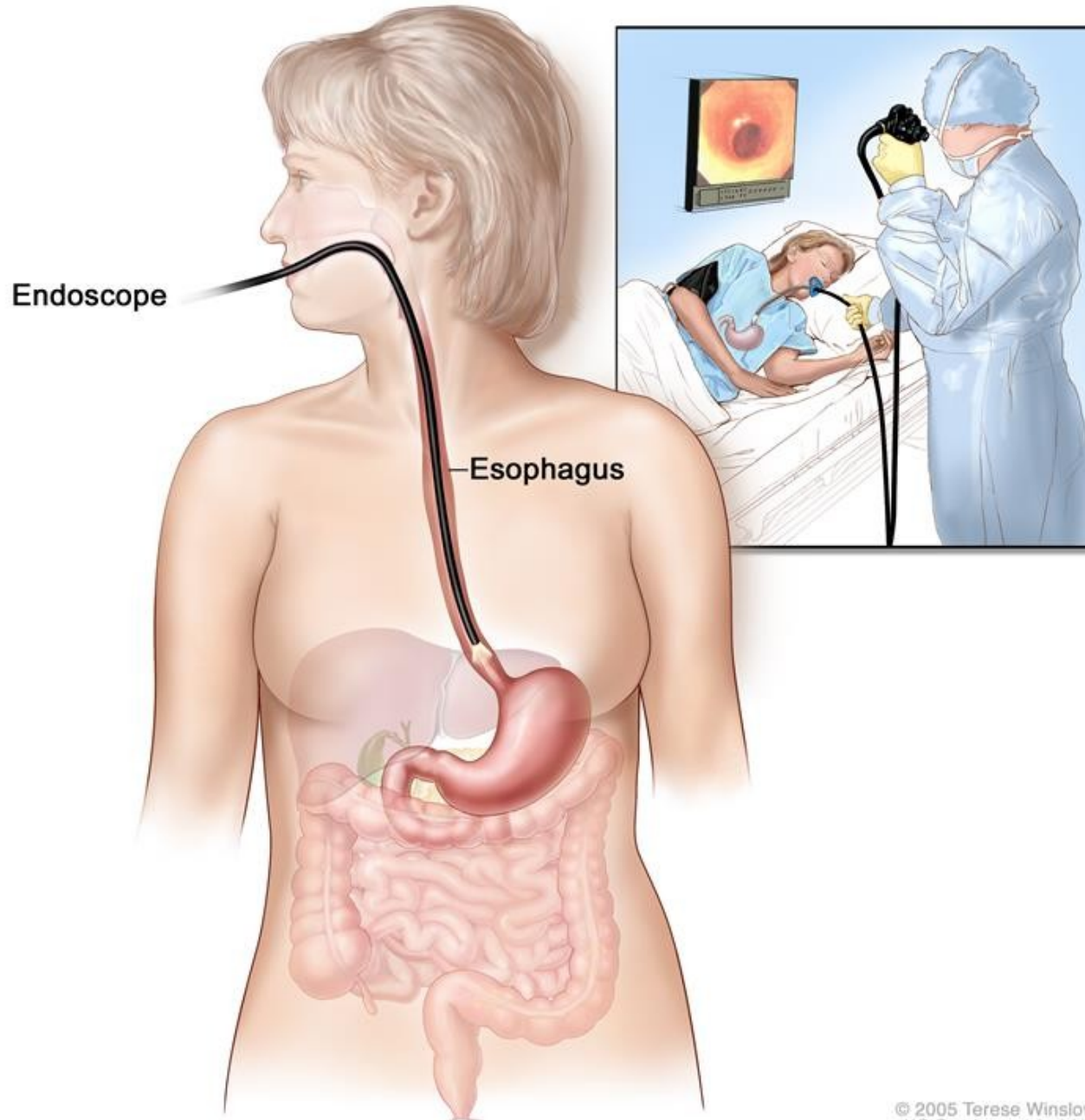


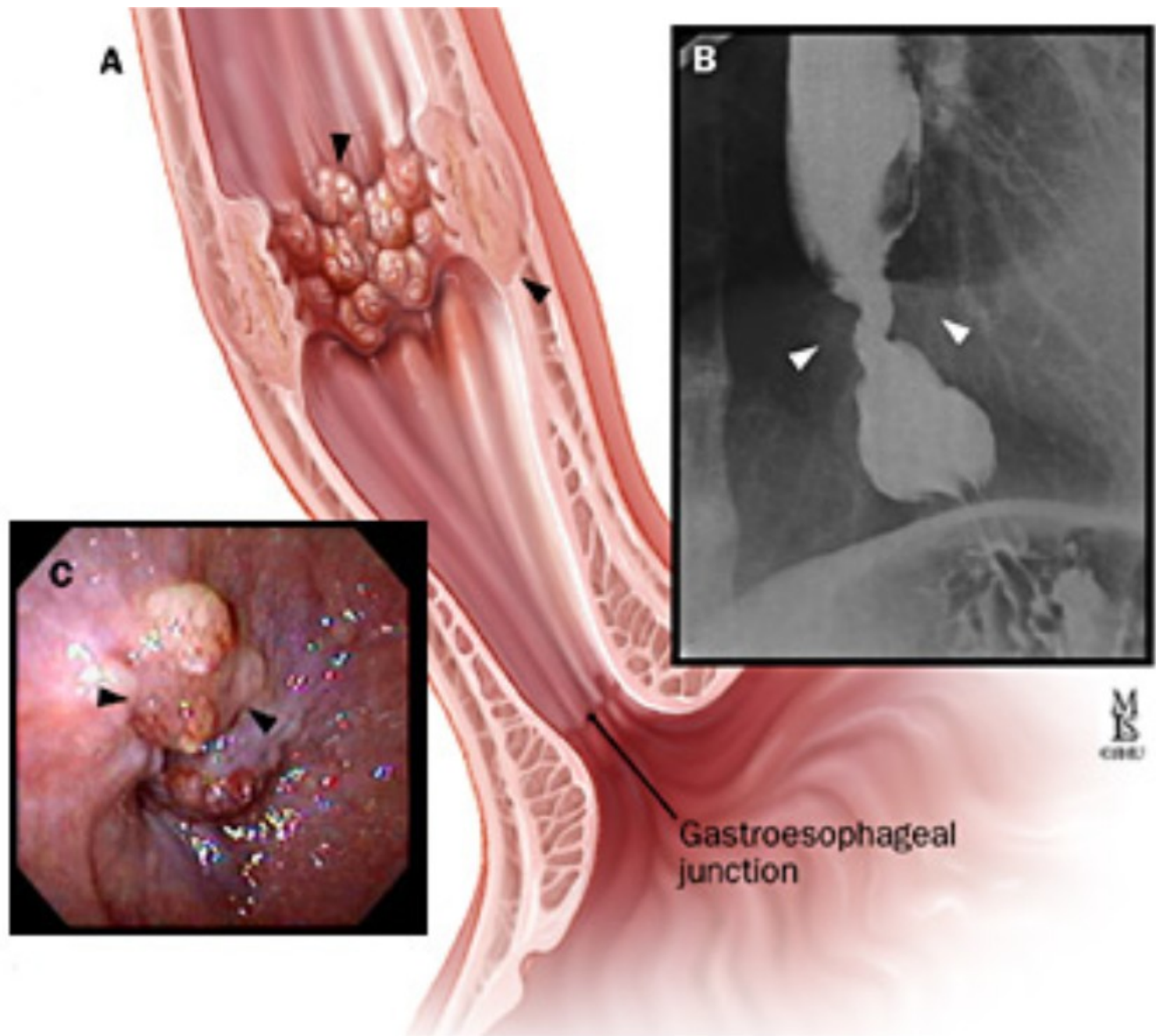
Circumferential ulceration esophageal cancer



Malignant stricture of esophagus

Esophagoscopy





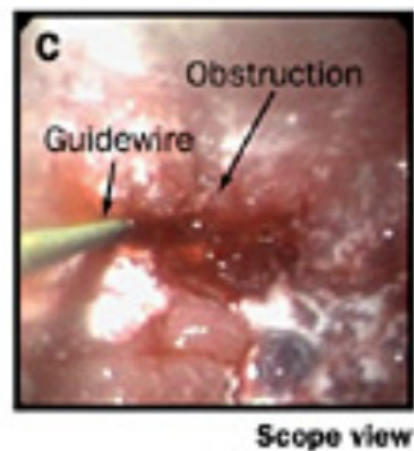
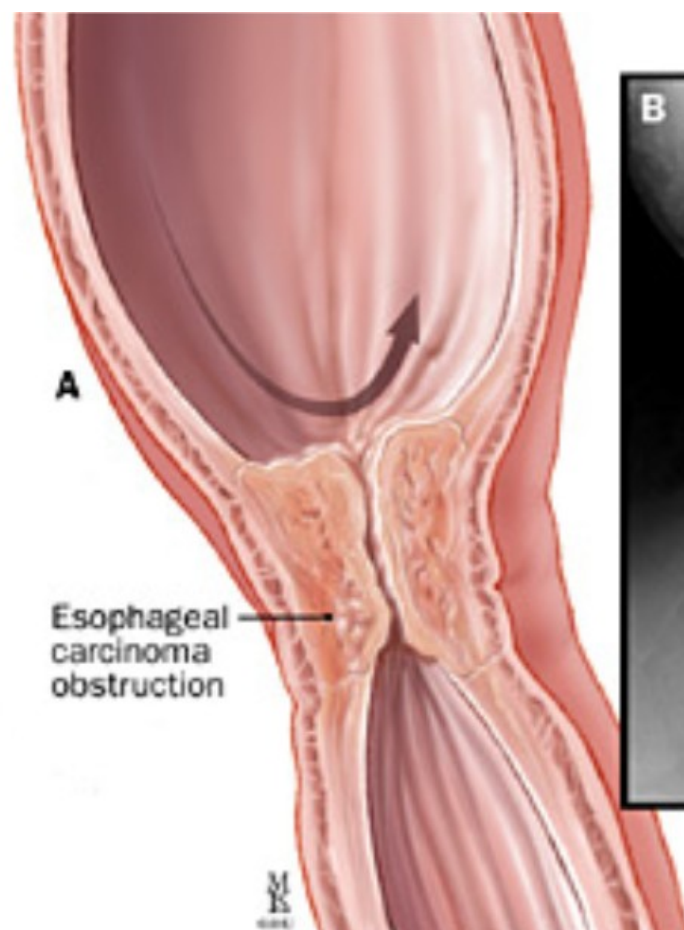
A

B

C

Gastroesophageal junction

MBS
CIBU



Staging:

- **CT chest and abdomen:** Essential for staging because it can identify extension beyond the esophageal wall, enlarged lymph nodes and visceral metastases.

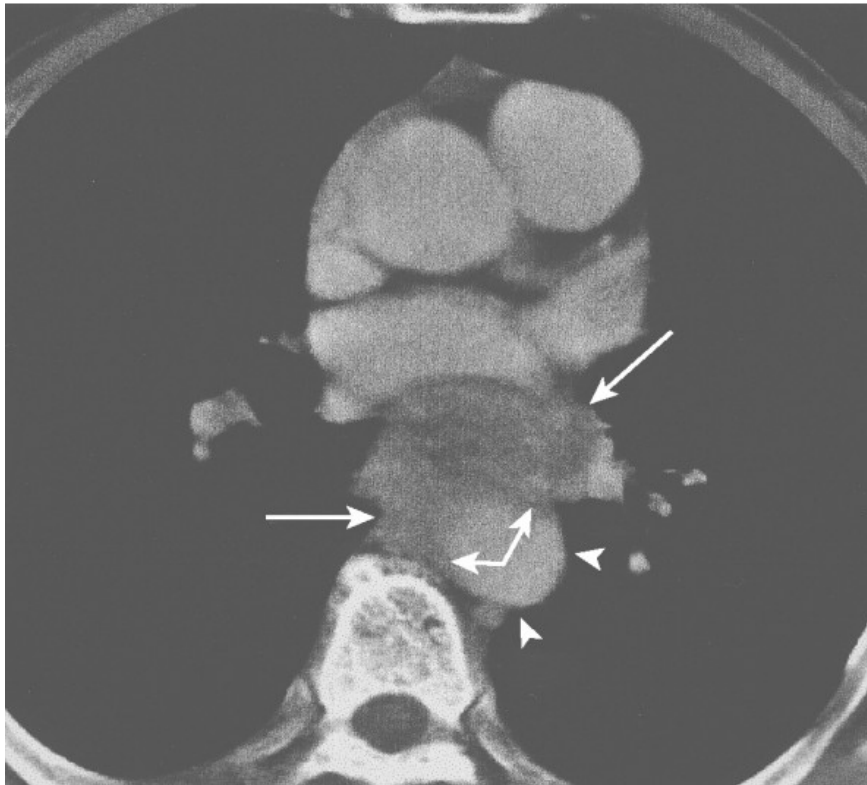


Figure Esophageal cancer with aortic invasion. An arc (*bent arrow*) of the contact between the esophageal cancer (*arrows*) and the aorta (*arrowheads*) is more than 90 degrees, indicating aortic invasion.

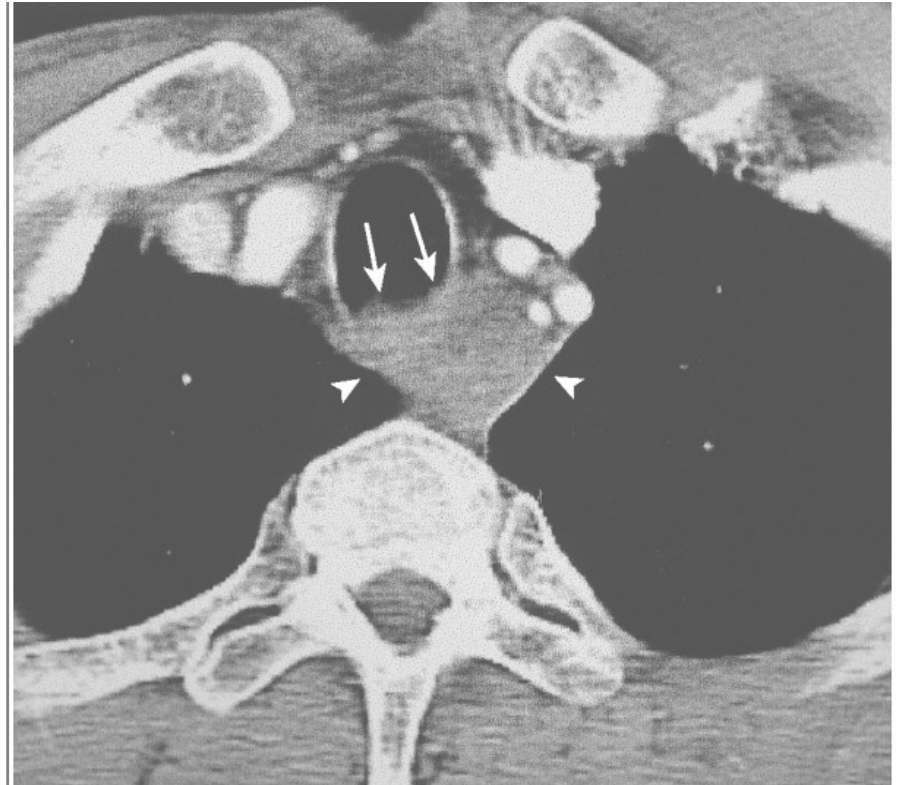
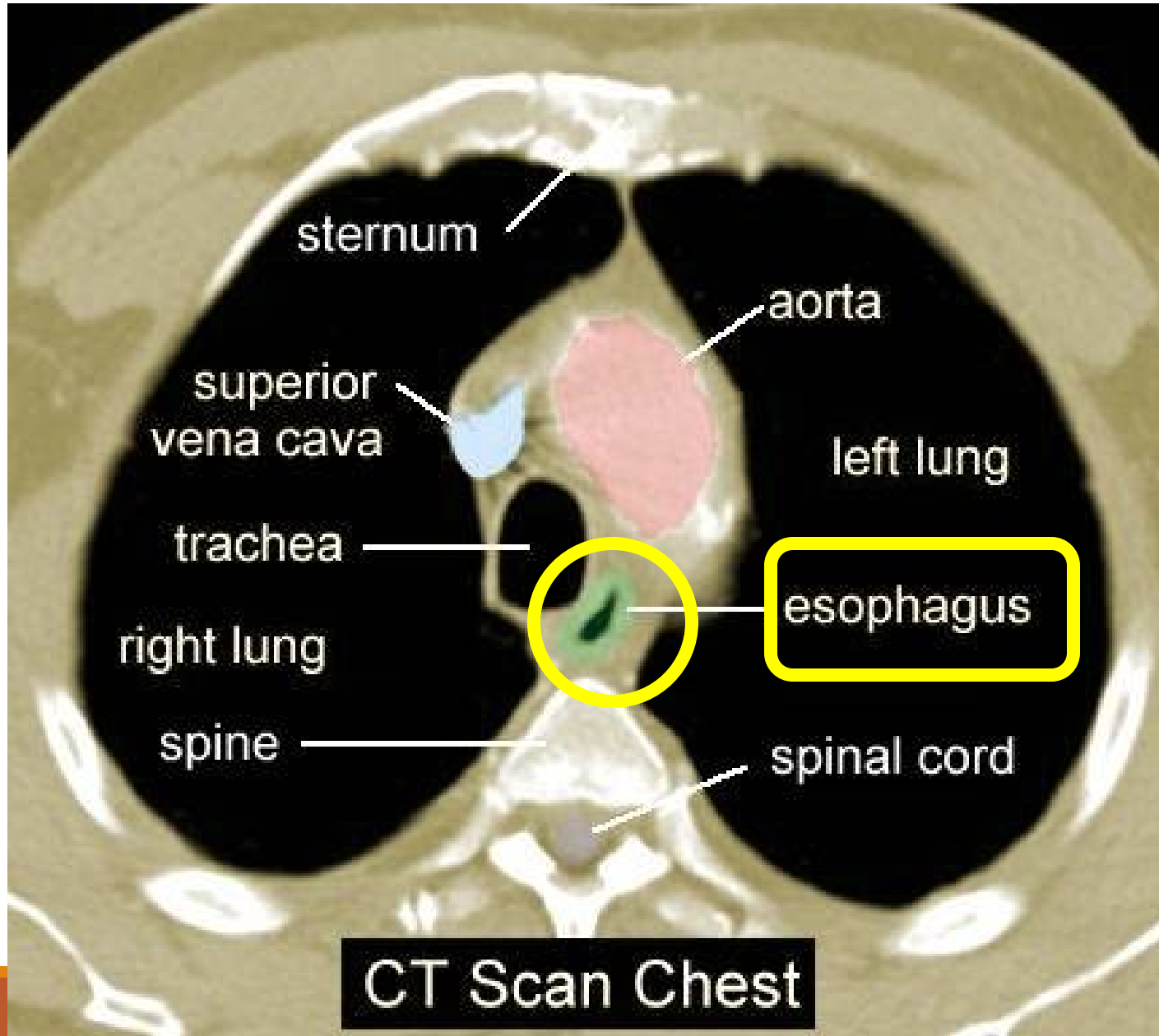
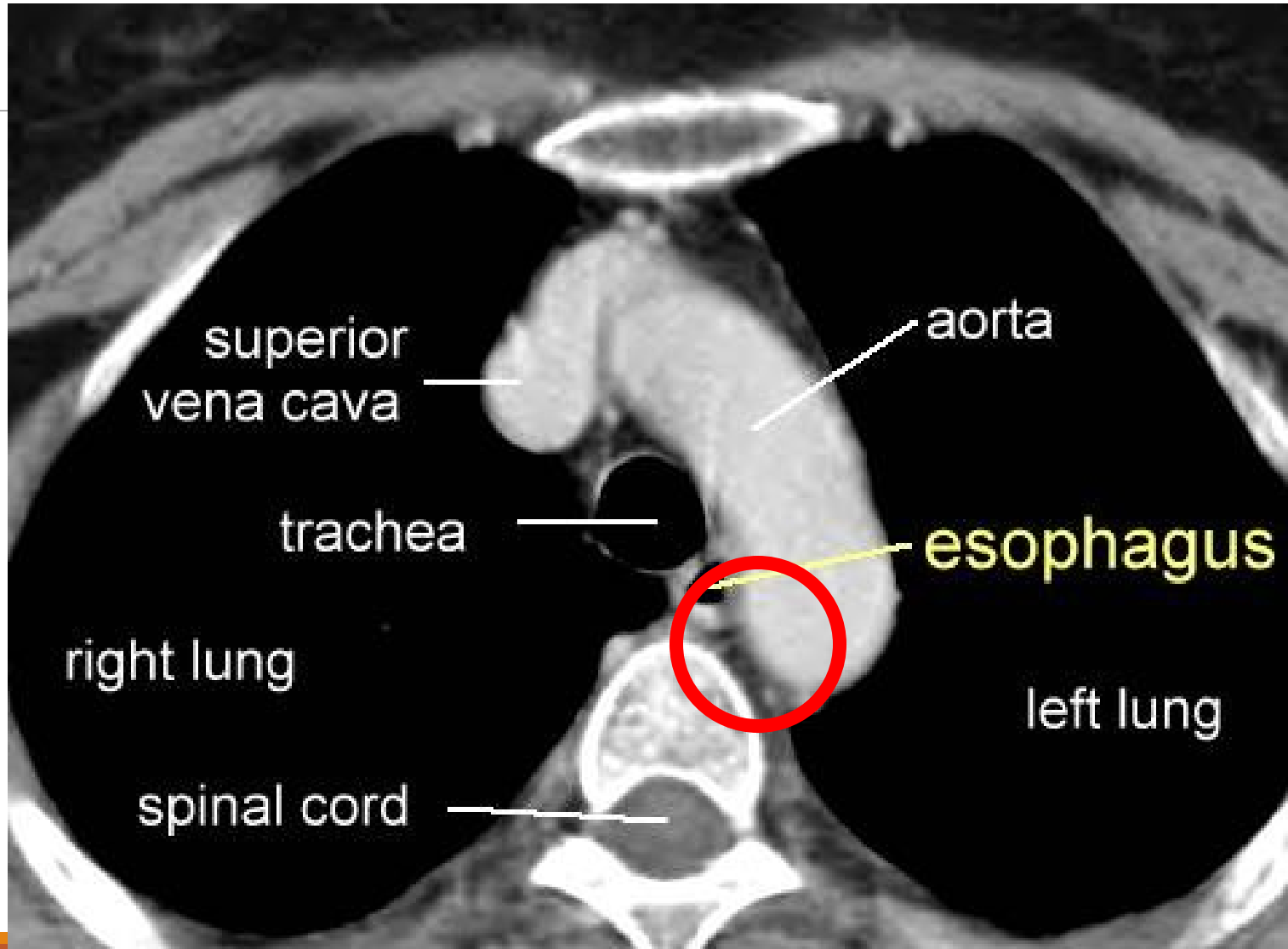


