Surgical Treatment of Esophageal Cancer

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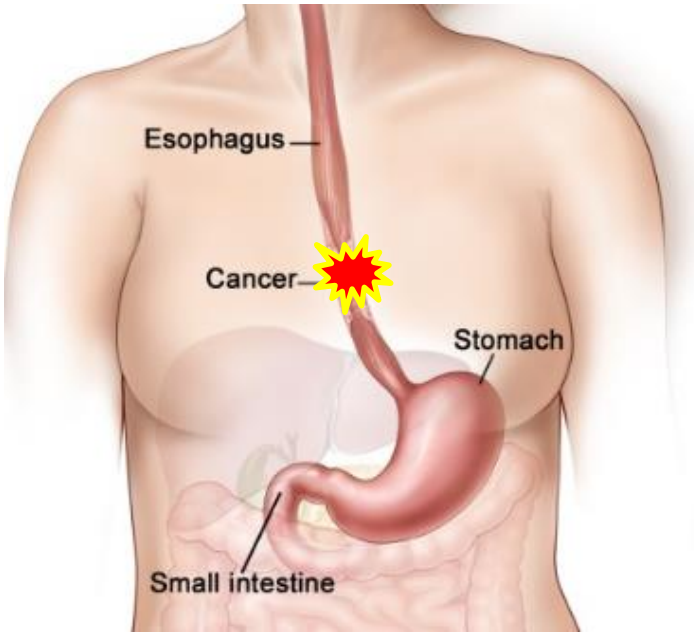
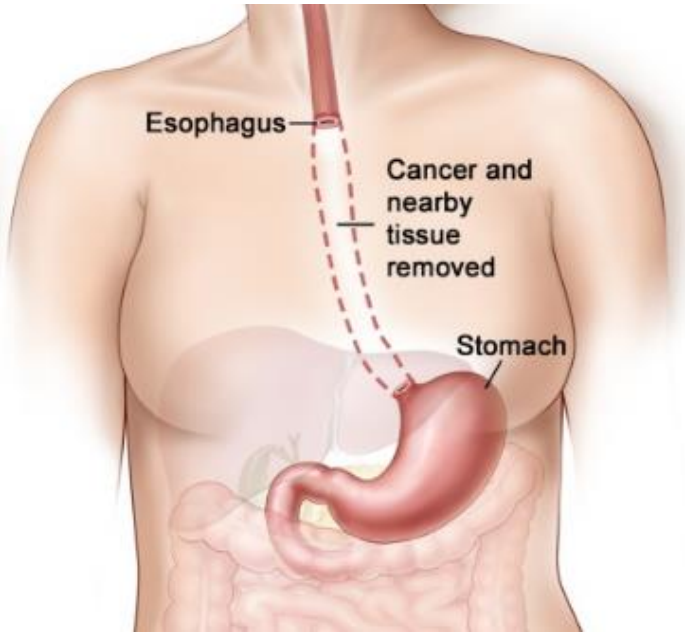
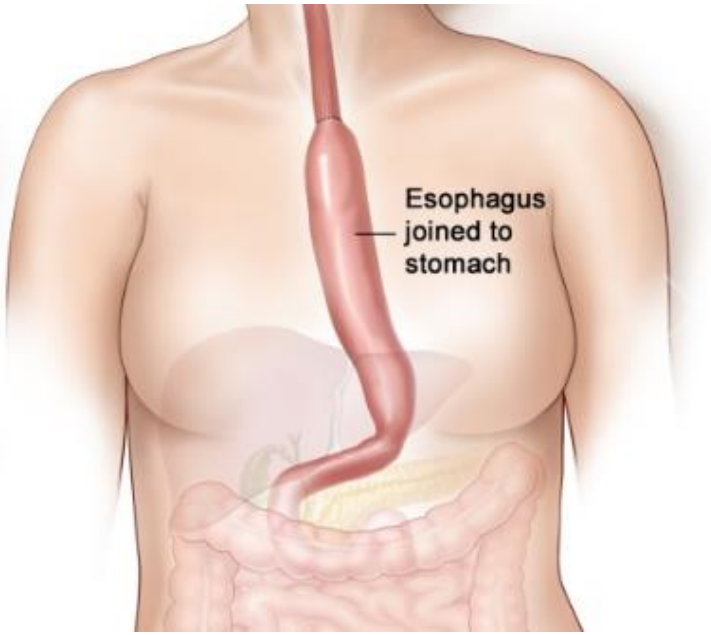
National Cancer Center

Esophagectomy & Reconstruction

국립암센터
NATIONAL CANCER CENTER





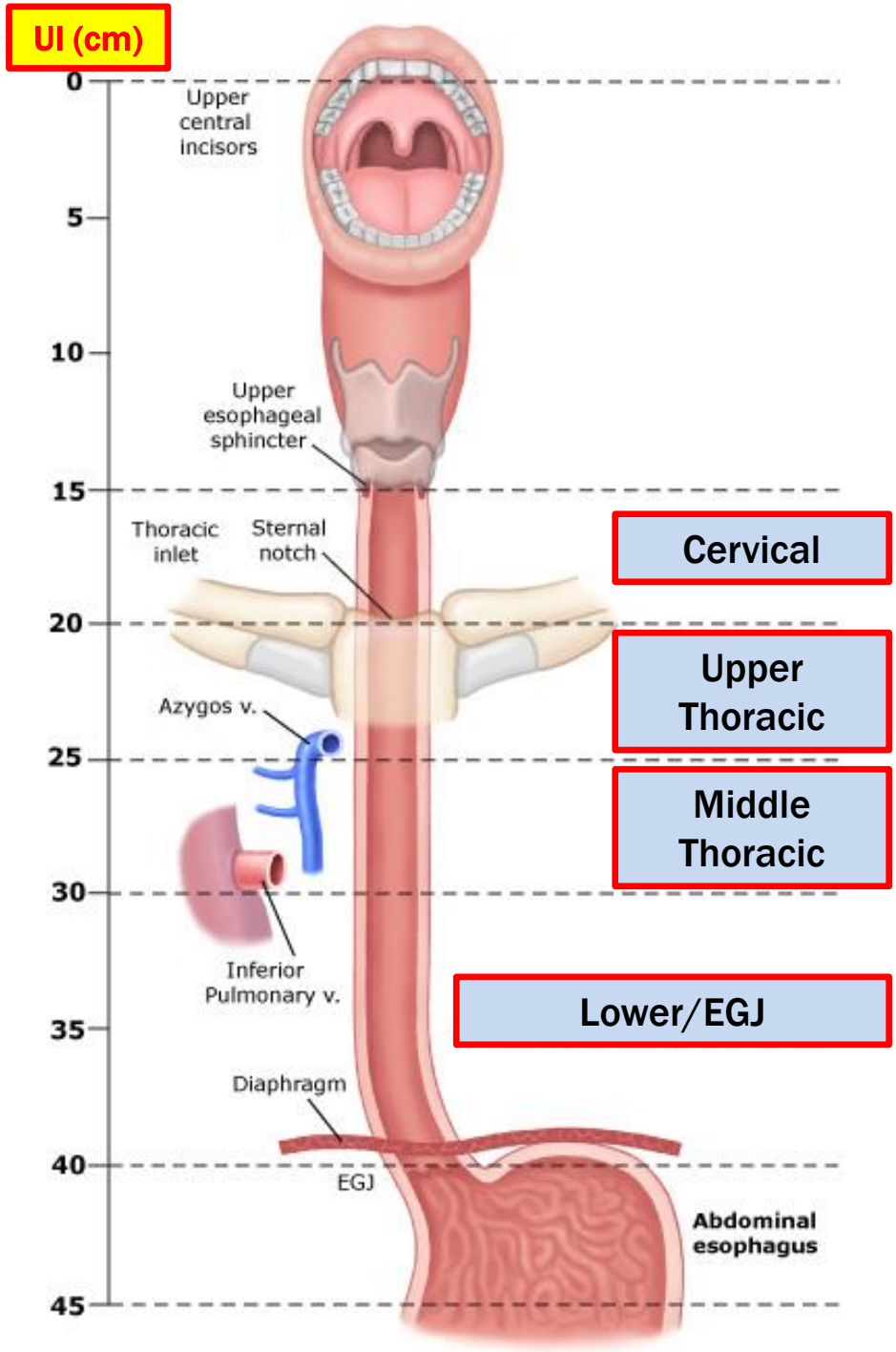


Esophagectomy **Reconstruction**

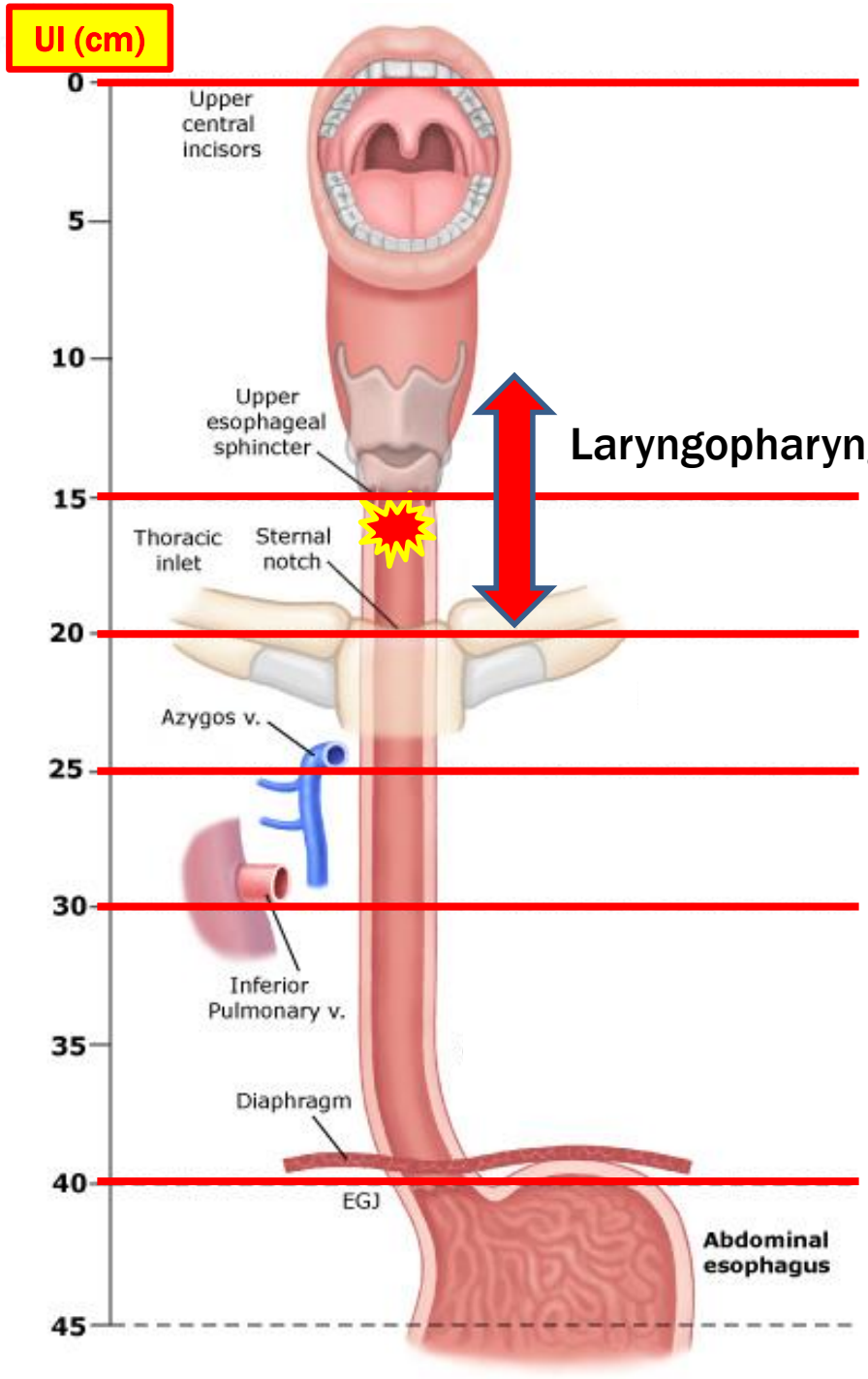
CONTENTS