Figure Esophageal cancer with tracheal invasion. CT scan shows circumferential wall thickening of the proximal esophagus (*arrowheads*), which shows irregular interface with the posterior wall of the trachea (*arrows*), indicating direct extension into the lumen

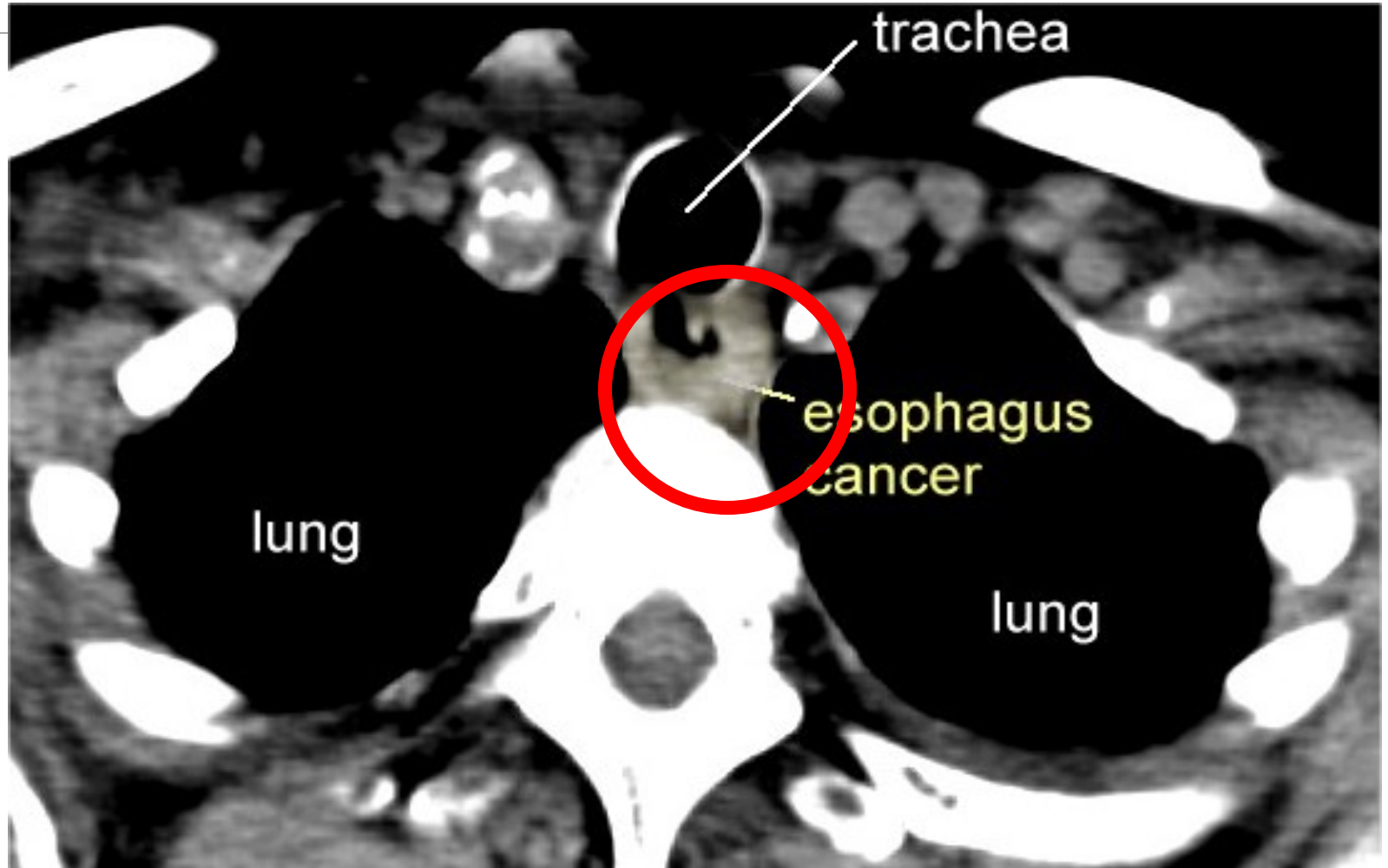
Reading a CT Scan near the Esophagus



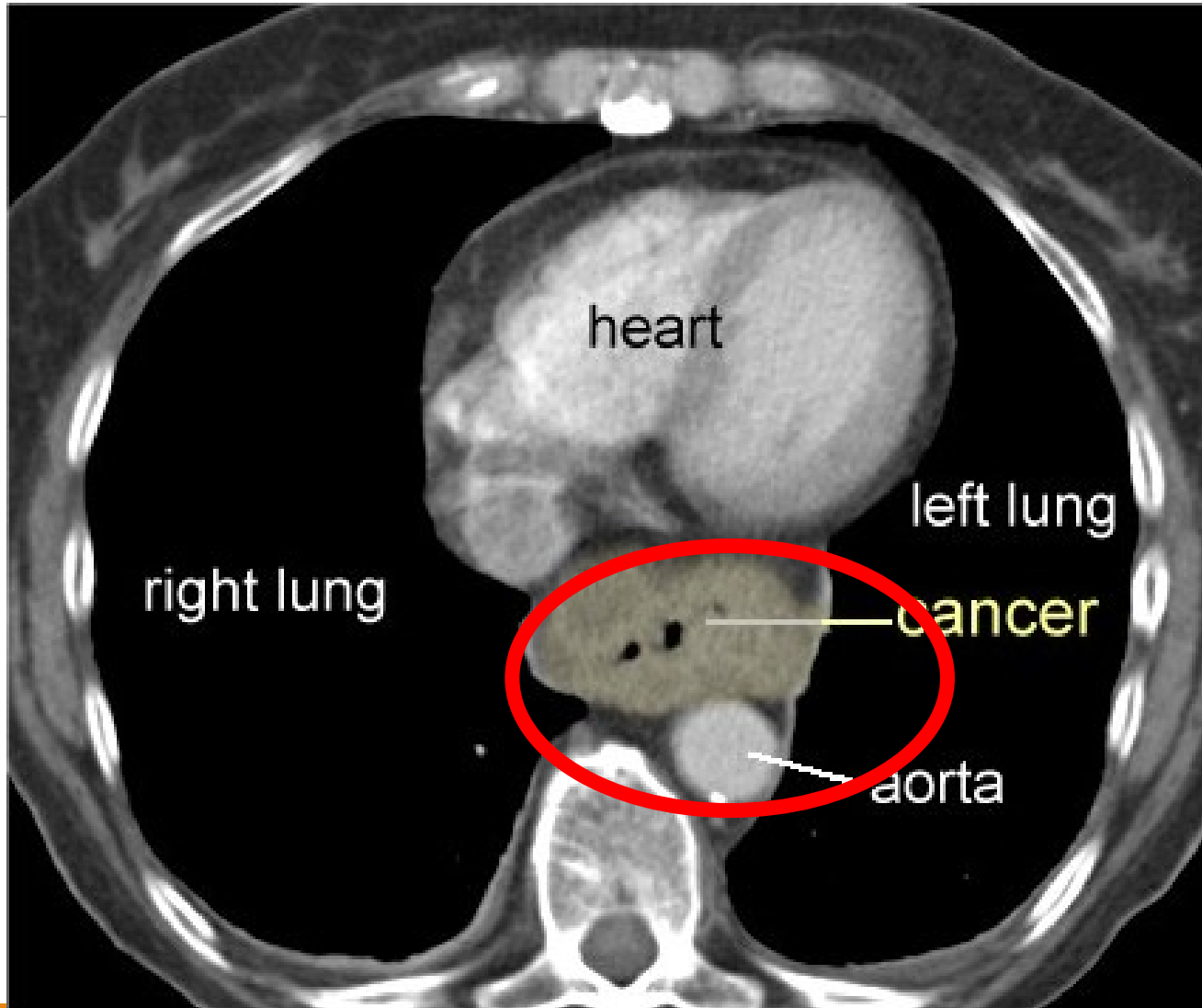
Normal CT of the Esophagus



CT Squamous Cancer in the Upper Esophagus



CT Adenocarcinoma Lower Esophagus



Endoscopic Ultrasonography

EUS:

- assess the depth of penetration and LN involvement. Limited by the degree of obstruction.
- Compared with EUS, CT is not a reliable tool for evaluation of the extent of tumor in the esophageal wall.

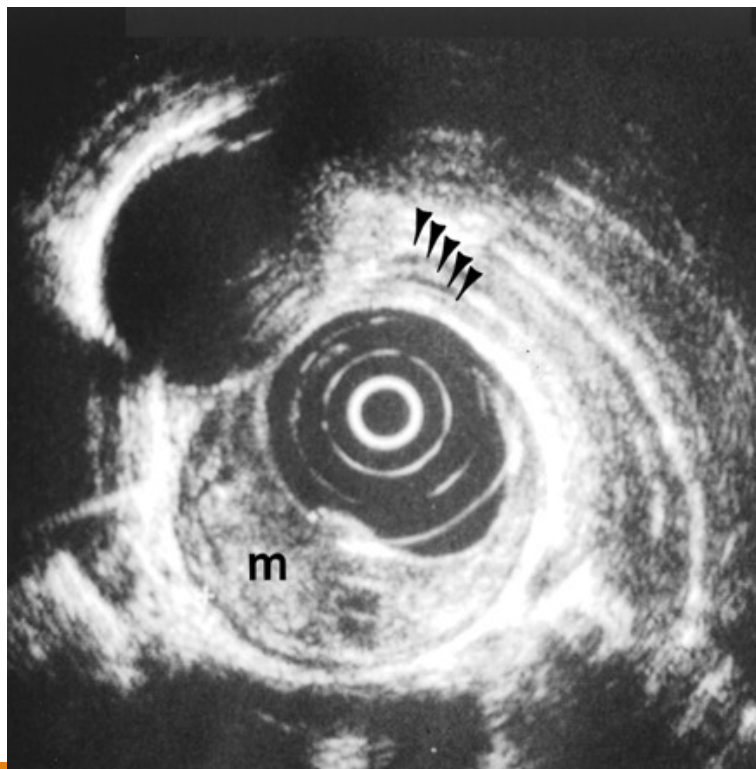
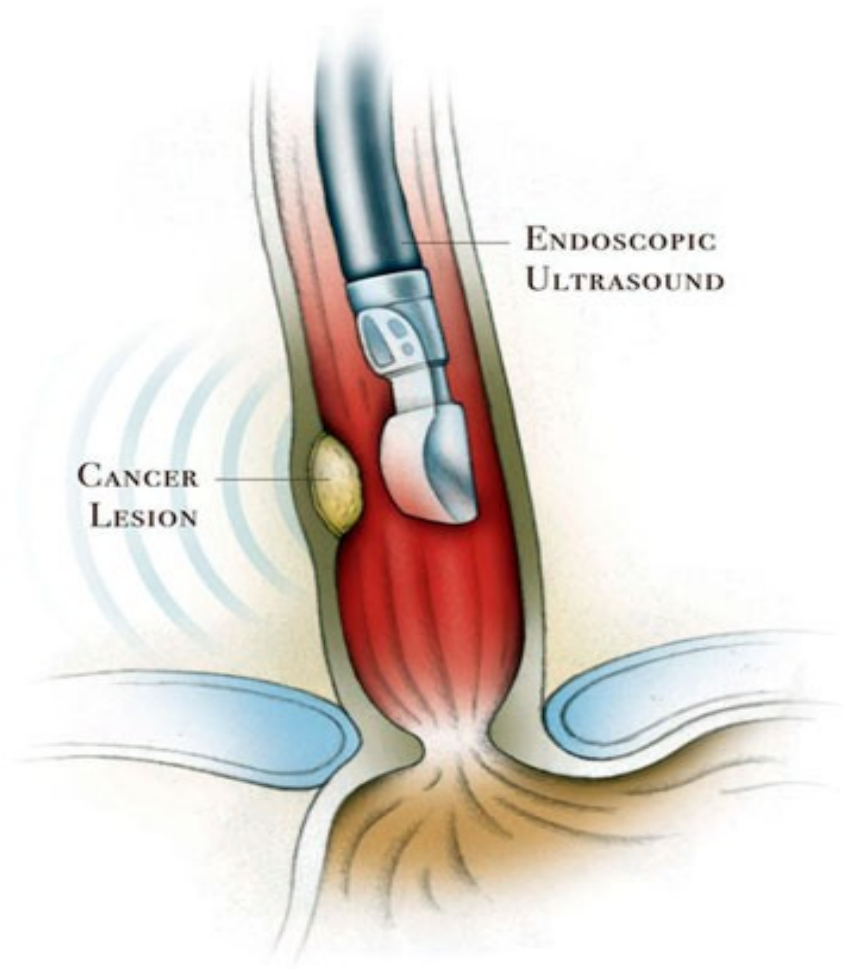
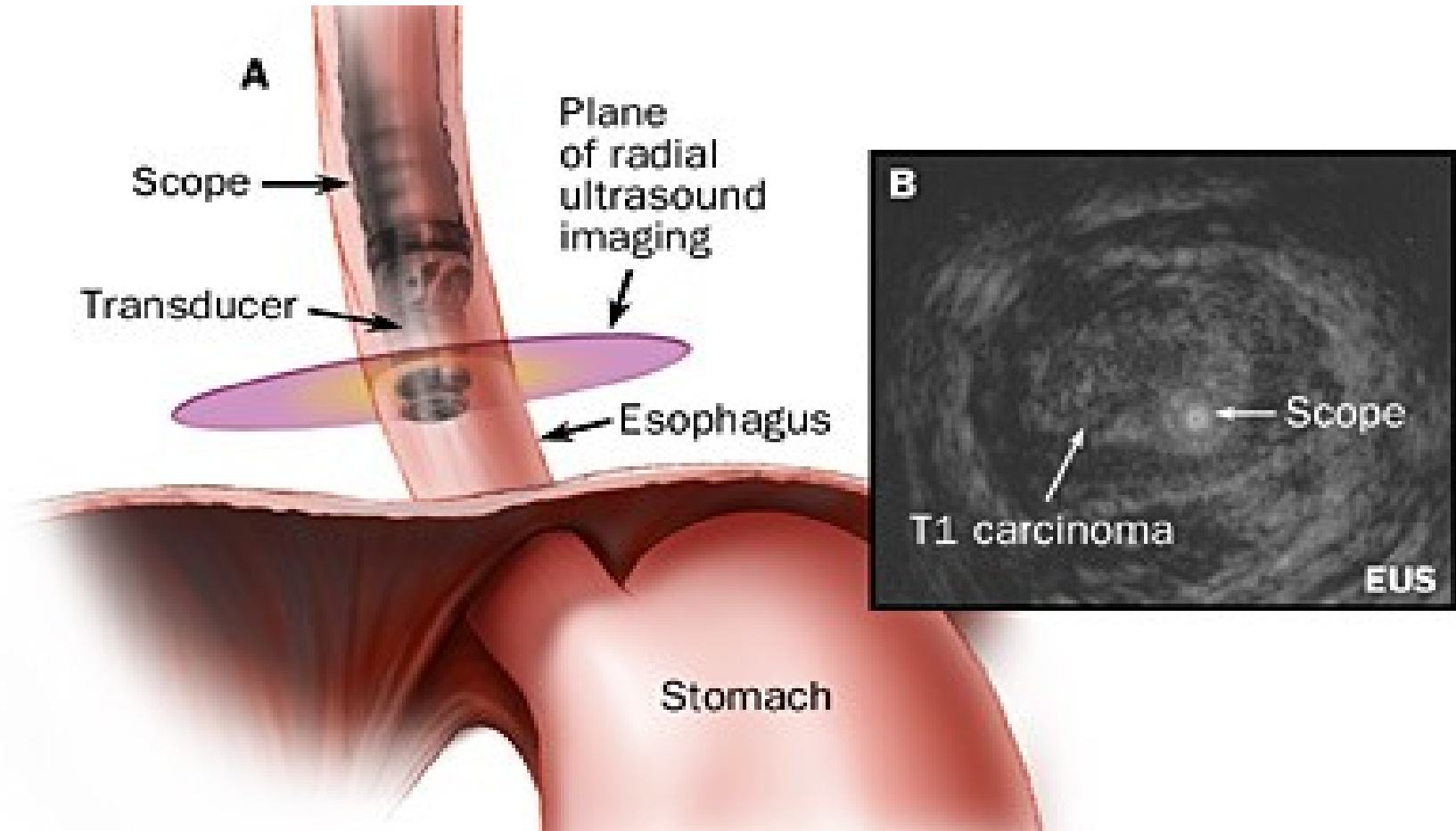


Fig. —55-year-old man with T2 esophageal tumor (m) shown on endoscopic sonogram. Note alternating hyperechoic and hypoechoic layers (*arrowheads*) of normal esophageal wall as seen on sonography. Innermost layer is hyperechoic and corresponds to superficial mucosa. Second layer is hypoechoic and corresponds to deep mucosa and muscularis mucosae. Third layer is again hyperechoic and corresponds to submucosa and its interface with muscularis propria. Fourth layer is hypoechoic and corresponds to muscularis propria, and outer fifth layer is hyperechoic and corresponds to adventitia.

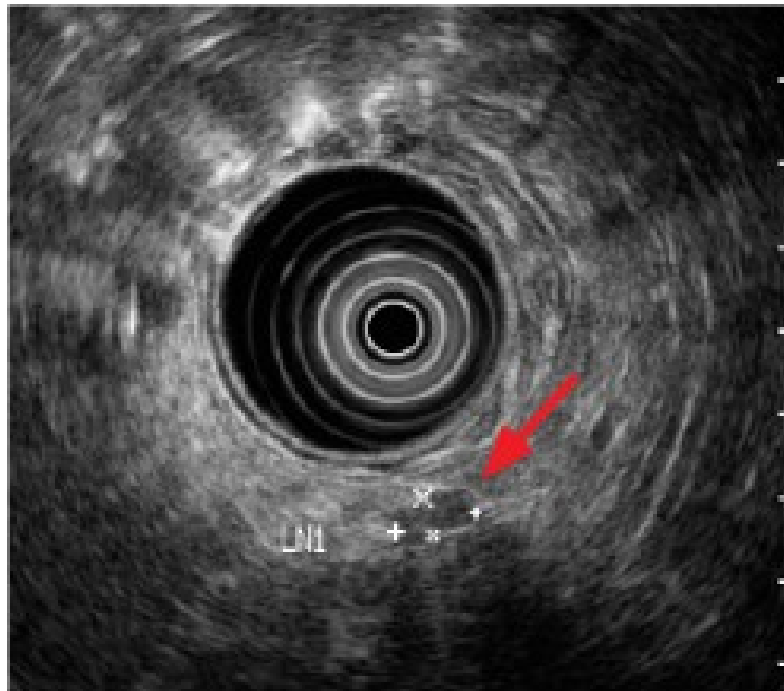
Endoscopic Ultrasound



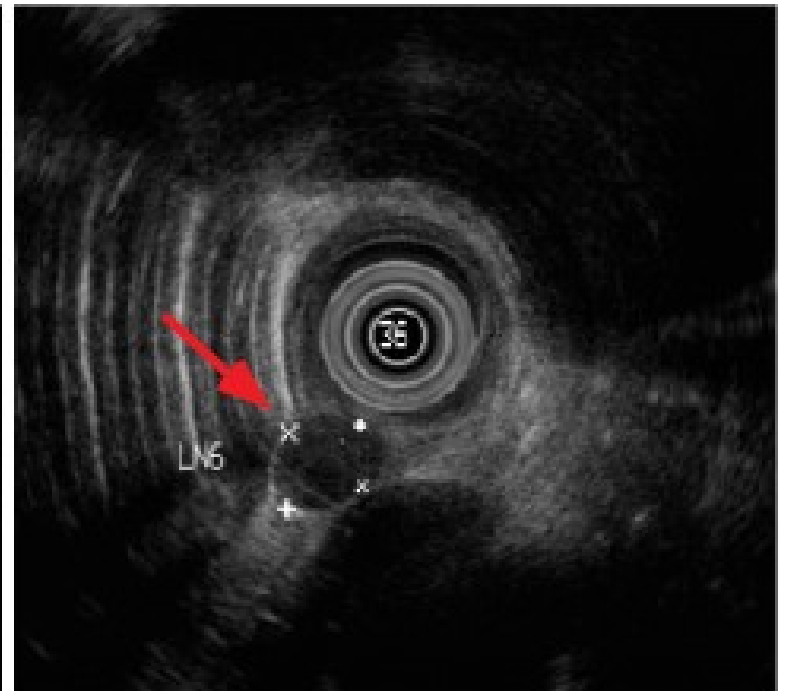
Endoscopic Ultrasound



Endoscopic Ultrasound and Peri-esophageal Lymph Nodes



Benign



Malignant

PET Scan

most recently, proven to be valuable staging tool

can detect up to 15–20% of metastases not seen on CT and EUS

low accuracy in detecting local nodal disease compared to CT / EUS

Value in evaluating response to Chemo Therapy & Radio Therapy

addition of PET to CT can improve specificity and accuracy of non-invasive staging

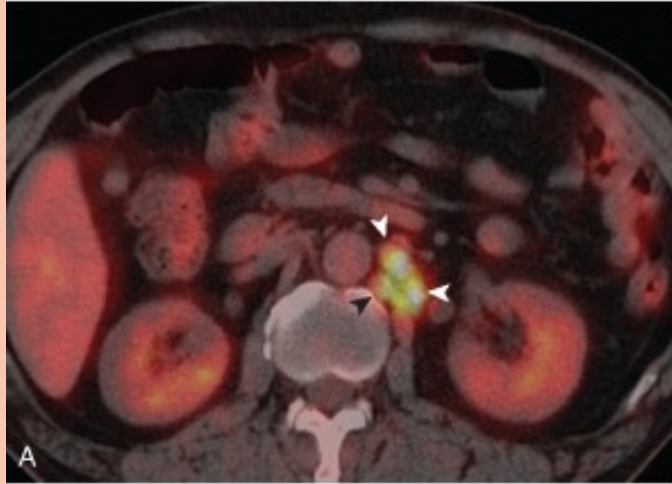
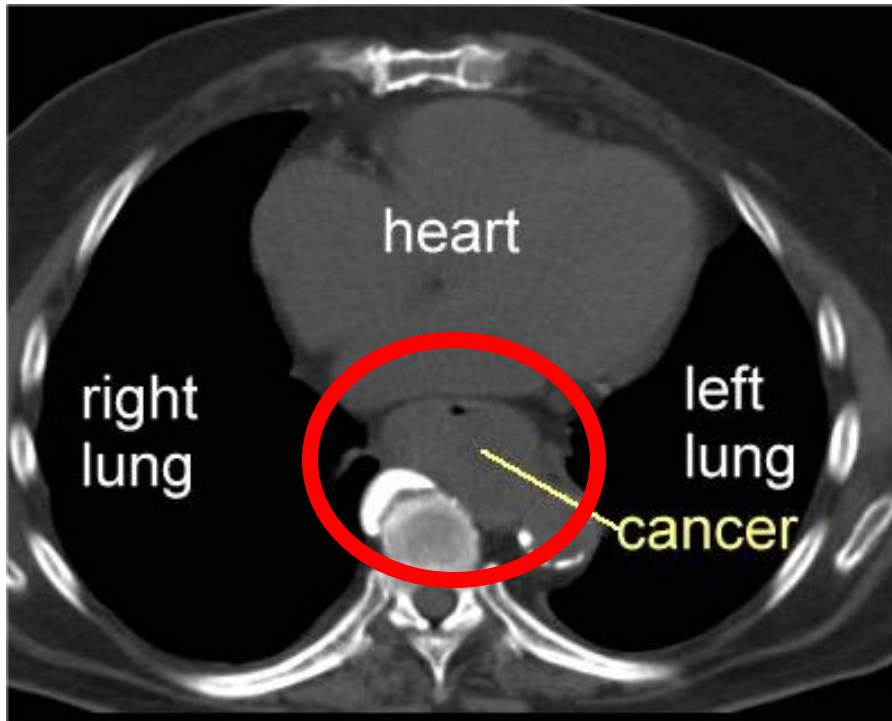
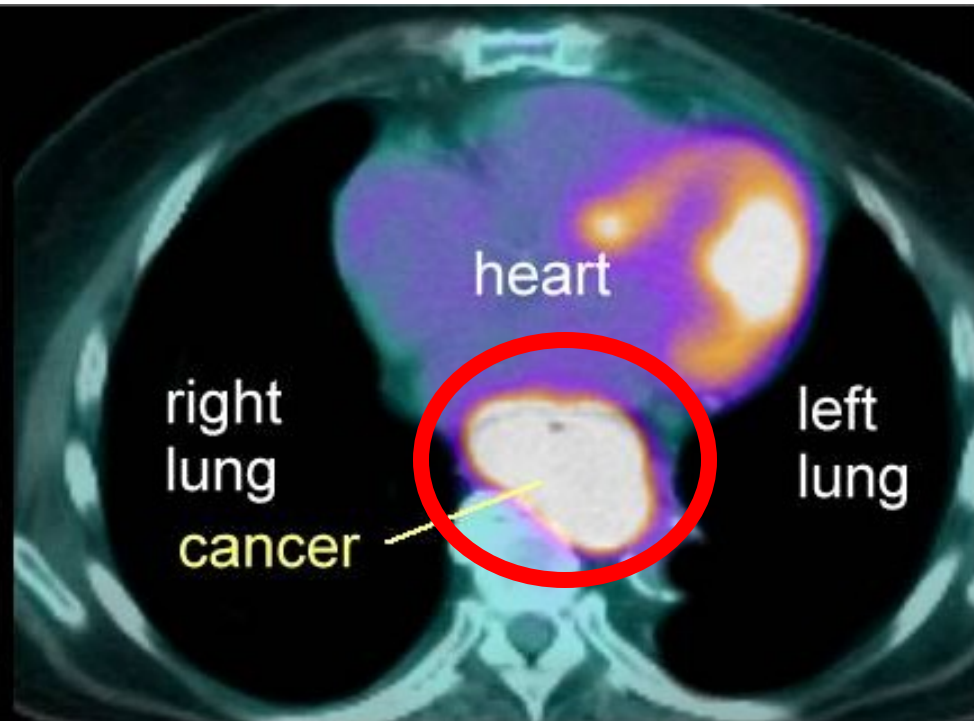


Figure Distant lymph node metastases of esophageal cancer detected by integrated CT PET. **A**, Integrated CT PET demonstrates para-aortic lymph node metastases showing increased FDG uptake (*arrowheads*). **B**, Corresponding CT image shows lymph nodes (*arrowheads*) measuring 5 to 8 mm in diameter. Based on size criteria, these lymph nodes may be considered benign on CT scan

CT and PET Scan

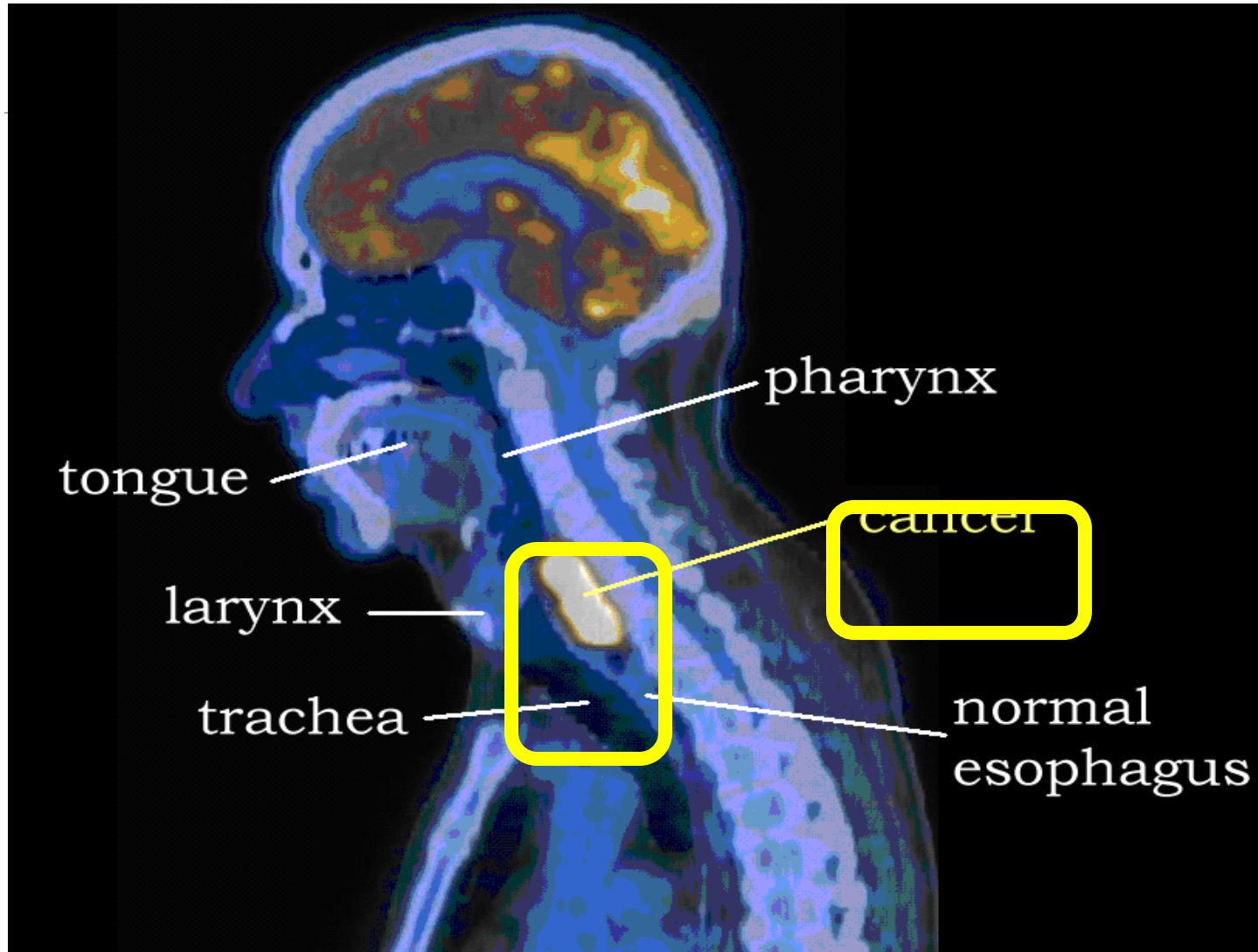


CT Scan

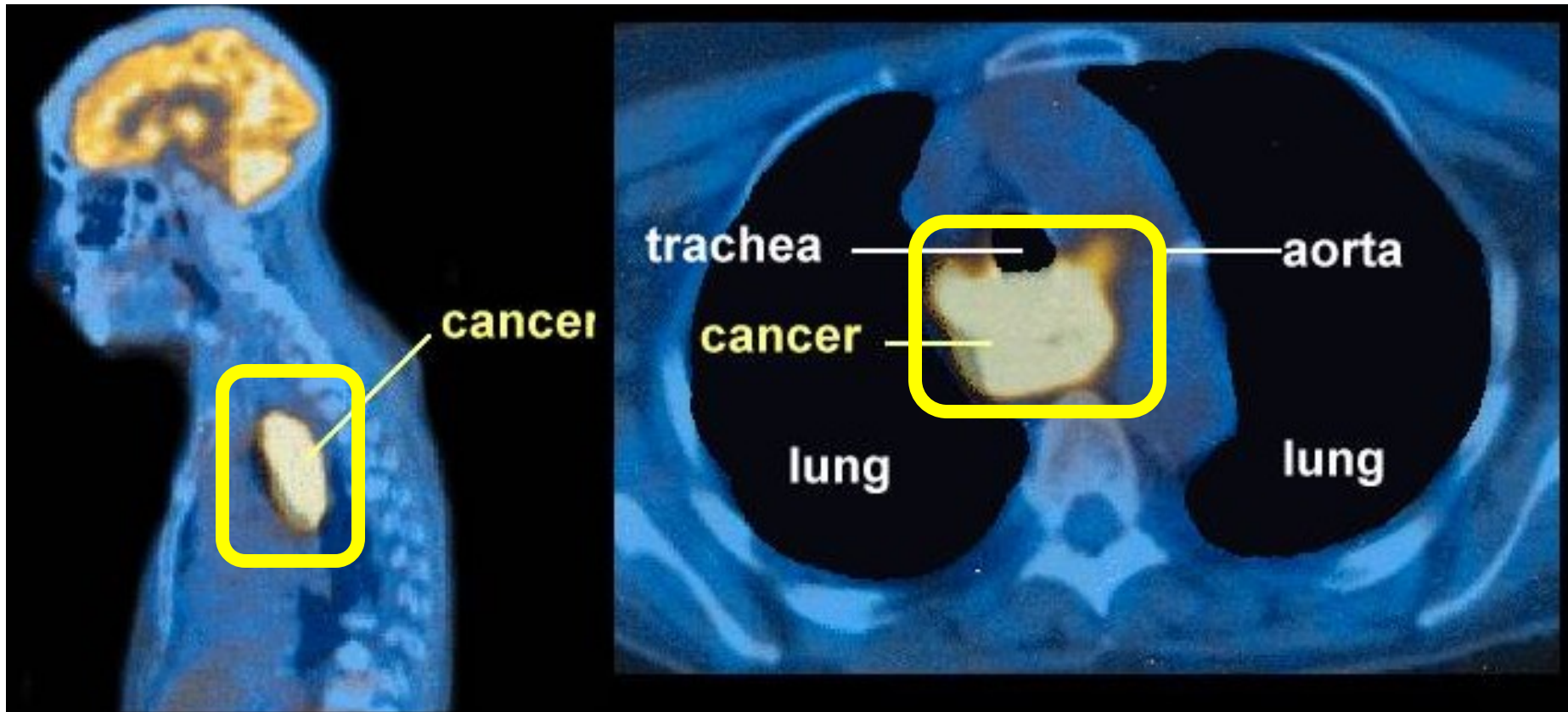


PET Scan

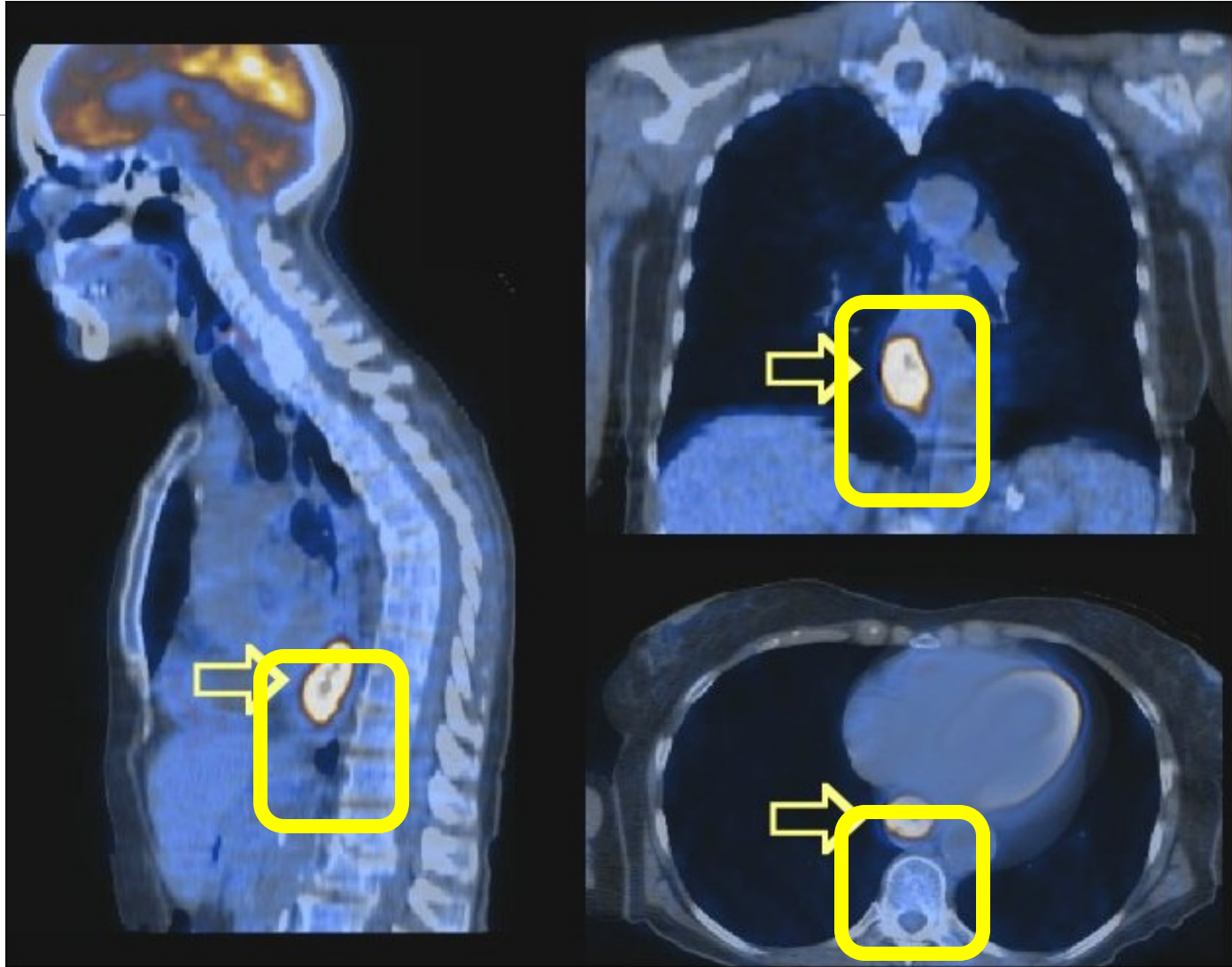
PET Scan: Large Squamous Cancer of the Upper Esophagus



PET Scan Mid Esophagus Cancer



FDG PET Scan Lower Esophagus Cancer

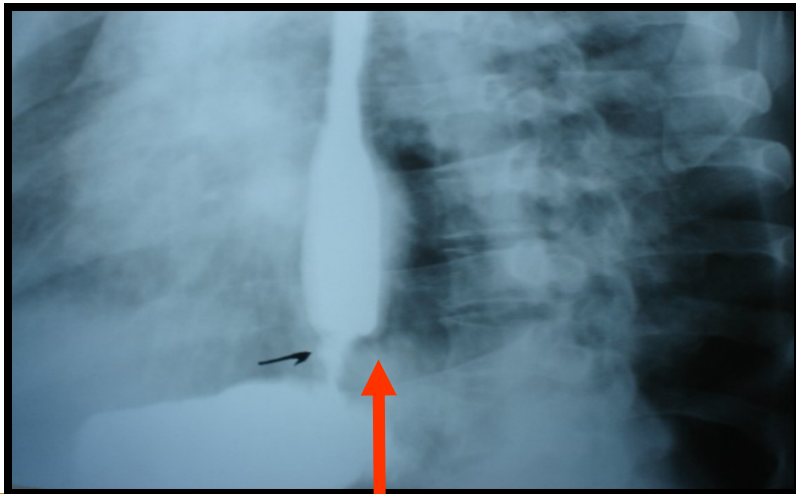


Barium swallow:

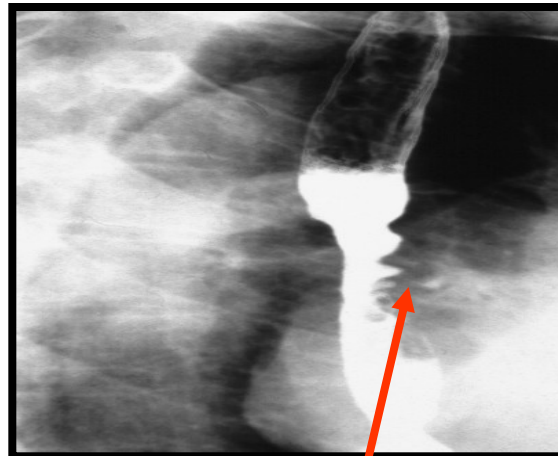
- can delineate proximal and distal margins as well as TEF
- Helpful for correlation with simulation film.

Bronchoscopy: rule-out fistula in midesophageal lesions.

Routine Investigations: CBC, chemistries, LFTs.