- Esophagectomy
- Reconstruction
- Lymphadenectomy
- Others

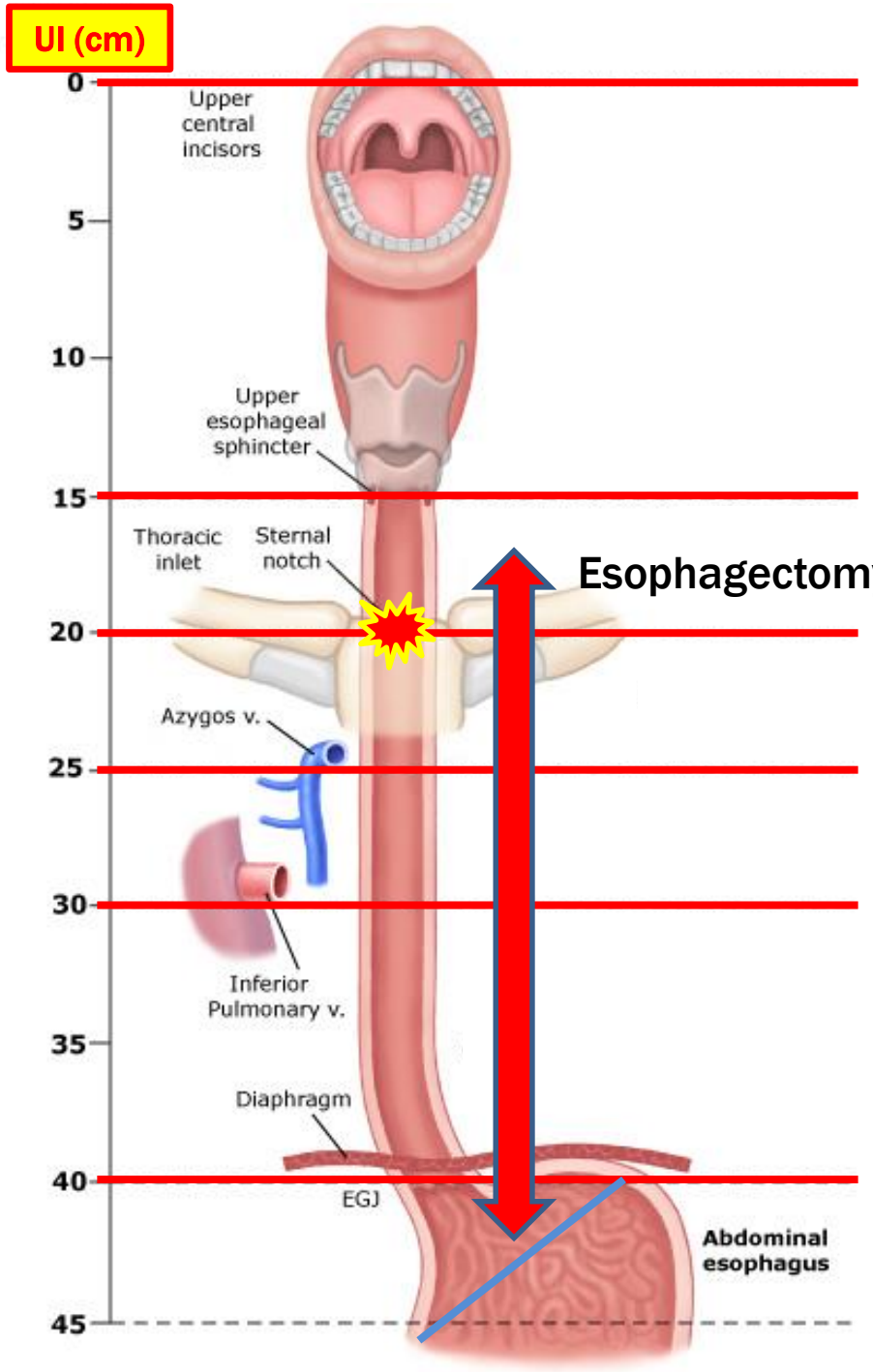
Esophagectomy



Cervical	Hypopharynx ~ Thoracic inlet
Upper Thoracic	Thoracic inlet ~ Lower border of azygos vein
Middle Thoracic	Lower border of azygos vein ~ Inf. pulmonary vein
Lower/EGJ	Inf. pulmonary vein ~ Stomach



Laryngopharyngectomy + Regional flap, Free flap (Free jejunum graft)