Rat tail appearance

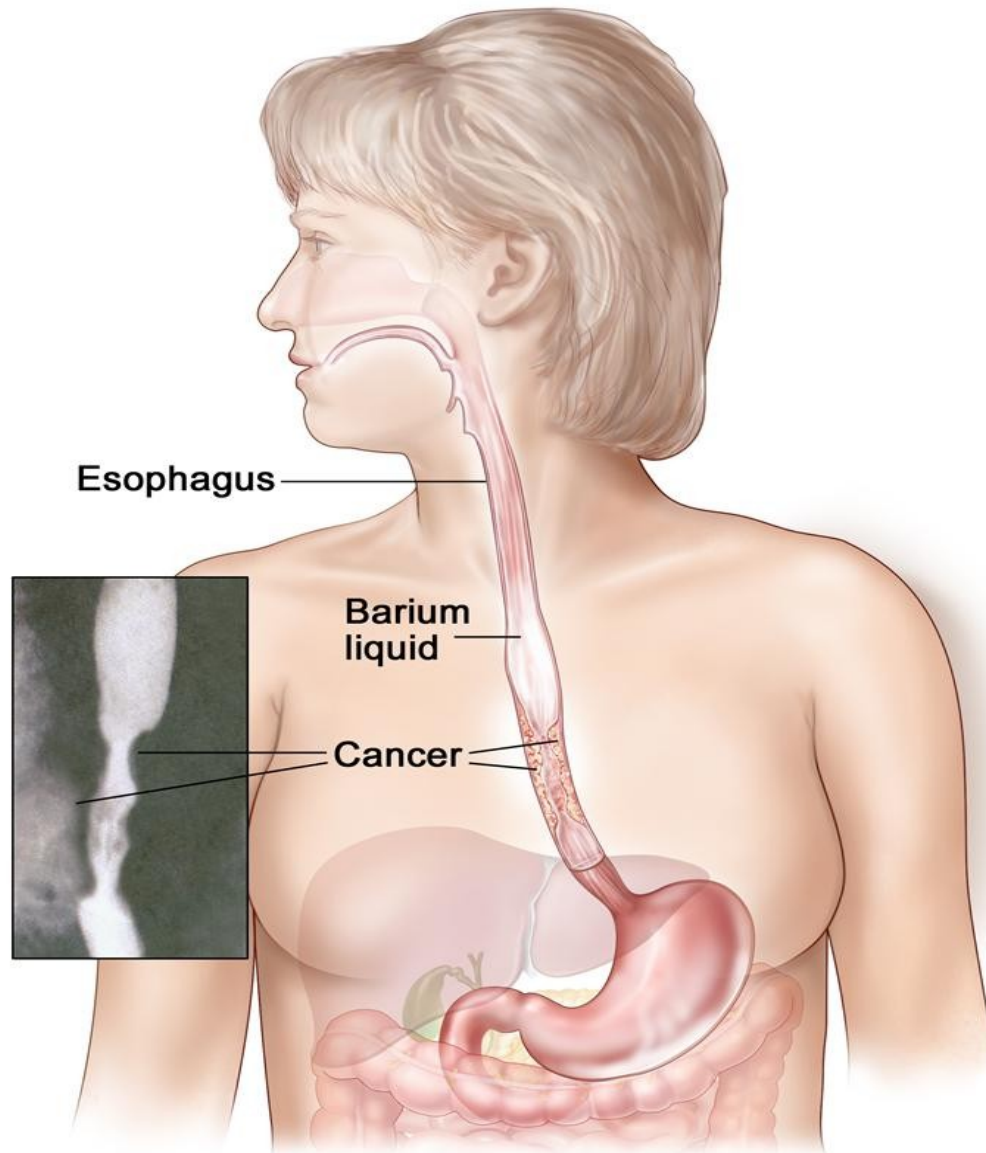


Cancer lower 1/3
Filling defect (ulcerative type)

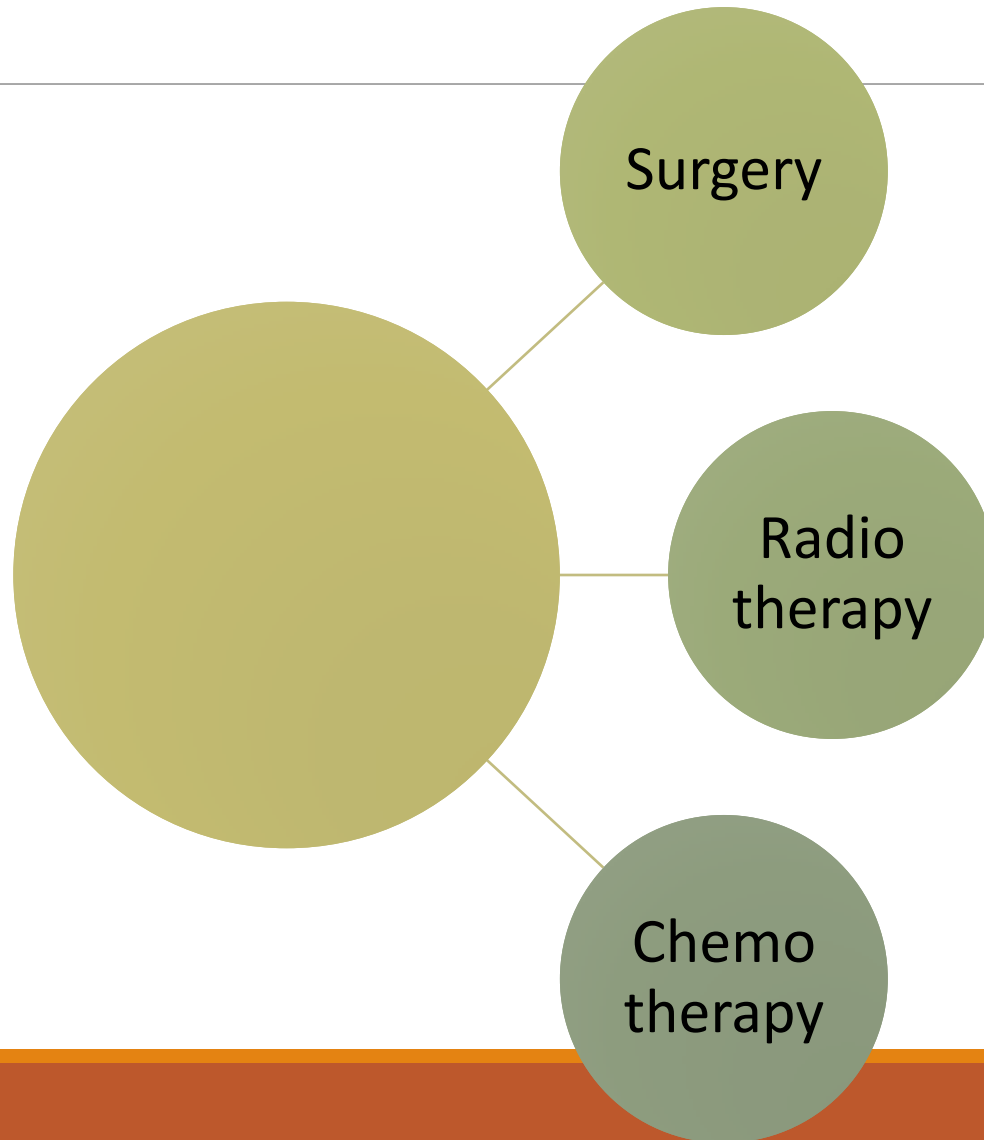


Apple core appearance

Barium Swallow



Treatment



Management depends upon:

Site of disease

Extent of disease involvement

Co-morbid conditions

Patient preference.

Surgery

Prerequisite for surgery

- disease should be 5 cm beyond cricopharynx.

Surgery indications

- Lower 1/3 rd oesophageal ds involving GE junction.
- Tumor size <5 cm .
- palliative surgery

5-Year OS for surgery alone is 20–25% (no significant difference between surgical techniques according to results of 2 meta-analyses)

Local failure rate around 19–57% when used alone

surgical morbidity/mortality related to experience of the surgeons.

Types of Surgery

Transhiatal esophagectomy: for tumors anywhere in esophagus or gastric cardia. No thoracotomy. Blunt dissection of the thoracic esophagus. Left with cervical anastomosis. Limitations are lack of exposure of midesophagus and direct visualization and dissection of the subcarinal LN cannot be performed.

Right thoracotomy (Ivor-Lewis procedure): good for exposure of mid to upper esophageal lesions. Left with thoracic or cervical anastomosis.

Left thoracotomy: appropriate for lower third of esophagus and gastric cardia. Left with low-to-midthoracic anastomosis.

Radical (en block) resection: for tumor anywhere in esophagus or gastric cardia. Left with cervical or thoracic anastomosis. Benefit is more extensive lymphadenectomy and potentially better survival, but increased operative risk.

Miniinvasive approach – MIE- minimally invasive esophagectomy

Incisions

Dictated by Approach to Resection

- Upper midline laparotomy
- Right thoracotomy
- Left Thoracotomy
- Left Thoracoabdominal incision
- Left Neck incision
- Ivor-Lewis (Laparotomy/Right thoracotomy)
- McKewn (Right thoraco/Laparotomy/Neck incision)
- MIE- Right toracoscopy/Laparoscopy/Neck incision

Rules for Anastomotic Technique

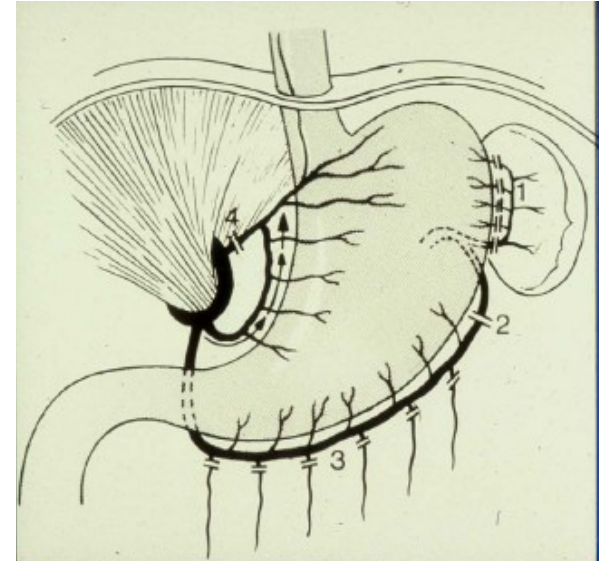
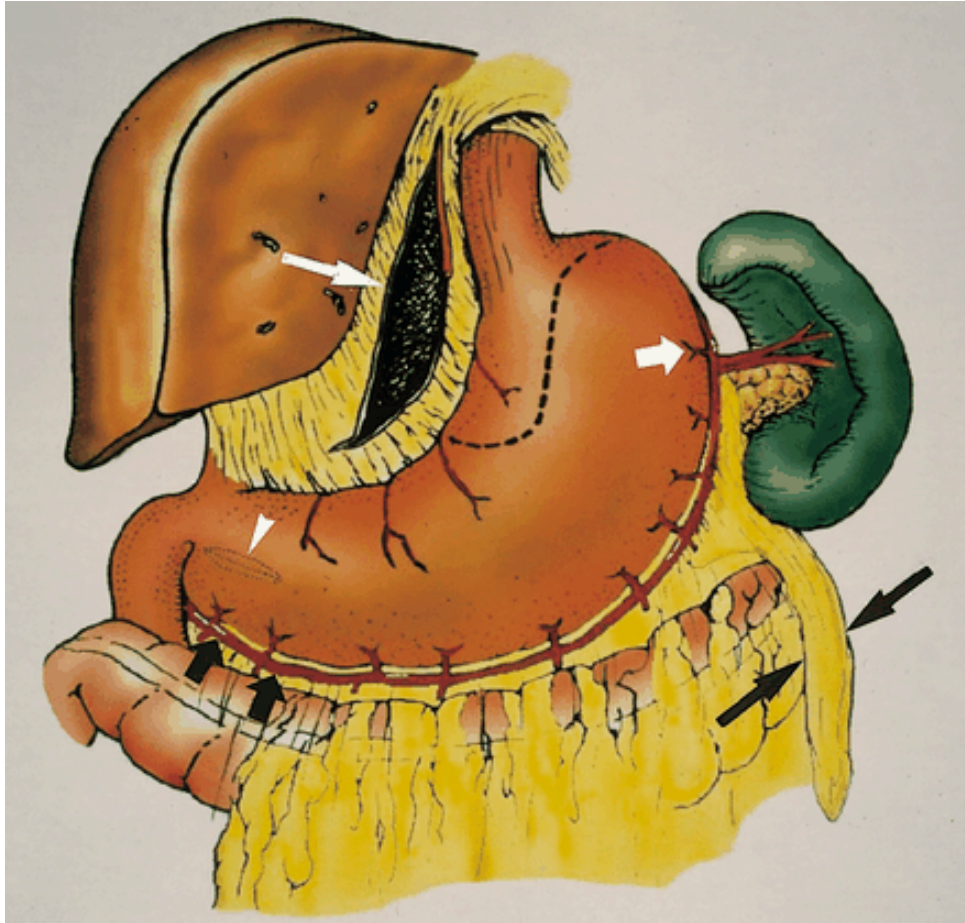
Hand Sewn:

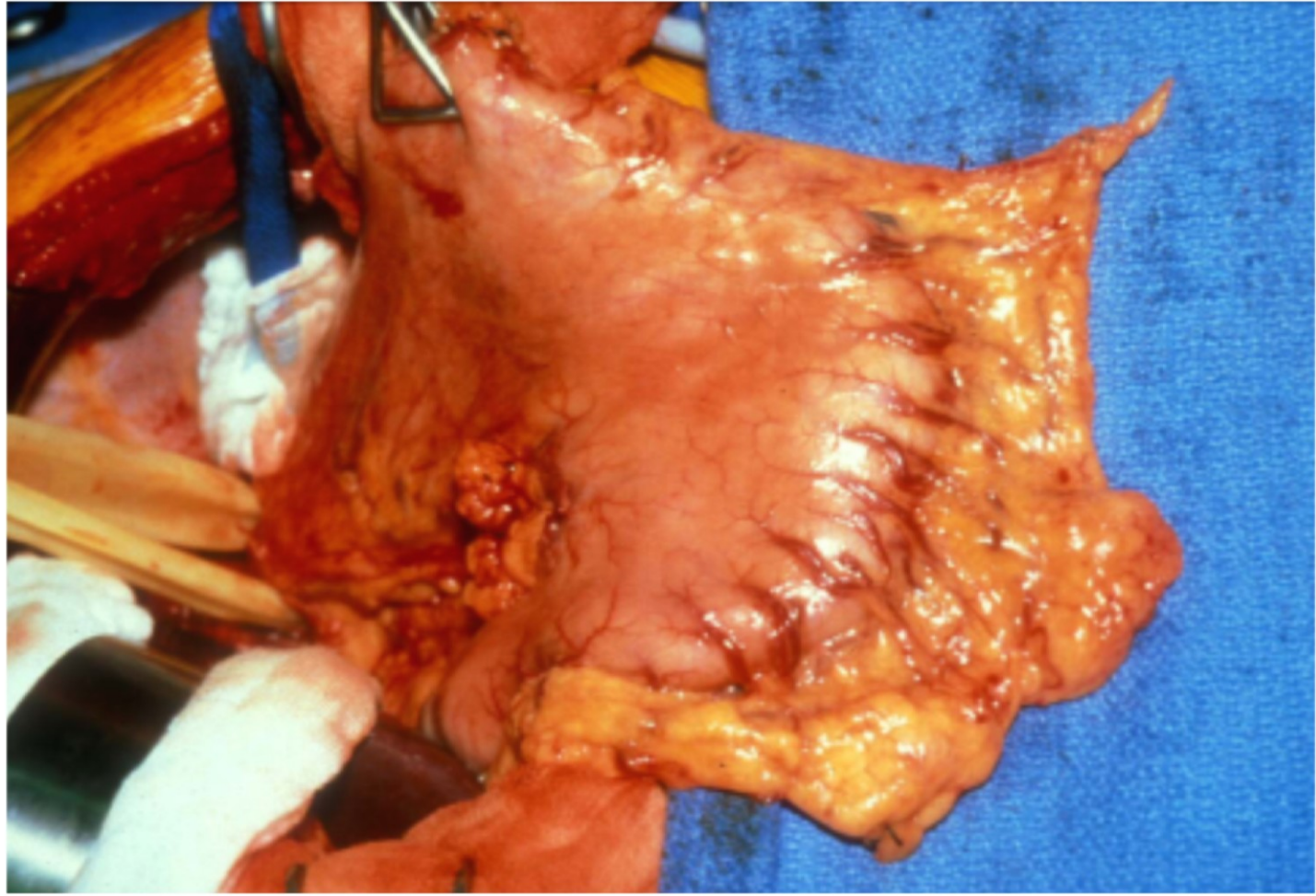
- Double layer
- Single layer
- Interrupted suture
- Continuous suture
- Combination