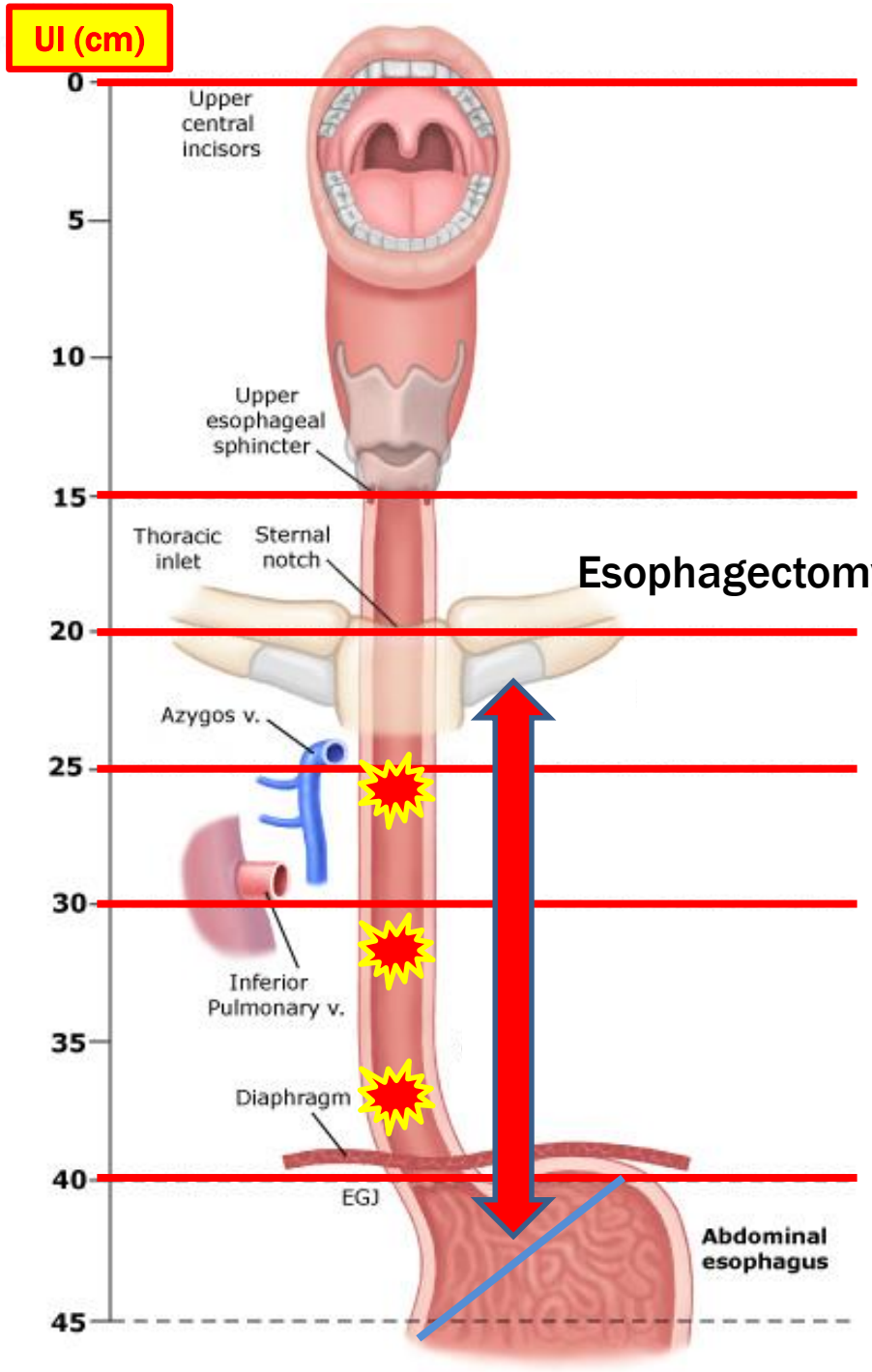


Esophagectomy (three incisional approach) + Reconstruction

Mckeown operation (modified)

1. Rt. thoracotomy: transthoracic esophagectomy
2. Abdominal & Cervical incision:
   - Stomach preparation
   - Reconstruction using Stomach Conduit
   (cervical esophago-gastrostomy)

Total three stage oesophagectomy for cancer of the oesophagus.
McKeown KC. Br J Surg, 1976;63:259



Esophagectomy (w/o cervical incision) + Reconstruction

Ivor-Lewis operation

1. Abdominal incision: Stomach preparation
2. Rt. thoracotomy
   - transthoracic esophagectomy
   - thoracic esophagogastrostomy

The surgical treatment of carcinoma of the esophagus with special reference of a new operation for growths of the middle third.
Lewis I. Br J Surg. 1946; 34: 18-31

R0 Resection &
Adequate Resection margin !!!

PROXIMAL RM

Risk Factors for Local Recurrence and Optimal Length of Esophagectomy in Esophageal Squamous Cell Carcinoma

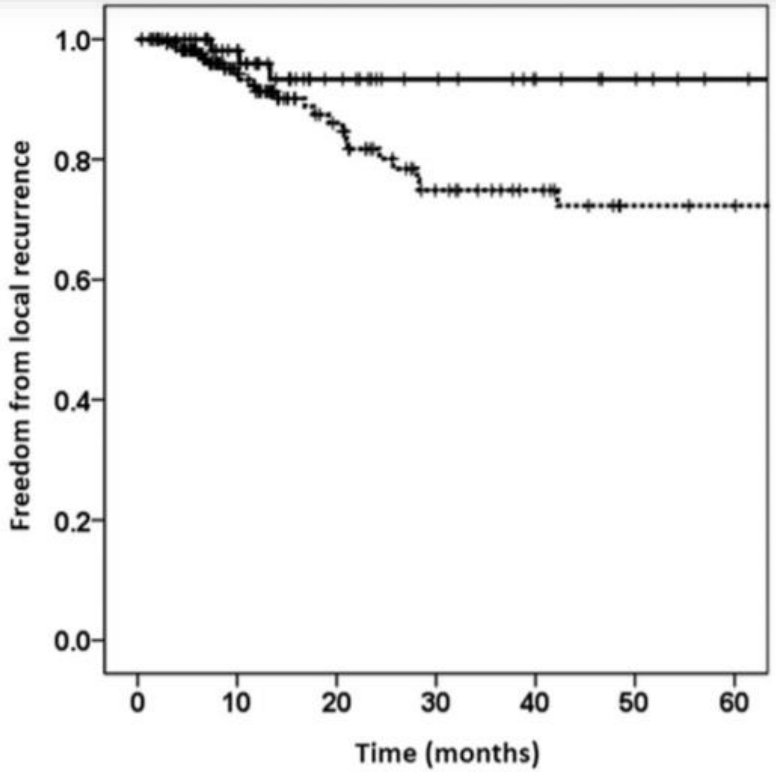


Fig 2. Freedom from local recurrence in the N+ patients with length

Kang et al. Ann Thorac Surg 2016;102:1074–80

freedom from LR

72% for LPM less than 5 cm

93% for LPM of 5 cm or greater

p = 0.040

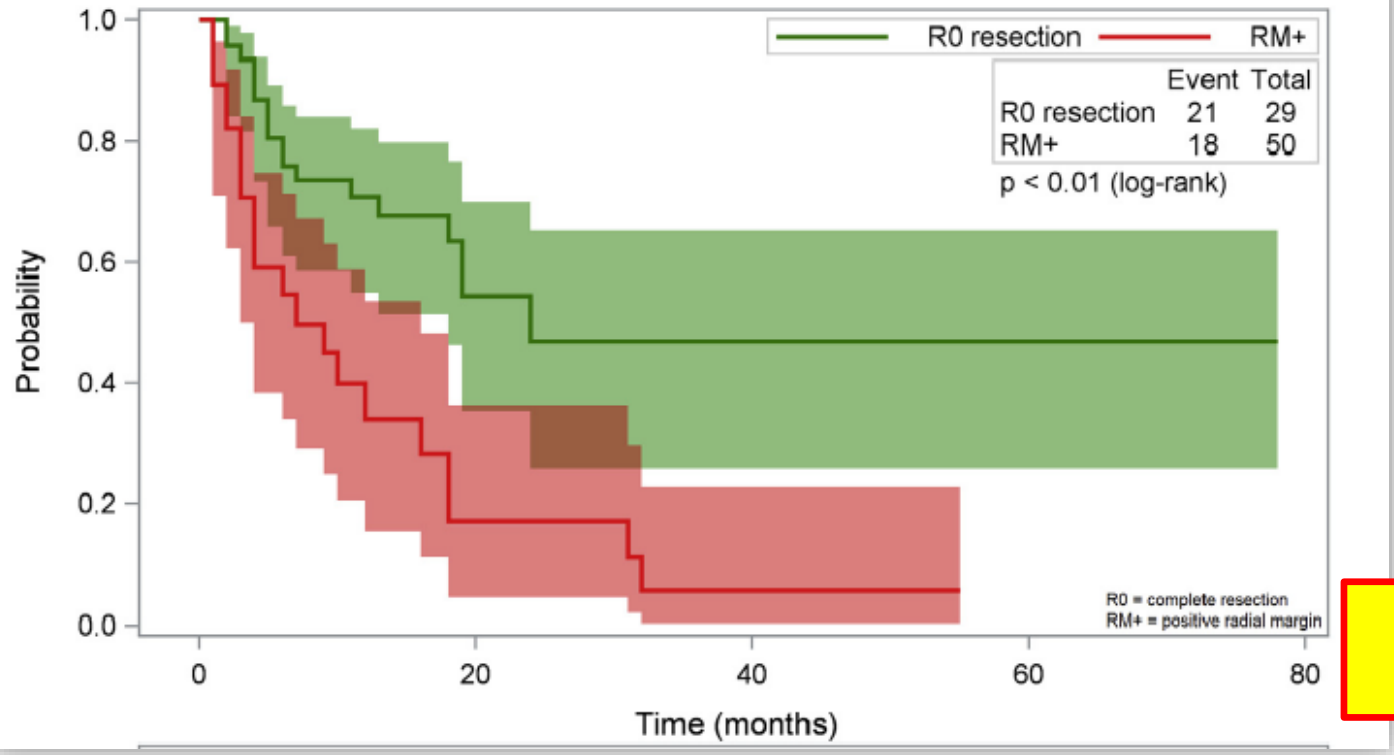
R0 Resection &
Adequate Resection margin !!!