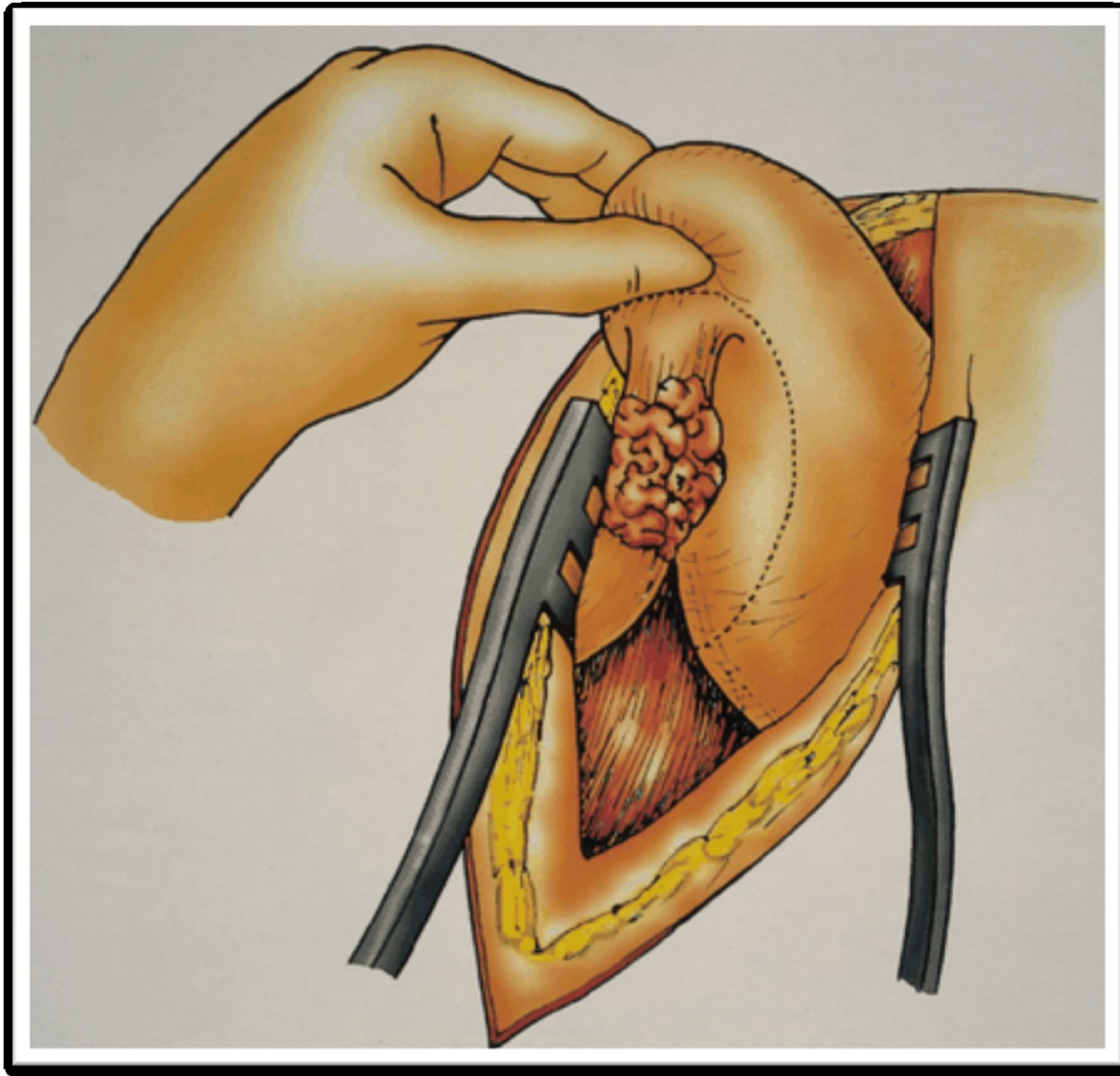
Stapled

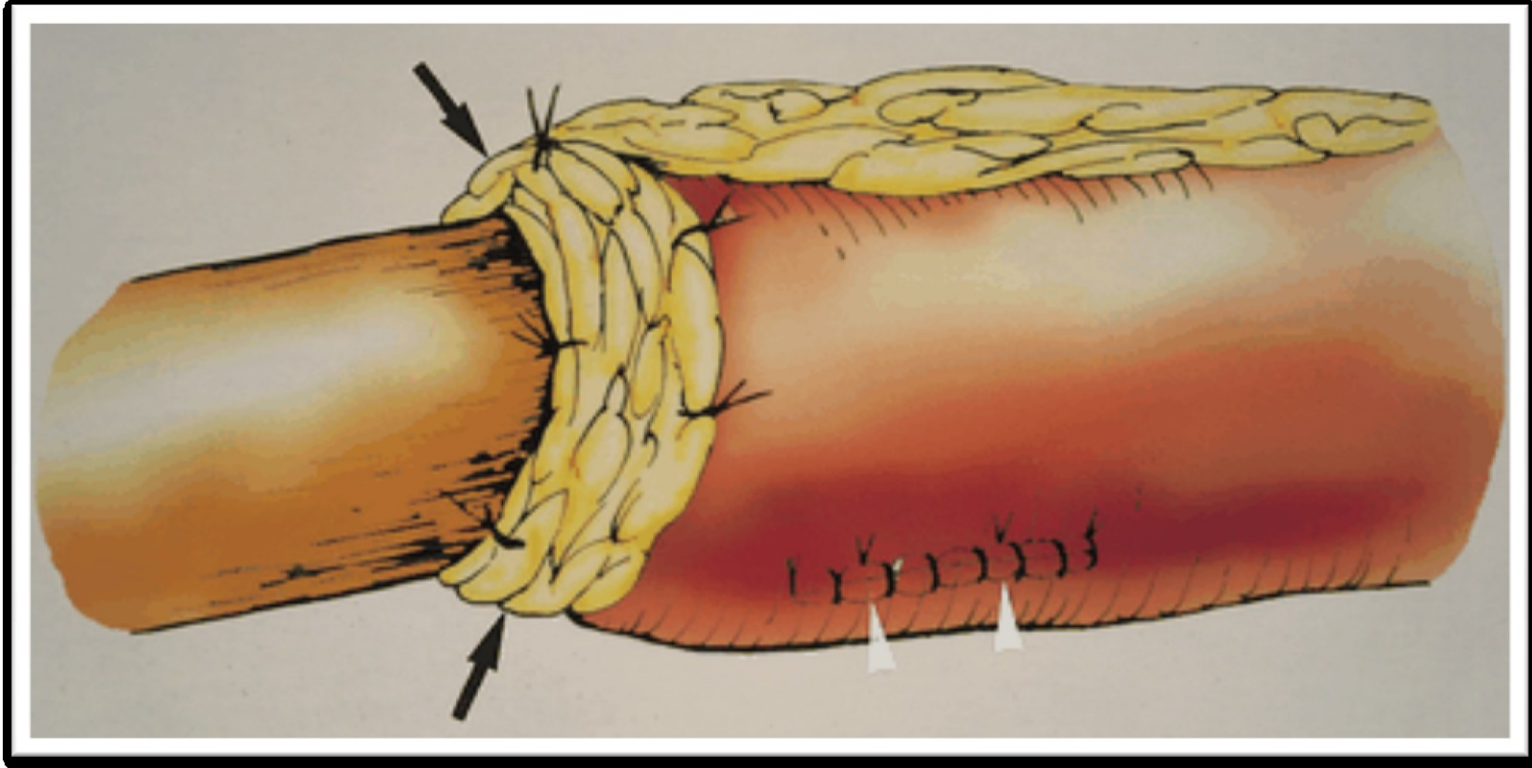
End to Side

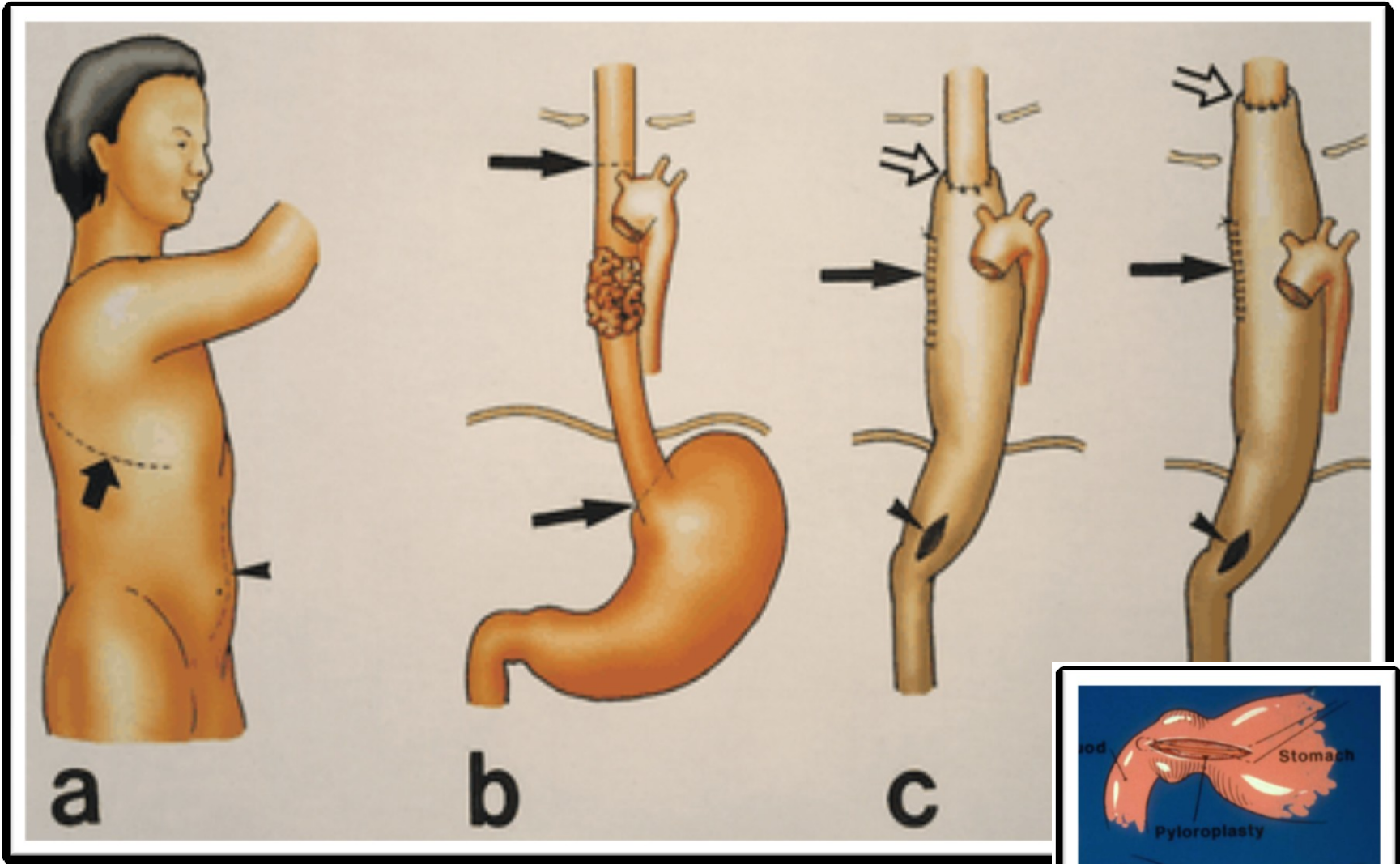
Tension Free anastomosis







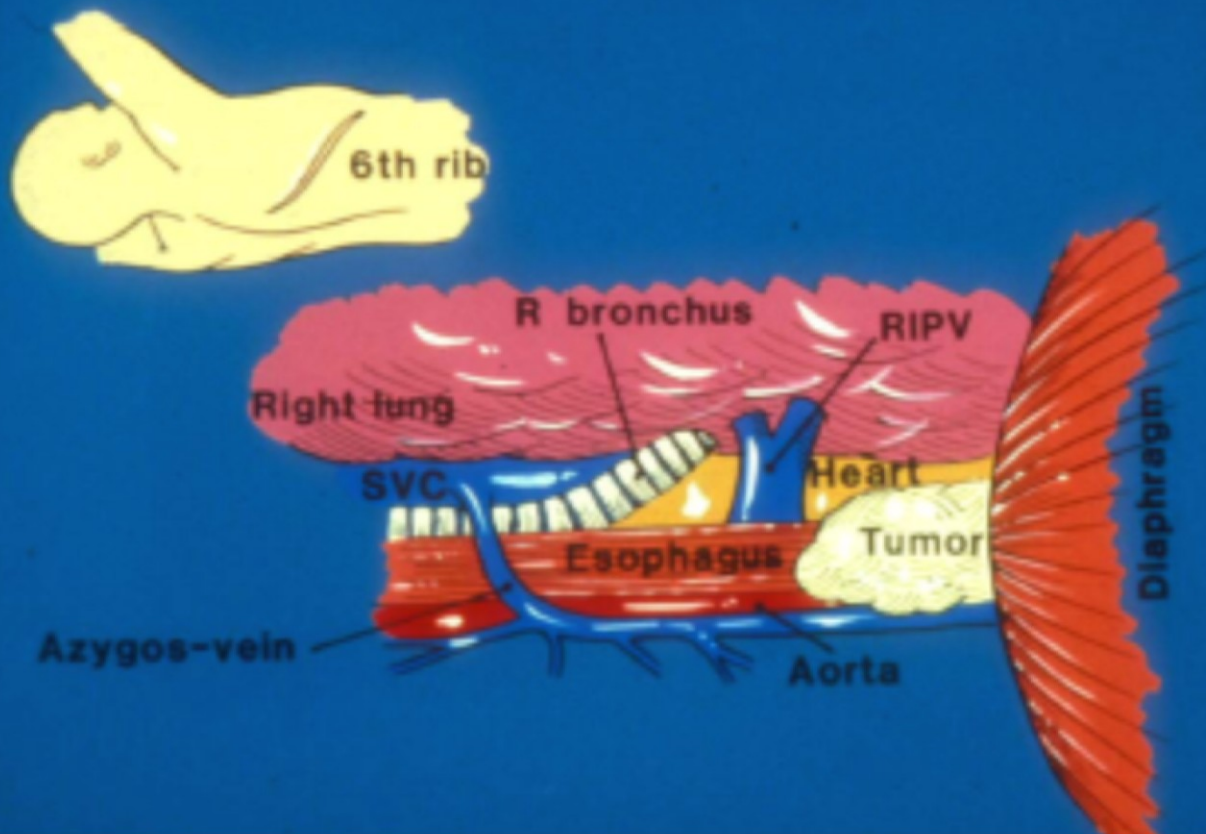




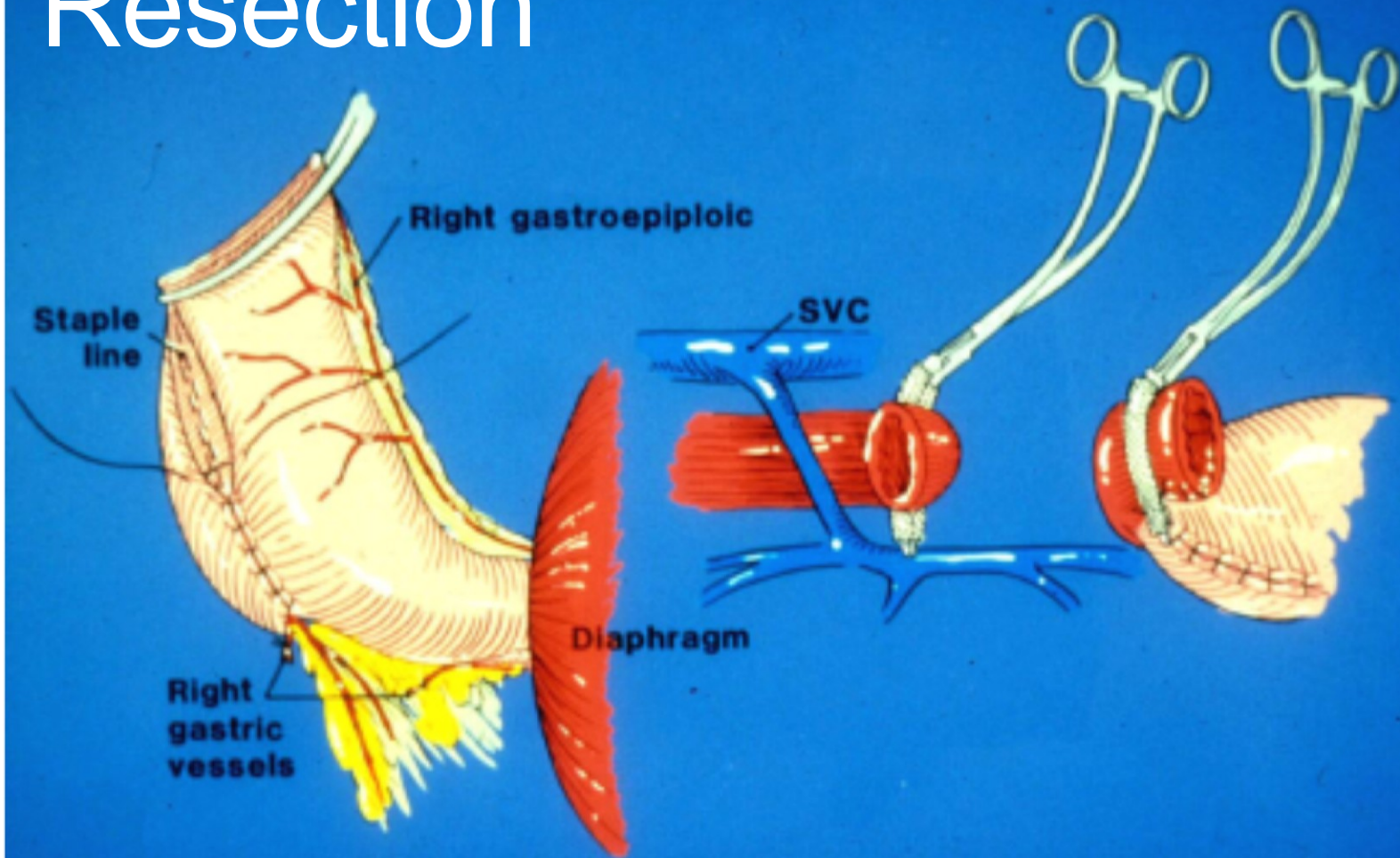


IVOR-LEWIS

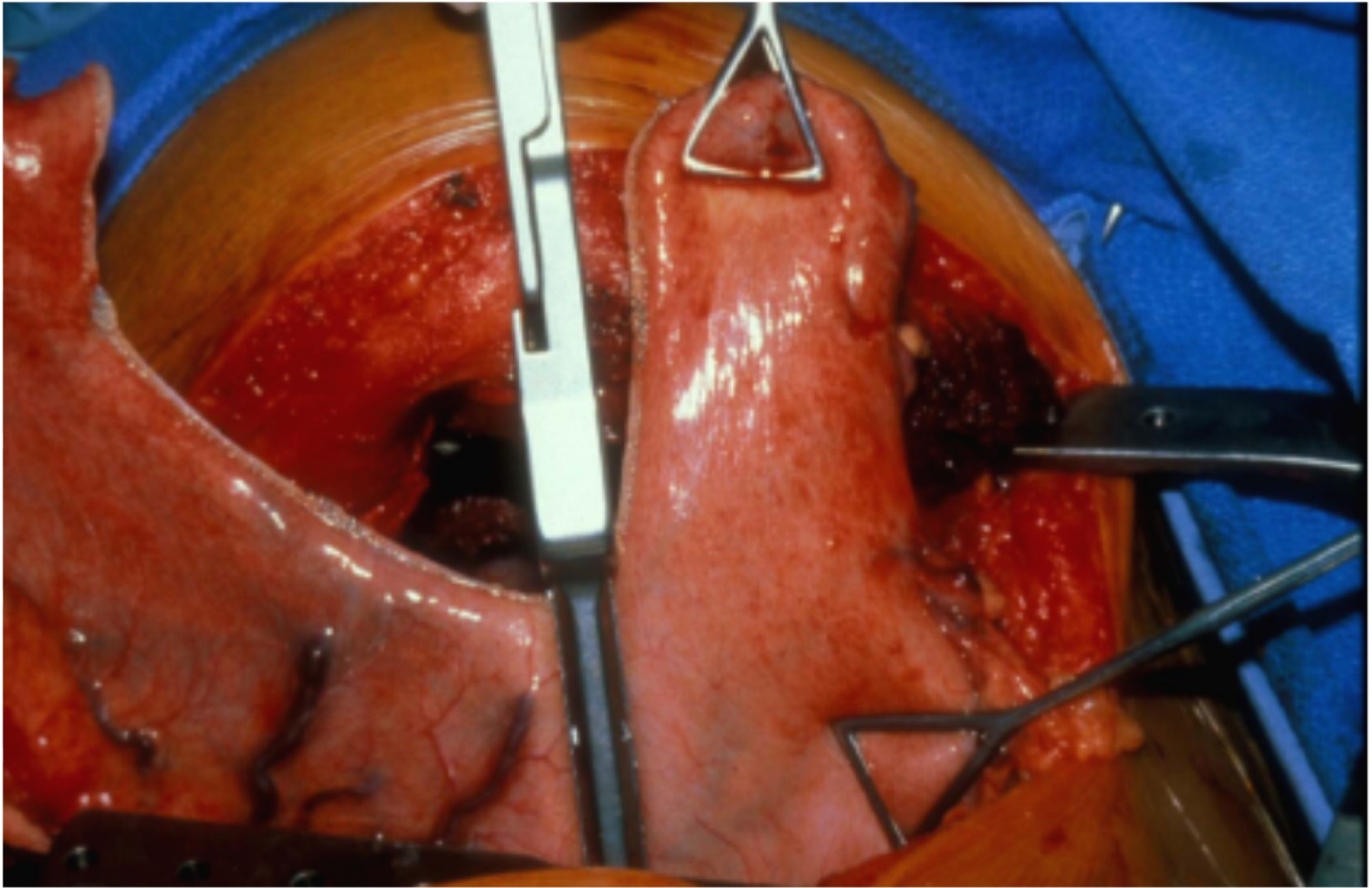
Phase II right transthoracic



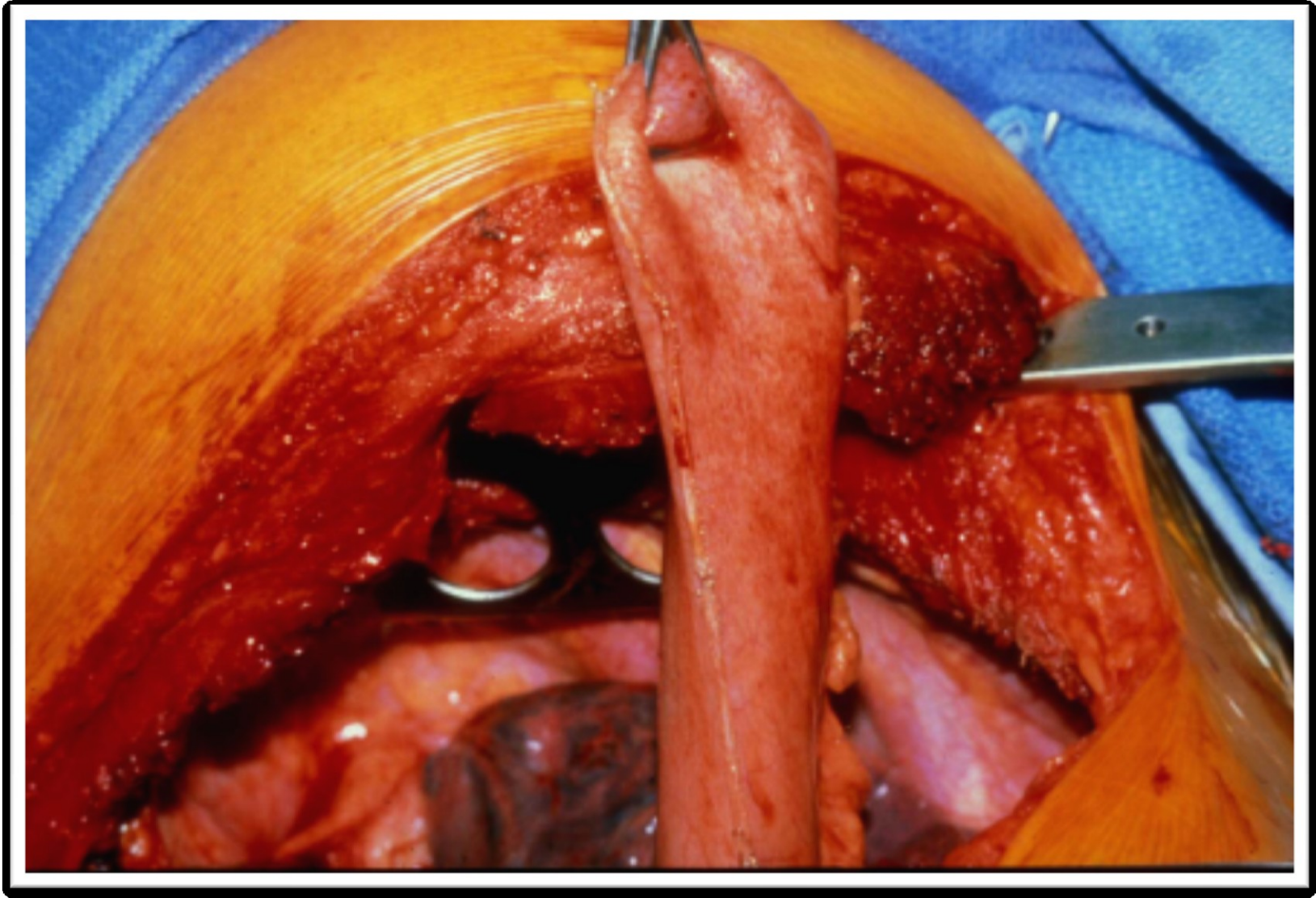
Resection



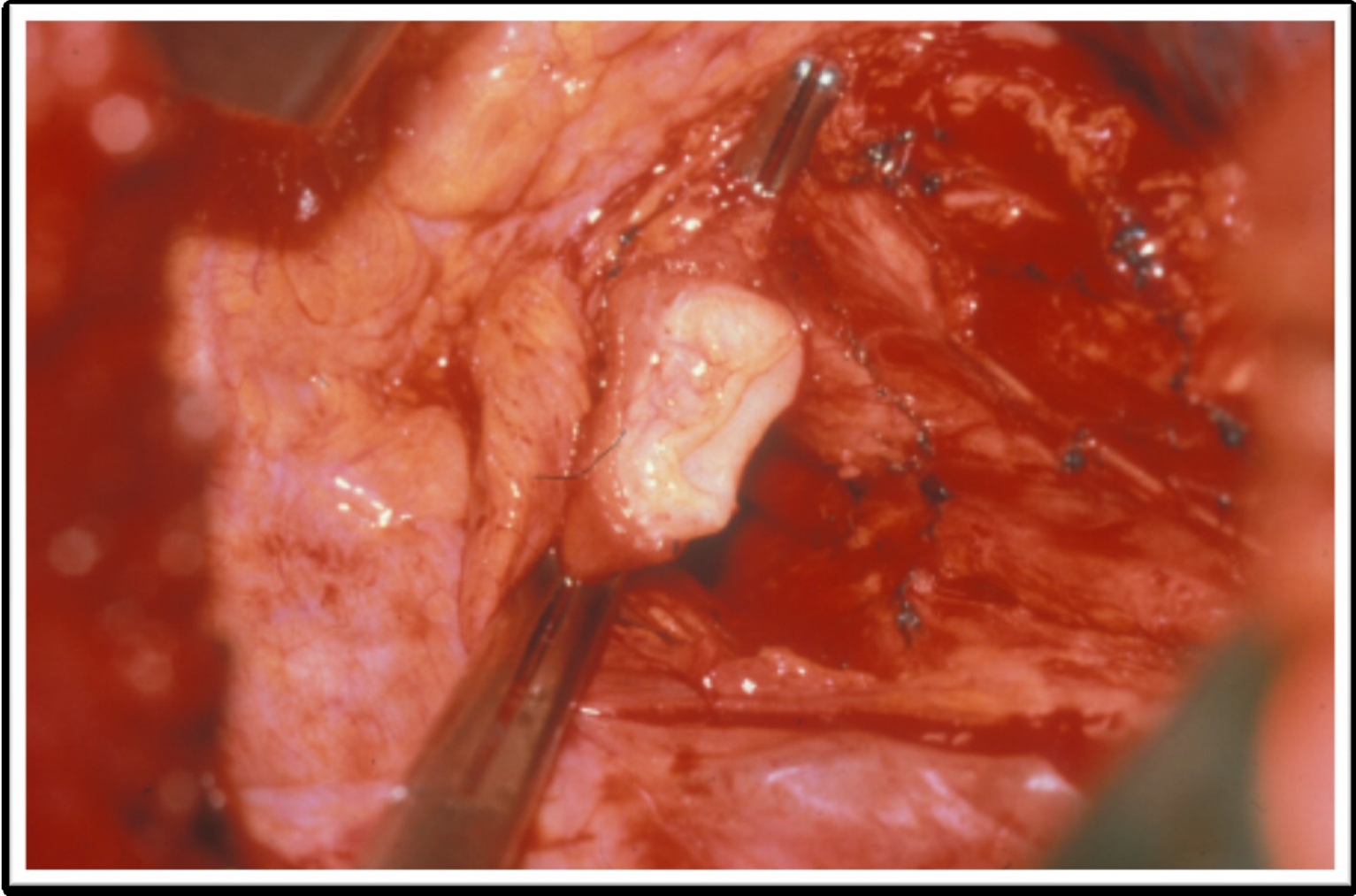
Gastric Tube - Stapling



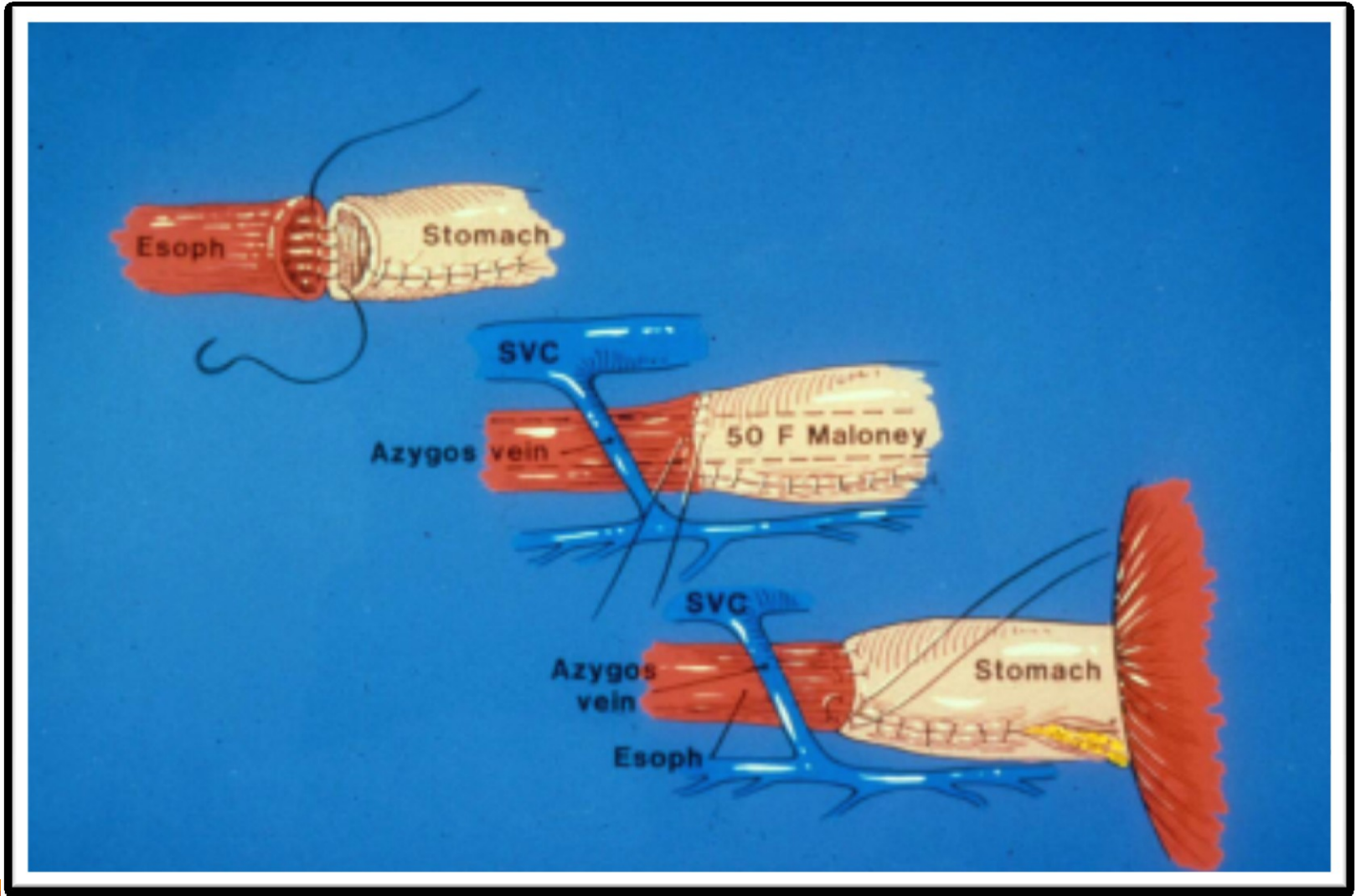
Gastric Tube - Length



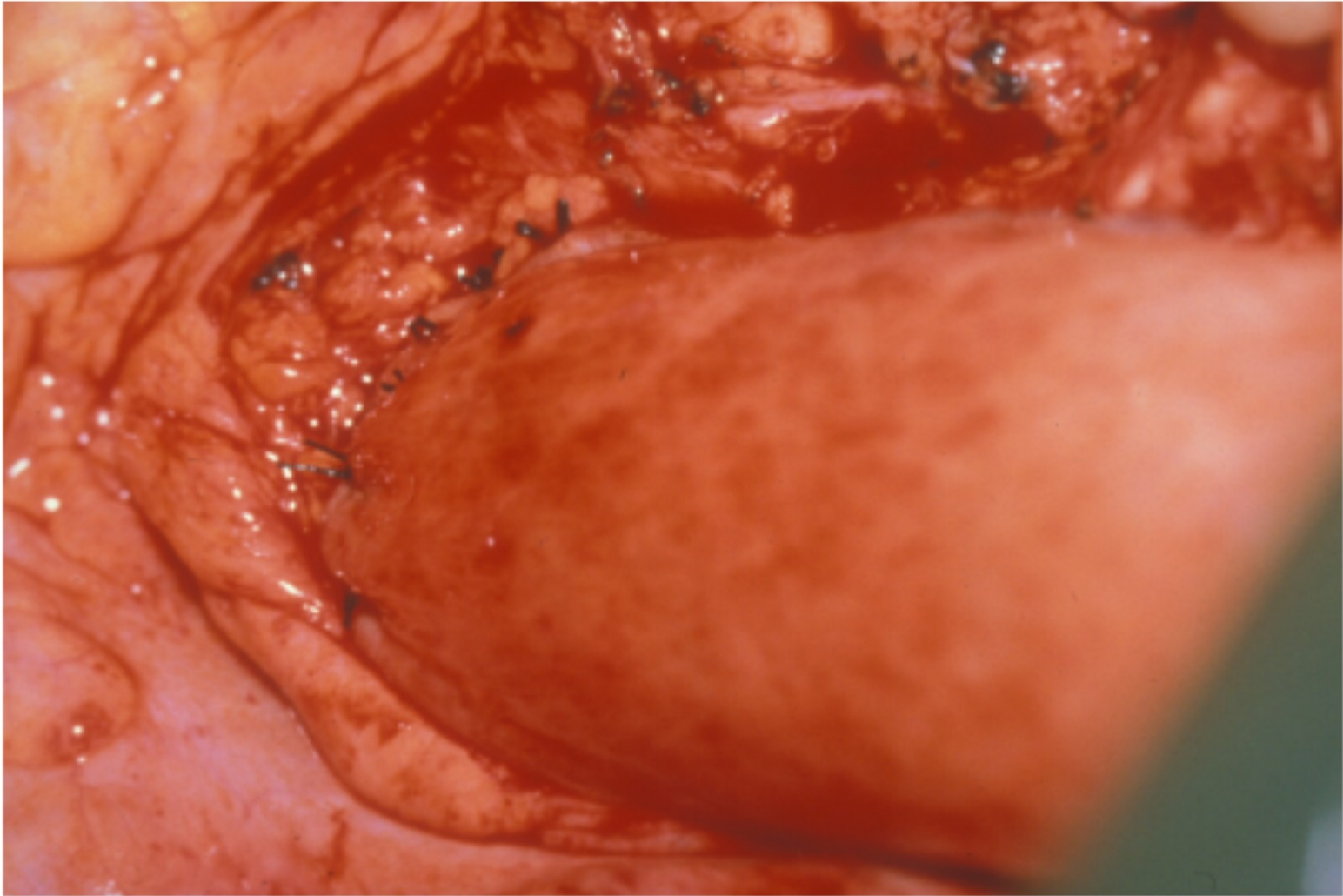
Proximal Esophagus



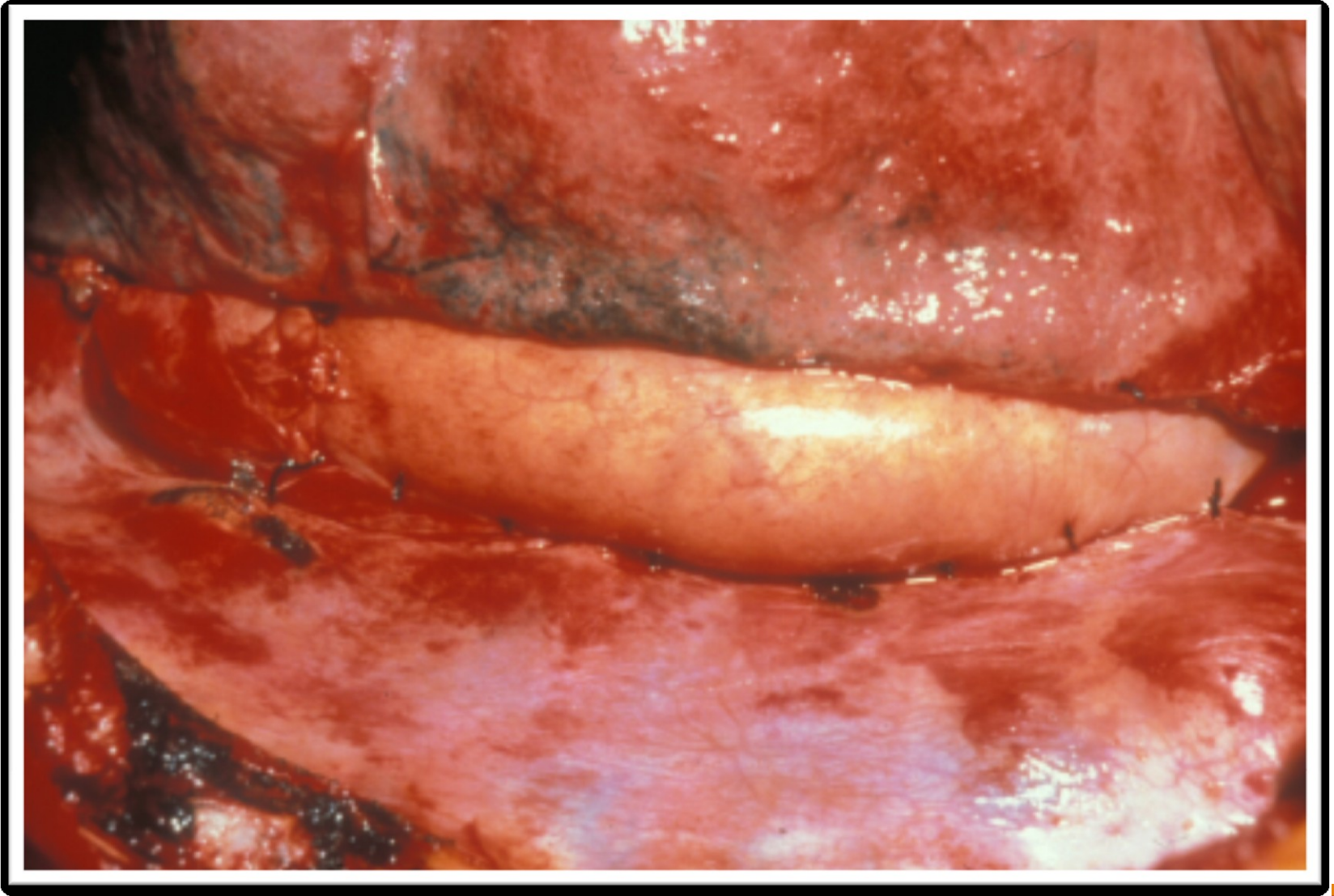
Anastomosis