RADIAL RM

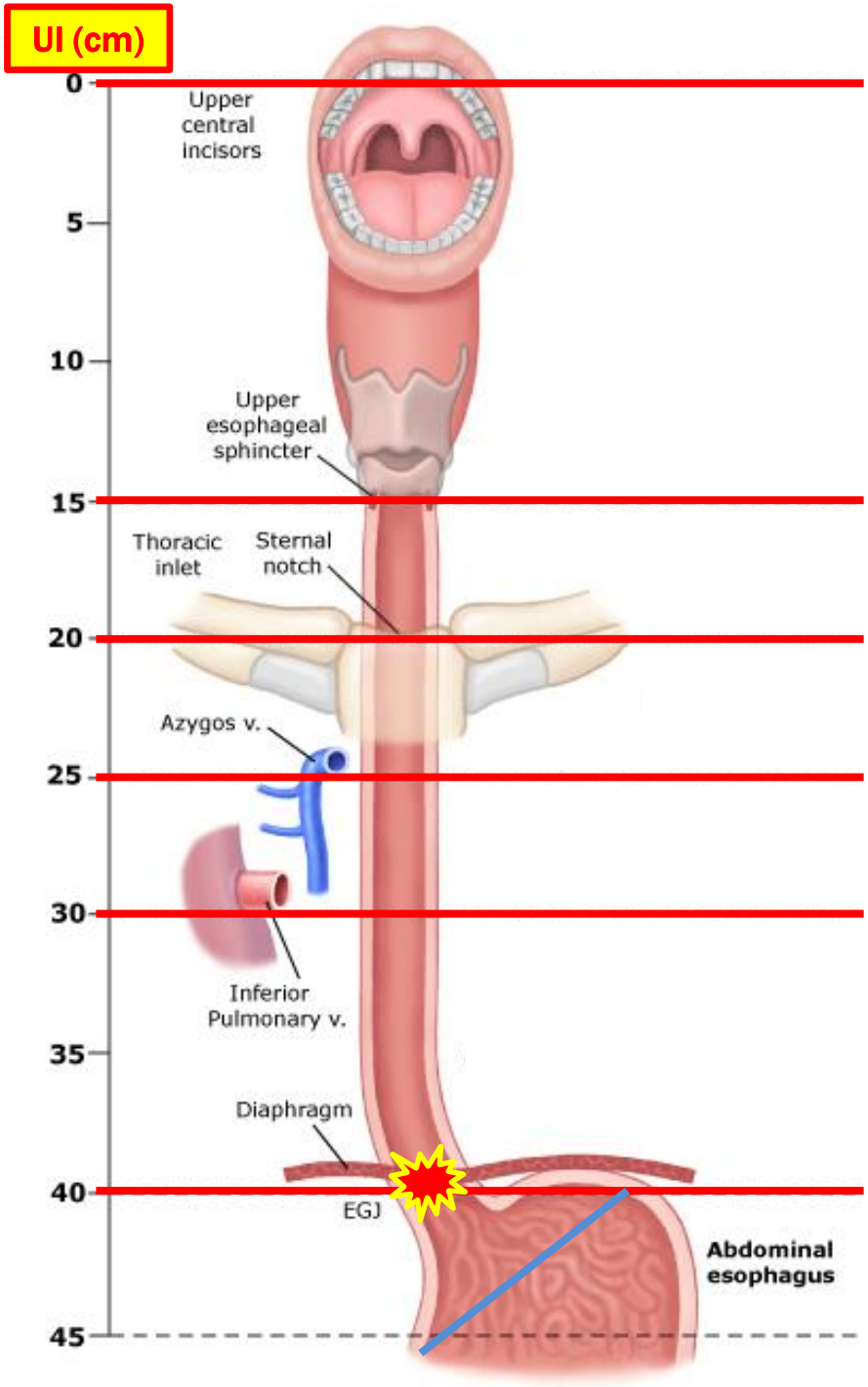
Prognostic significance of a positive radial margin after esophageal cancer resection

Sebastien Gilbert, MD,[a,b] Andre B. Martel, BSc,[c] Andrew J. Seely, MD, PhD,[a,b]
Donna E. Maziak, MD, MSc,[a] Farid M. Shamji, MD,[a] Sudhir R. Sundaresan, MD,[a] and
P. James Villeneuve, MD, PhD[a,b]

J Thorac Cardiovasc Surg 2015;149:548-55



R0 Resection &
Adequate Resection margin !!!