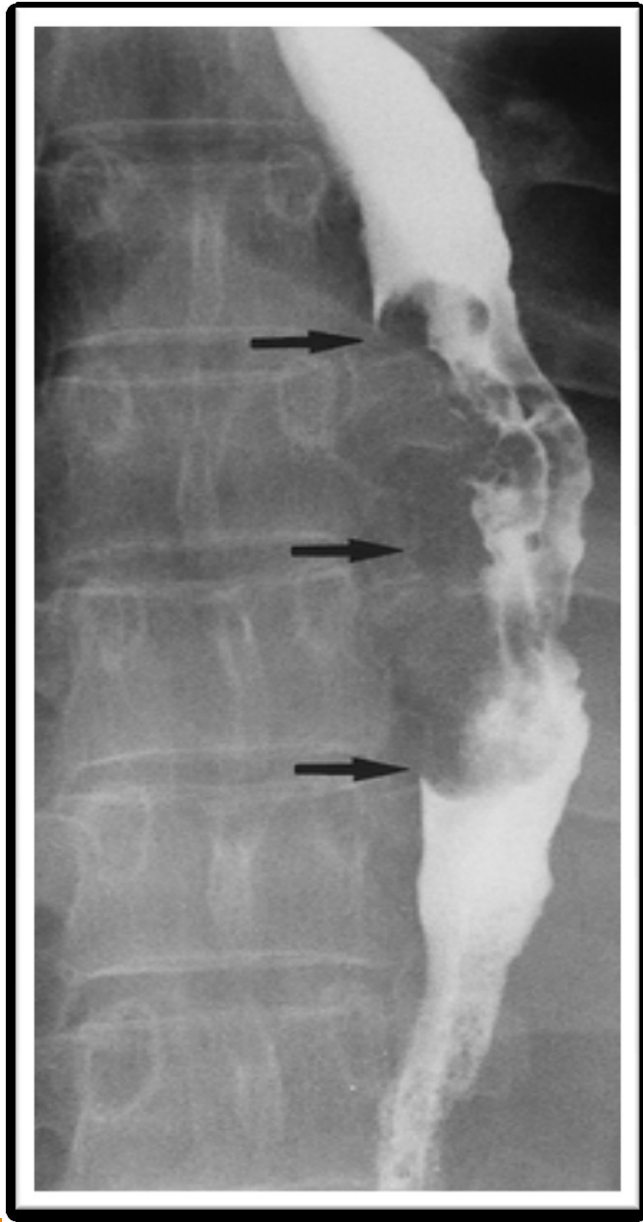
Gastric Tube - Anastomosis



Gastric Tube - Posterior Mediastinum



Indications



**Midesophageal
carcinomas**

Indications

High-grade dysplasia in Barrett esophagus.

Destruction of the distal two-thirds of the esophagus by :

- caustic ingestion, peptic stricture and ulcer,

Persistent reflux esophagitis causing pulmonary complications that fail to respond to antireflux procedures.

Perforation of the mid- to distal esophagus .

Contraindications

High **esophageal** carcinomas located within 20 cm of the incisors.

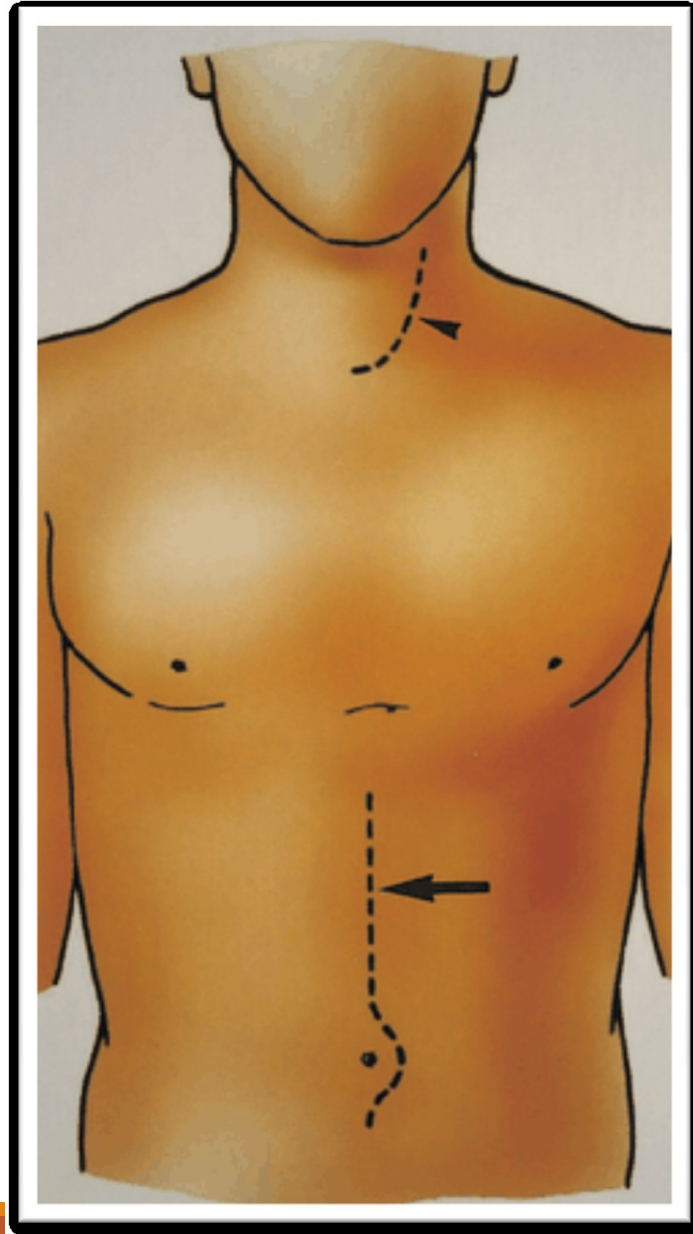
Patients with previous right thoracotomy due to postoperative adhesion

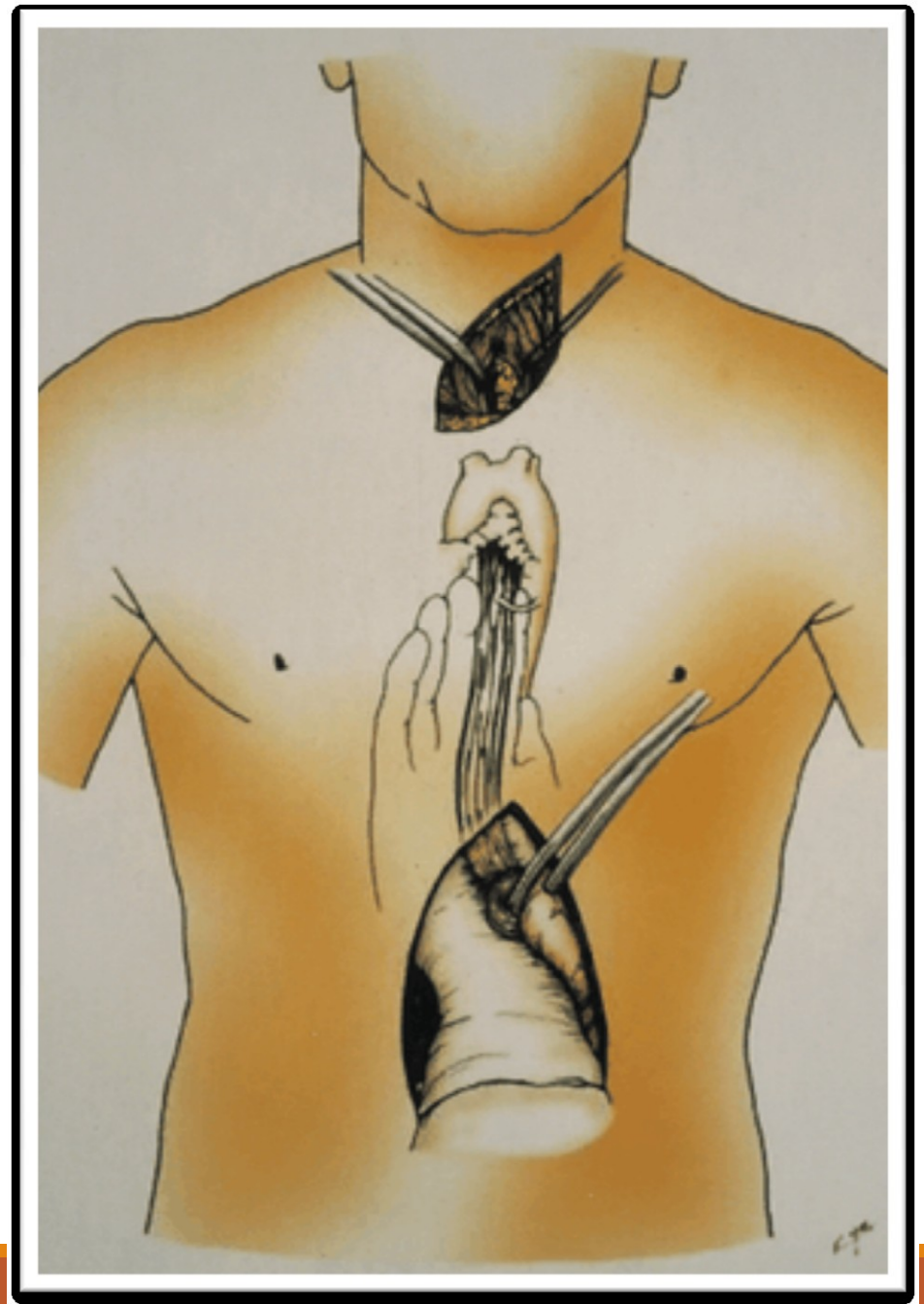
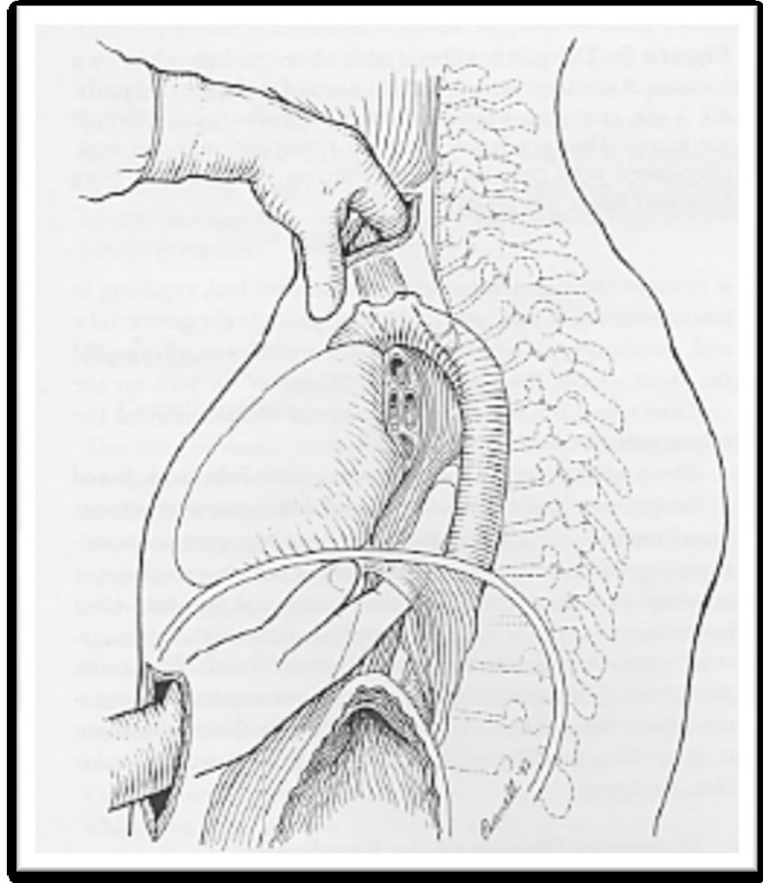
Transhiatal Esophagectomy without Thoracotomy

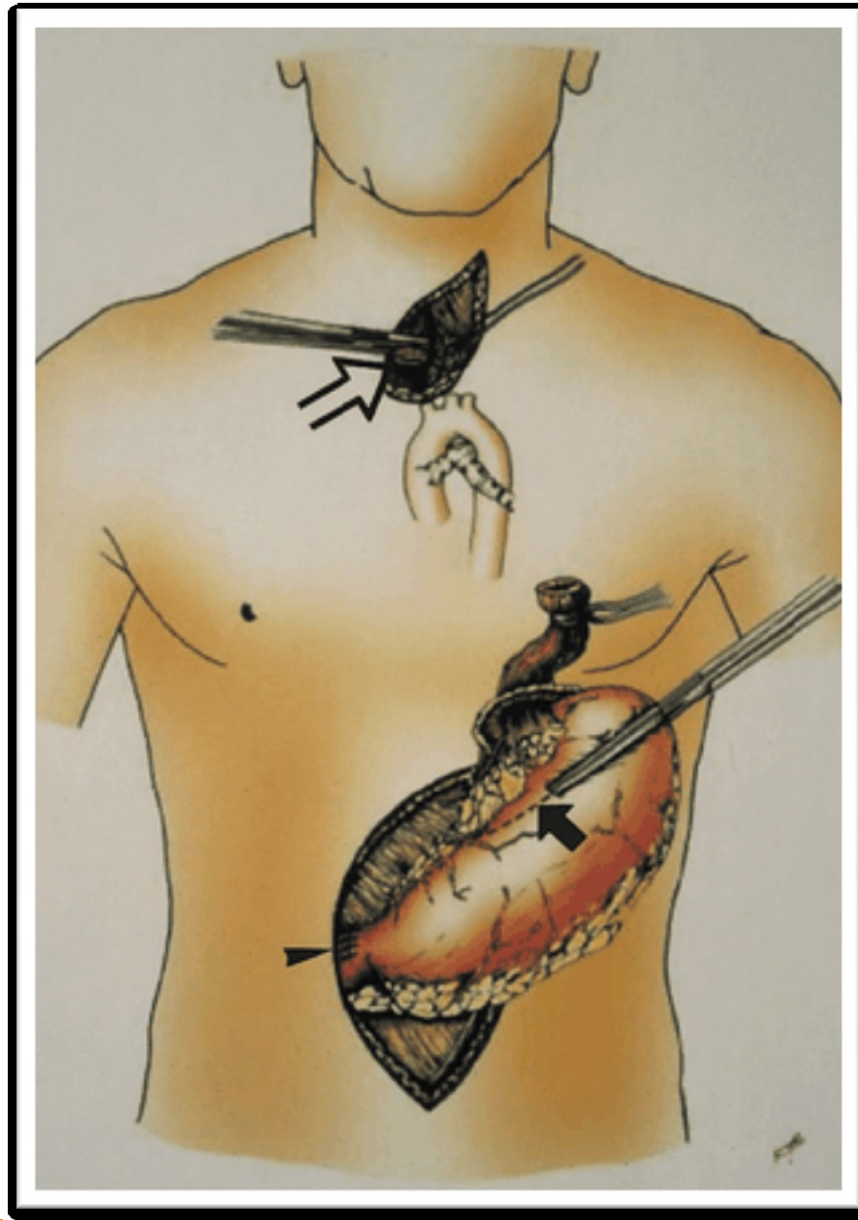
Same Indications

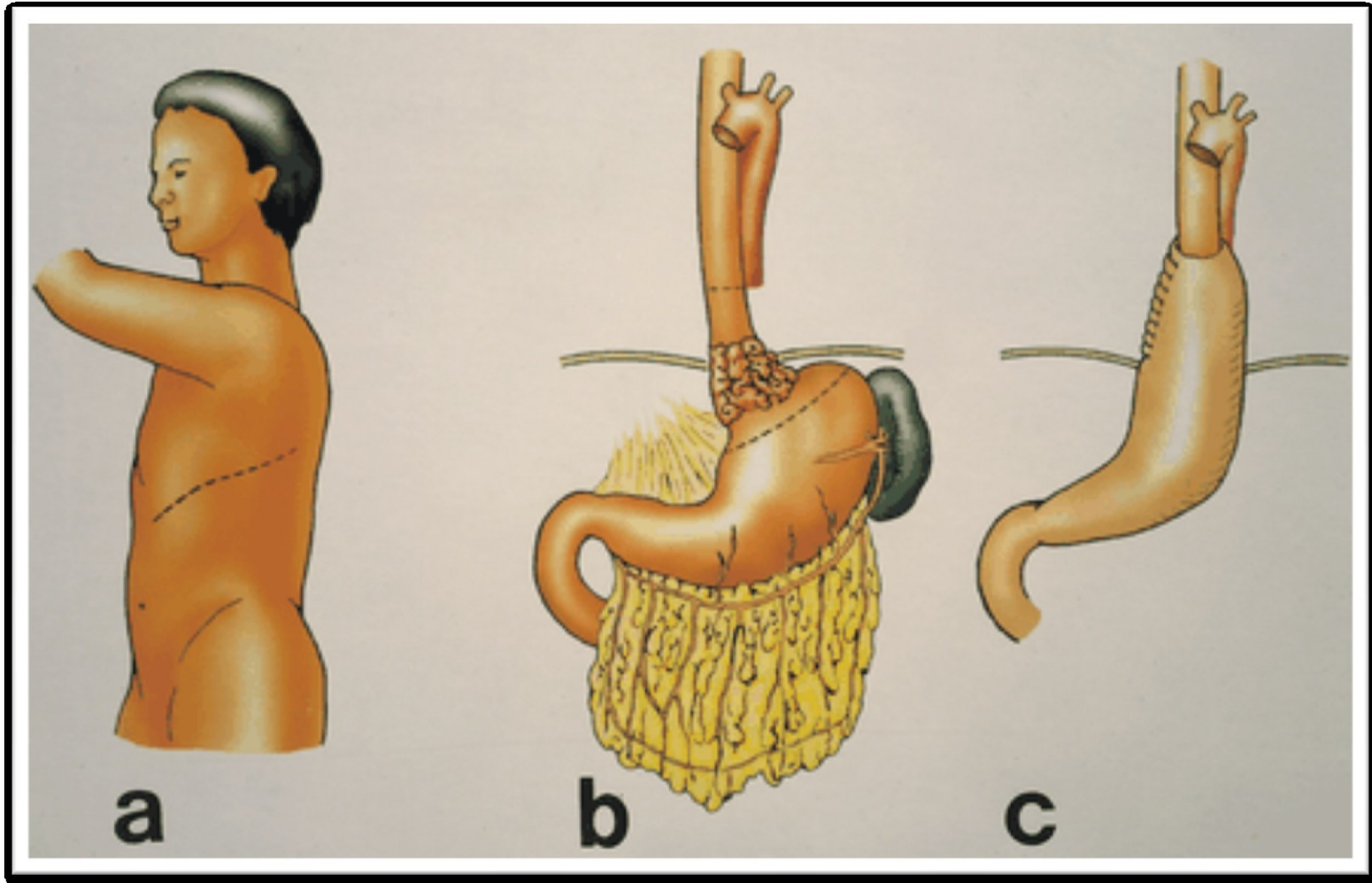
Safe procedure only when tracheobronchial or aortic involvement is Not suggested











Distal **esophageal** and gastroesophageal lesions

Conduits for Esophageal Reconstruction

Stomach

Colon

Jejunum

Stomach

Esophageal Reconstruction Stomach

Advantages

- Reliable blood supply
- Fashioned into tube
- Gastric function preserved
- Excellent length
- “One anastomosis”
- “Relatively simple”

Stomach

Esophageal Reconstruction Stomach

Disadvantages

Reduced reservoir function

Reflux

Regurgitation

Risk of splenectomy

Increased postoperative leak

Colon

Esophageal Reconstruction Colon

Advantages

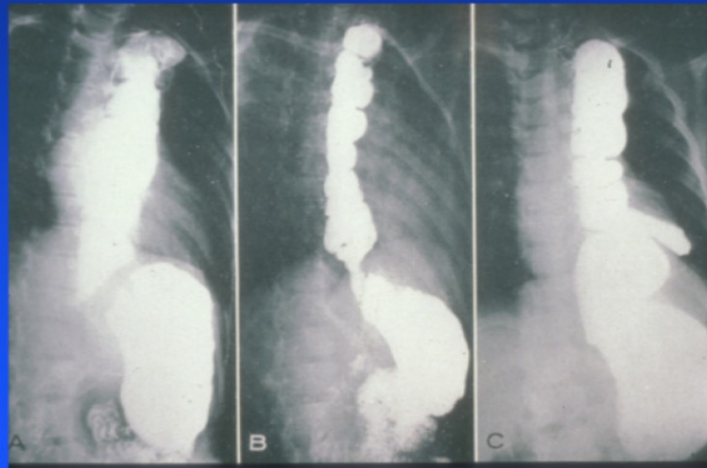
Excellent length
Preserves reservoir of stomach
“Resistant to reflux”

Disadvantage

Bloody supply tenuous
Redundancy
Obesity a problem
Increased morbidity and mortality

Colon Redundancy

Esophageal Reconstruction Colon Redundancy - Postoperative



ESORECON2004

- Short segment colon interposition grafts
 - Right or transverse
 - Intrathoracic esophagus

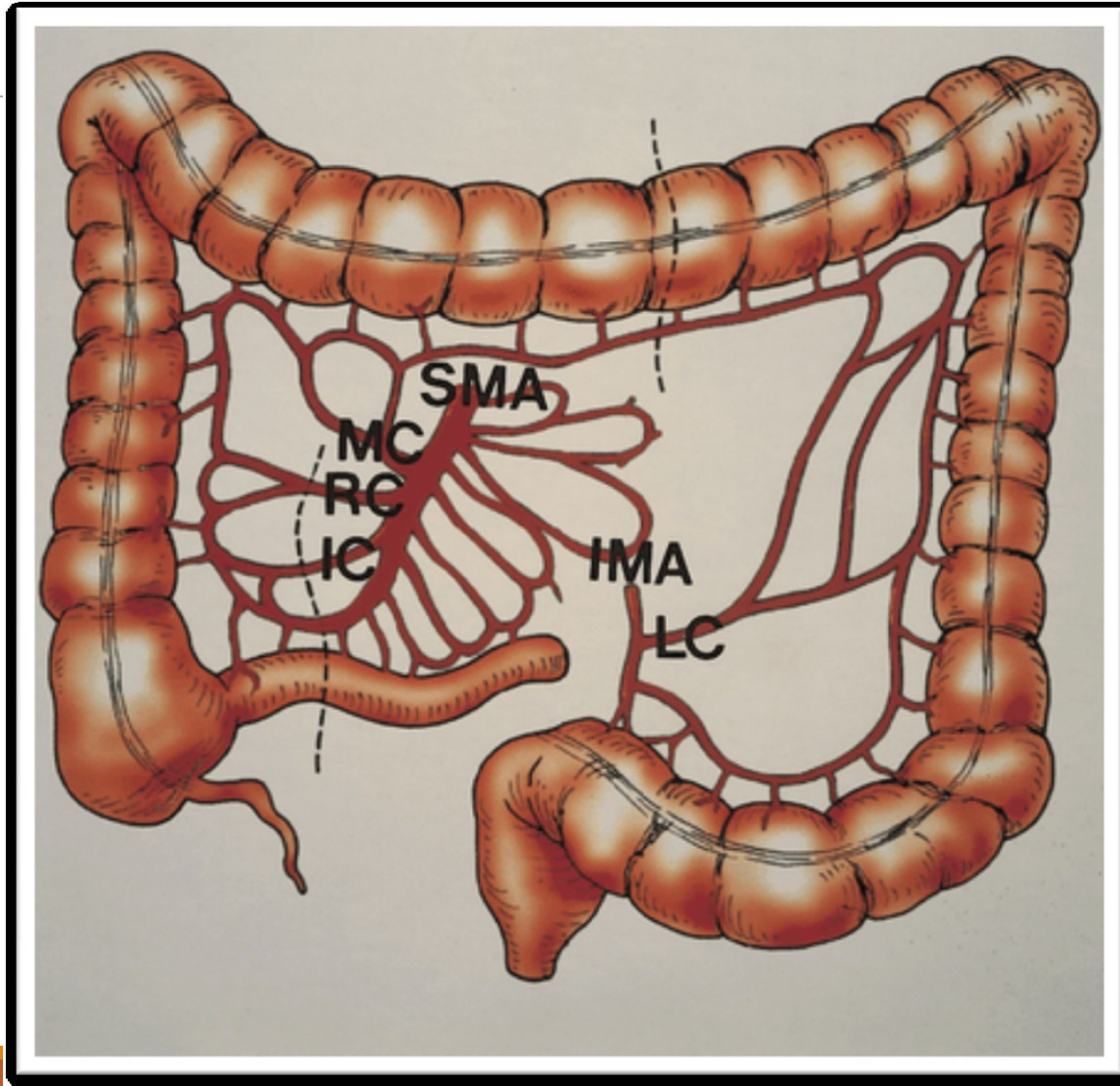
- Long segment colon interposition grafts
 - Left colon
 - Anastomosis to cervical esophagus or pharynx

Colon

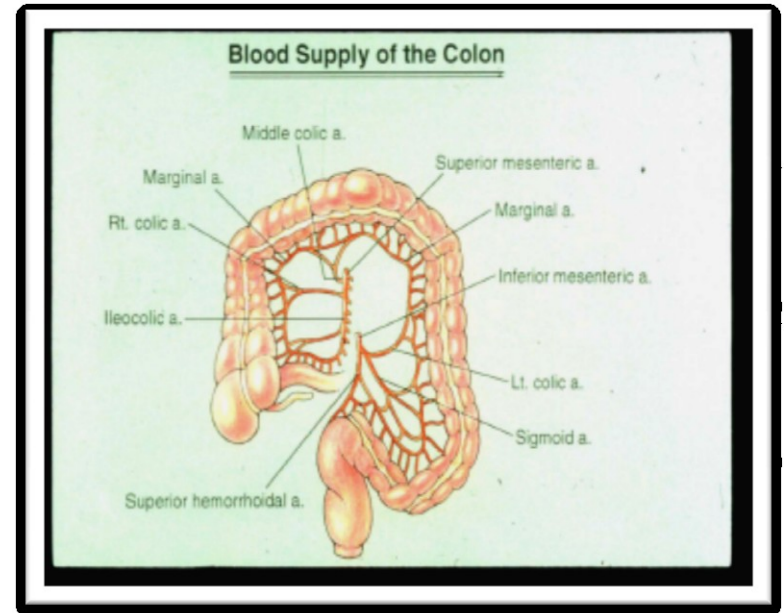
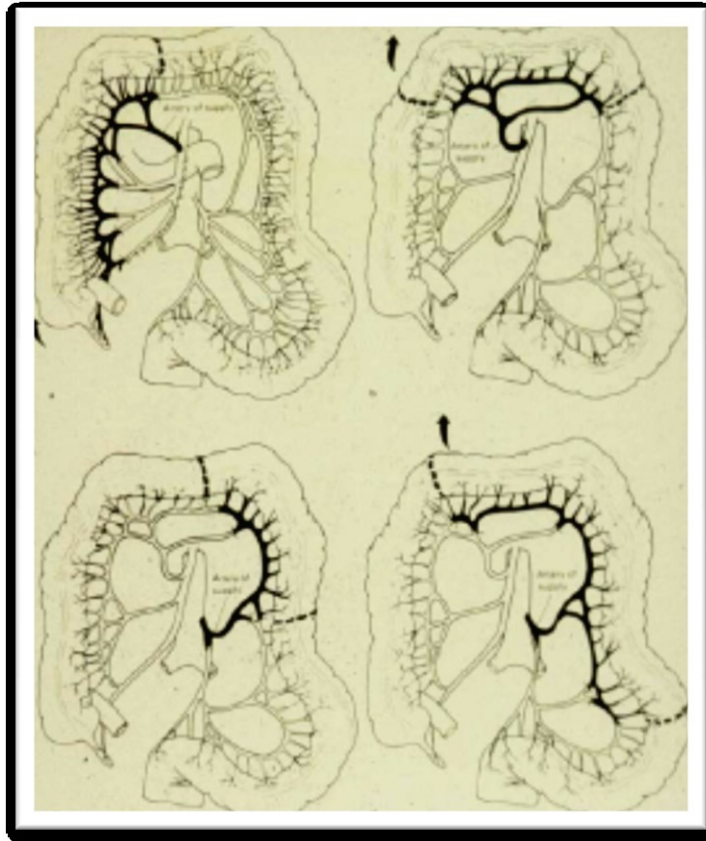
Esophageal Reconstruction Colon Conduit

- Isoperistaltic interposition graft
- Long-term survival anticipated
- Right versus left colon
- Most prefer left colon
 - Left colon diameter smaller
 - Less prone to dilate
 - Blood supply more reliable
 - Excellent length
 - Effective at propelling a solid bolus

Blood Supply of the Colon

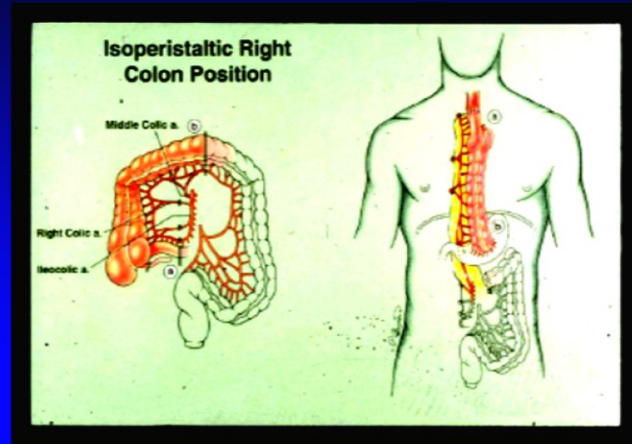


Different Segment Grafts



Right Colon Interposition

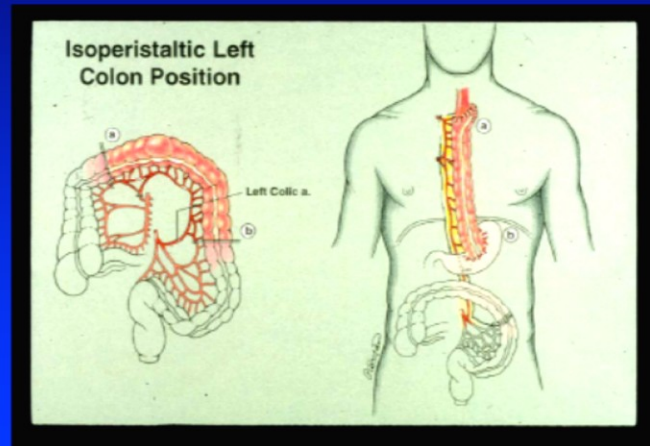
Esophageal Reconstruction Right Colon Interposition



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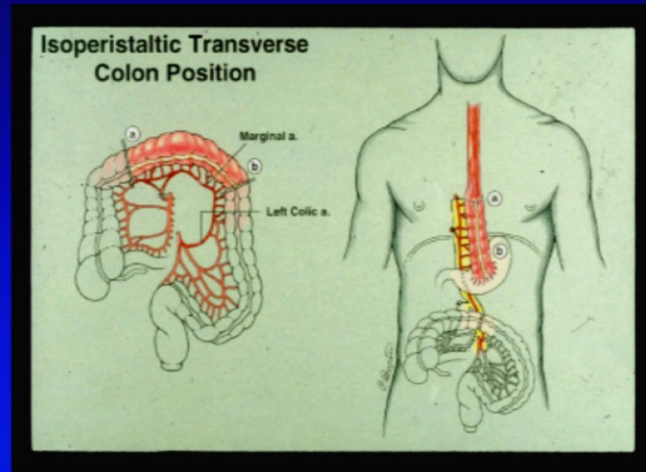
Left Colon Interposition

Esophageal Reconstruction Left Colon Interposition



Transverse Colon Interposition

Esophageal Reconstruction Transverse Colon Interposition

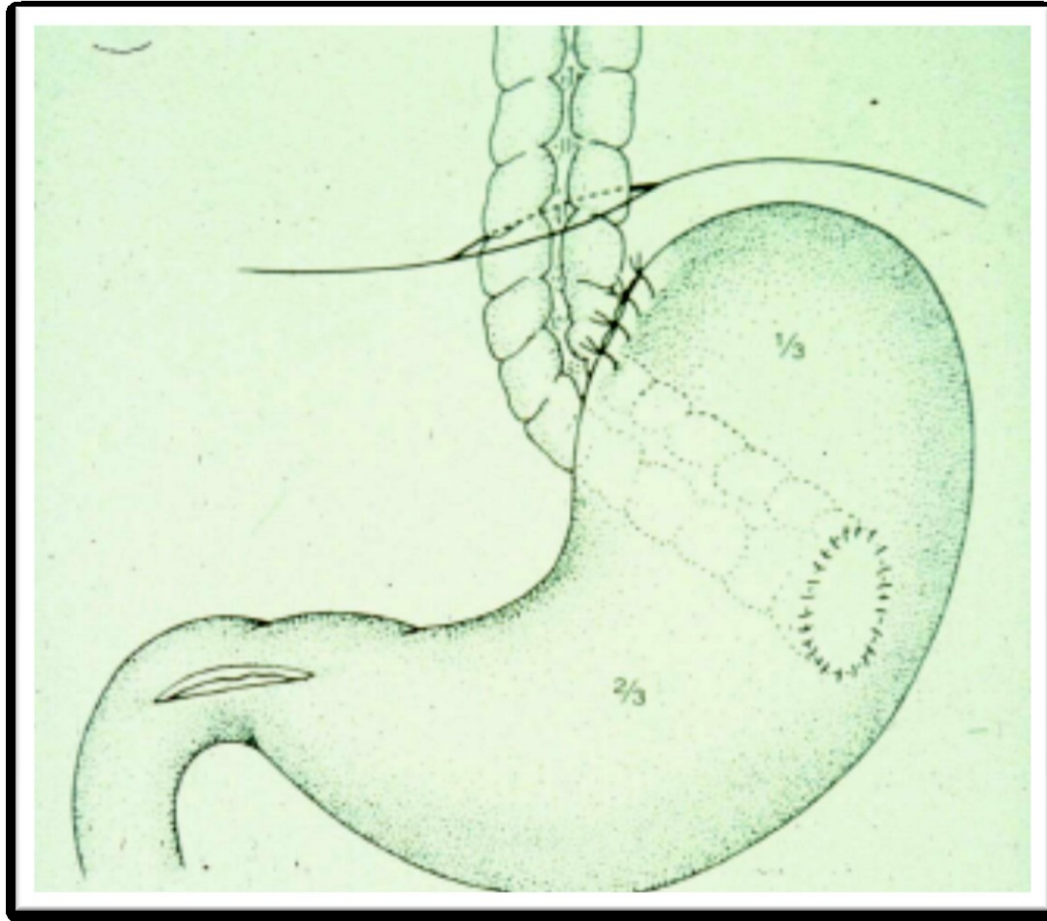


Colon – Surgical Hints

Esophageal Reconstruction Colon – Surgical Technique

- Isoperistaltic
 - Left colon – Left colic/marginal artery
 - Right colon – middle colic artery
 - Transverse colon – middle colic artery
- Antiperistaltic
 - Left colon – middle colic
- Posterior gastric anastomosis
- Colon fixation
- Minimize redundancy
- ? 2nd microvascular blood supply

Posterior Cologastric Anastomosis



Advantages

Peristaltic tube

No acid/alkaline reflux – Roux-en – Y

Free graft

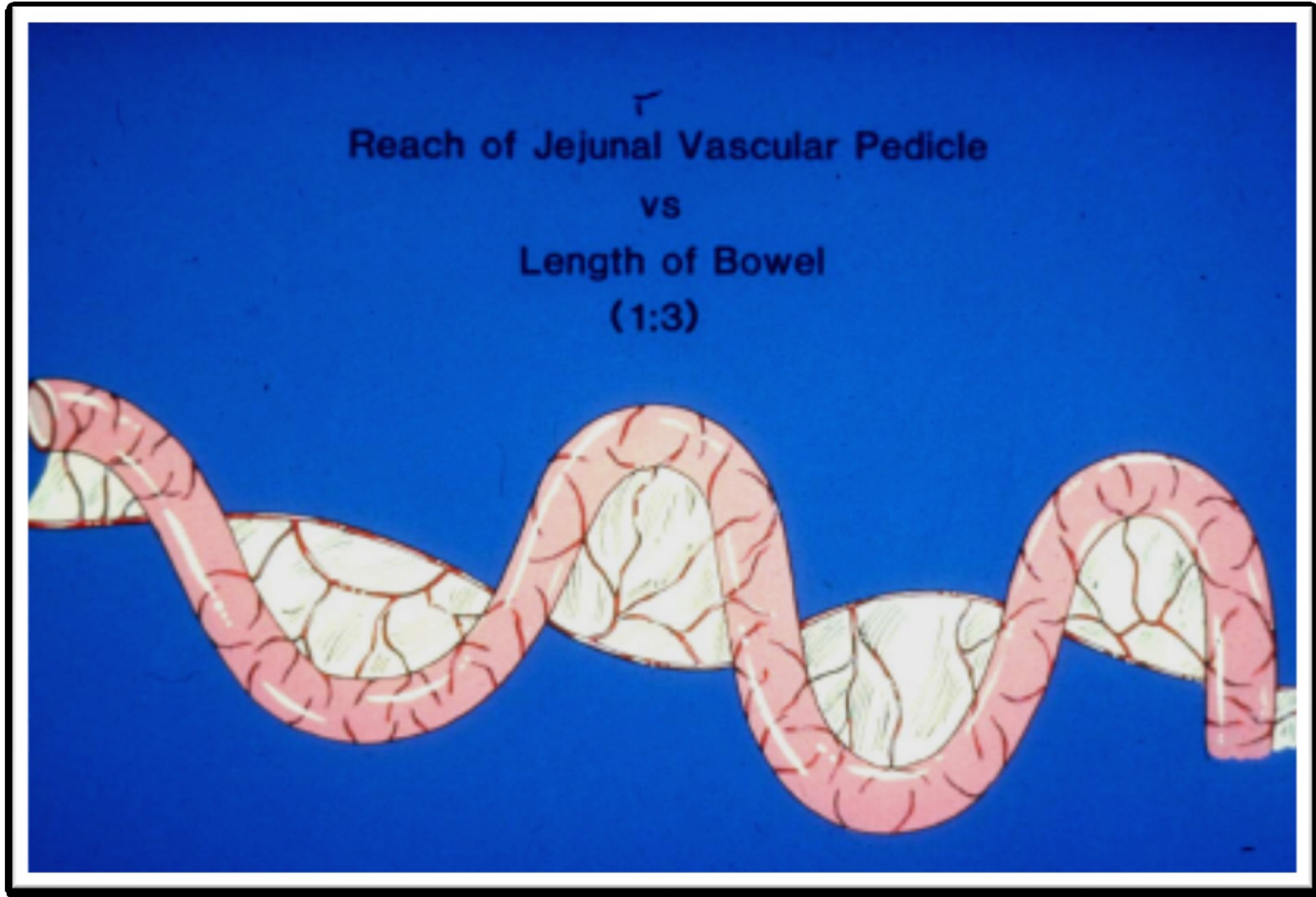
Disadvantage

Limited length

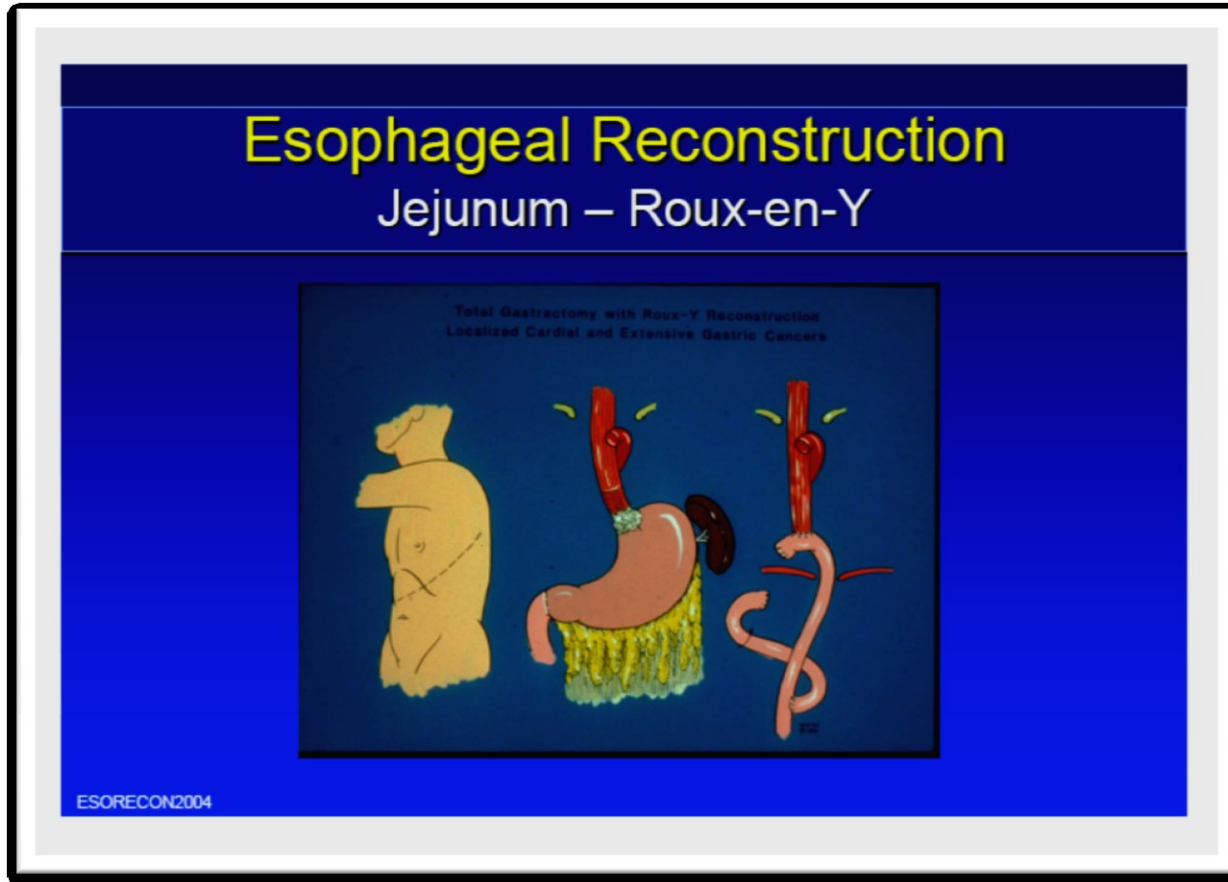
Redundancy

Size

Vascular Pedicle



Jejunum – Roux-en-Y



Jejunum – Free Graft

Esophageal Reconstruction

Jejunum – Free Graft

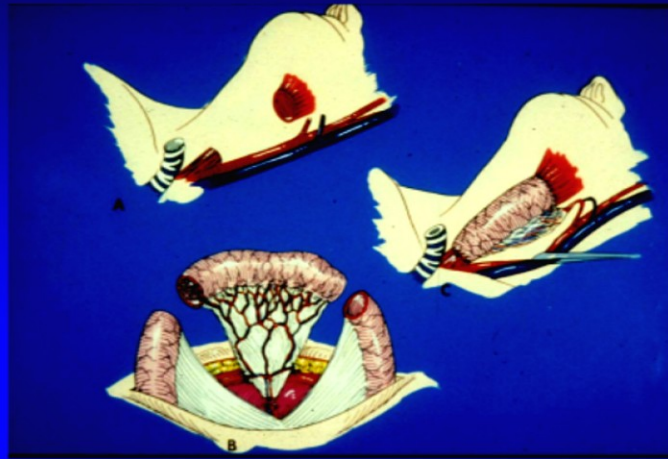
- Reconstruction of cervical esophagus
- Salvage partially failed gastric/colonic interposition

Advantages

- Dependable donor site
- One-stage procedure
- Transfer independent of radiation therapy
- Less bulky than myocutaneous flap
- GE junction undisturbed

Jejunum – Free Graft

Esophageal Reconstruction Jejunum – Free Graft



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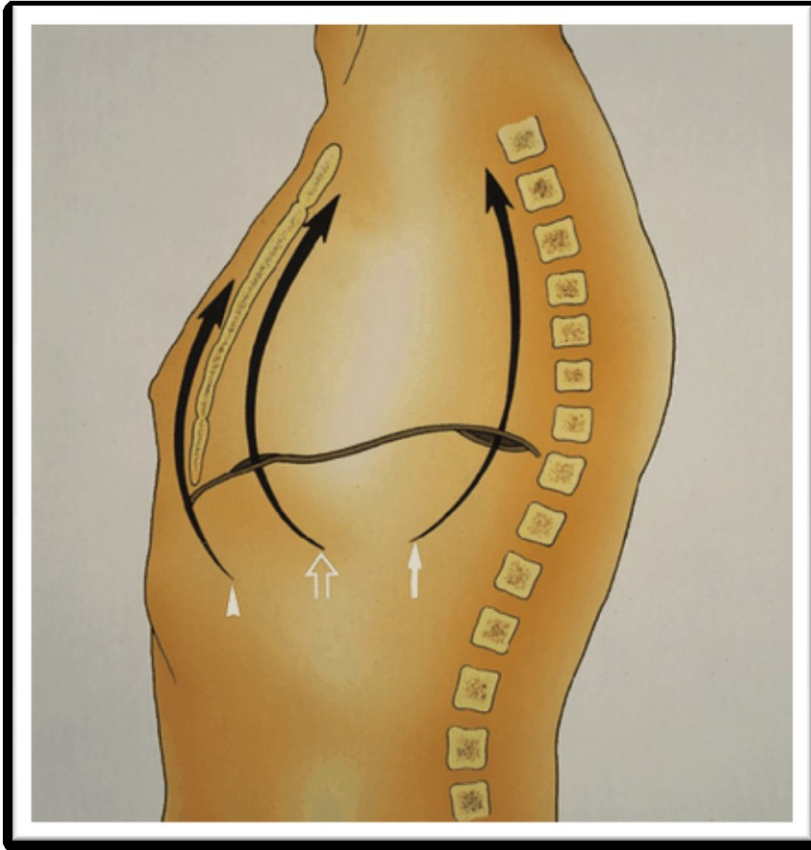
Esophageal Reconstruction

Jejunum – Free Graft Isolated



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Routes of Reconstruction



Posterior Mediastinal (Esophageal Bed)

Substernal

Subcutaneous

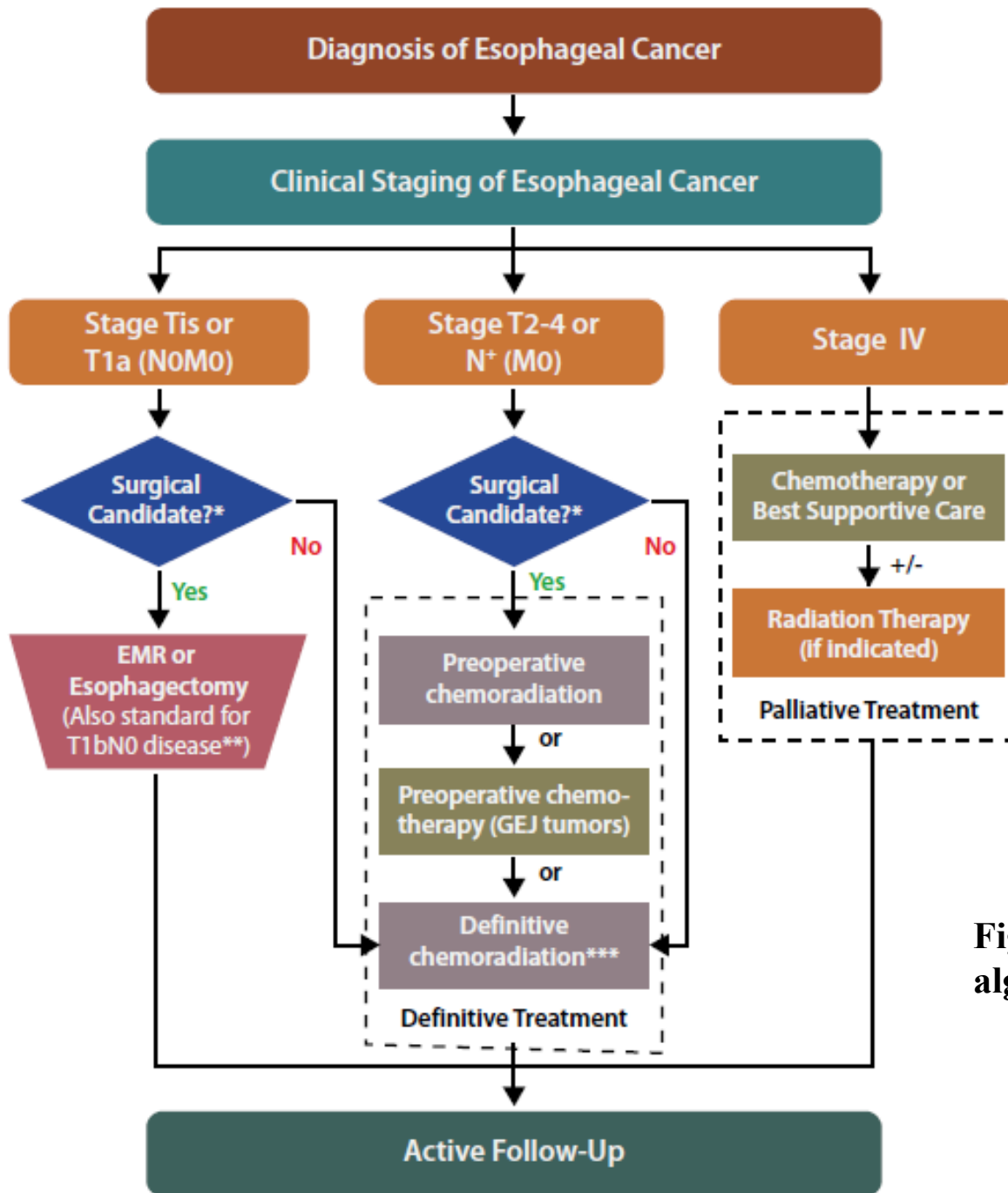


Figure: A proposed treatment algorithm for esophageal cancer.

Conclusion

Esophageal cancer is the 7th leading cause of cancer deaths.

Adenocarcinoma now accounts for over 50% of esophageal cancer in the USA, due to association with GERD & obesity.

Dysphagia and weight loss are the two most common presentations in patients with esophageal cancer.

Endoscopic ultrasound (EUS) is necessary to accompany a complete workup for proper staging and diagnosis of esophageal cancer.

Surgery is the standard of care for early-stage esophageal cancer.

Preoperative chemotherapy and radiation is the standard option for locally advanced esophageal cancer in surgically eligible patients.