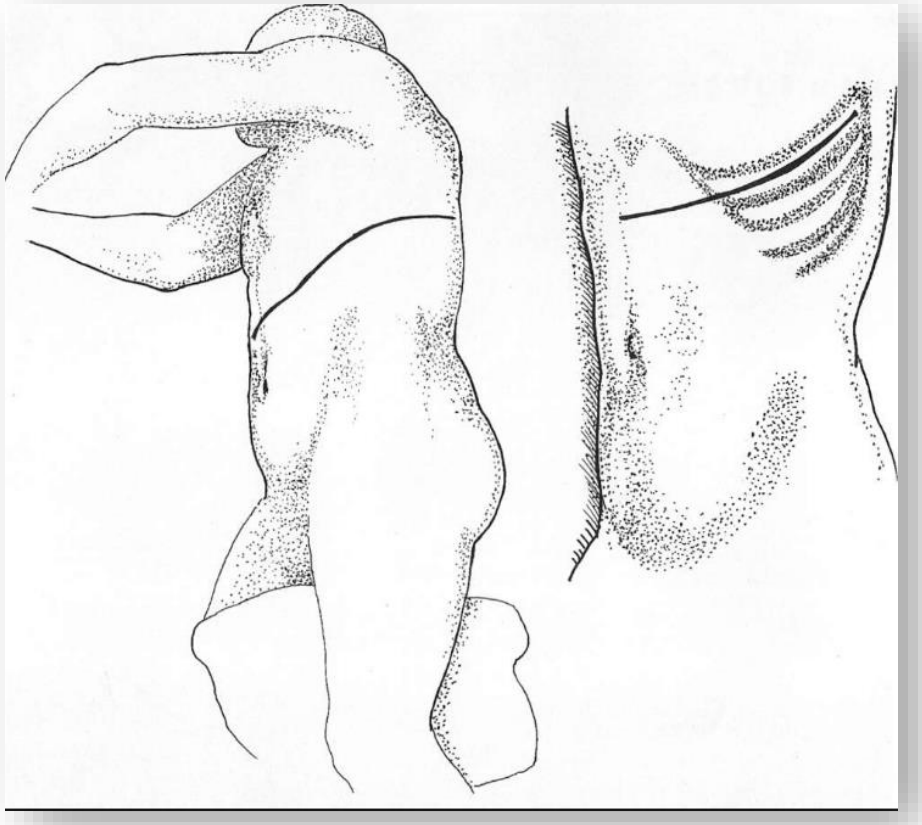
GE junction tumor

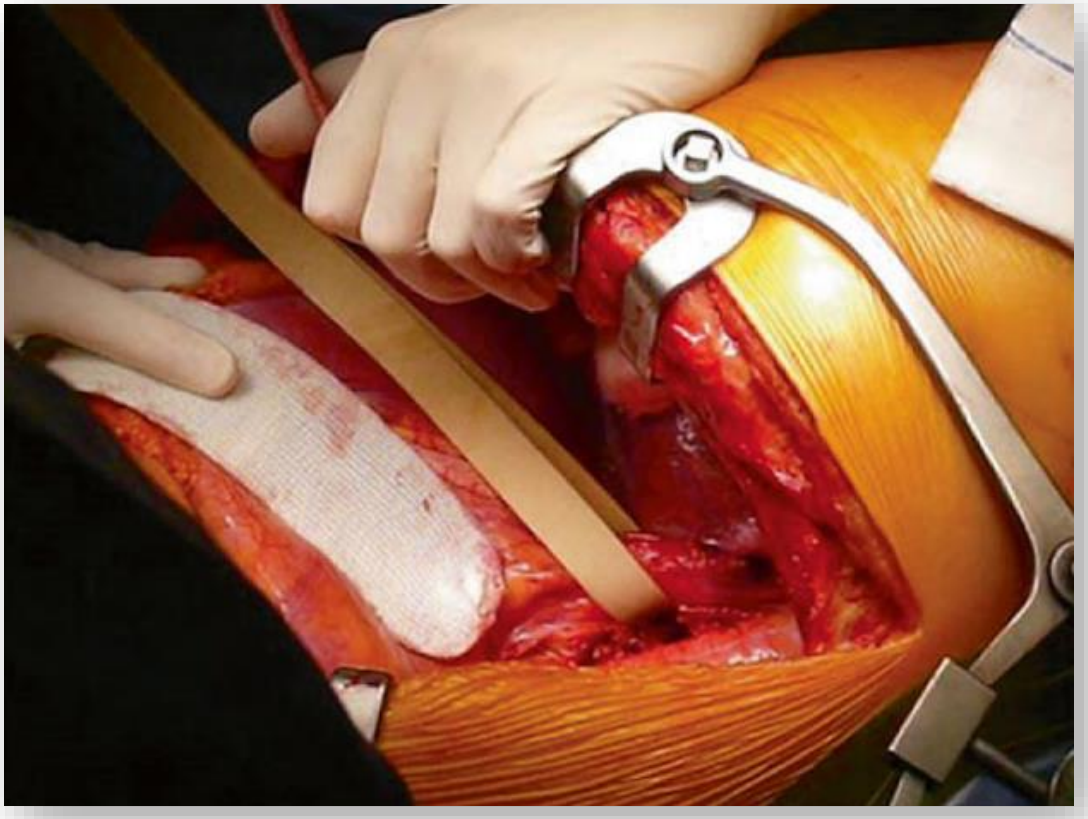
Type I: Adenocarcinoma of the distal esophagus, arising as intestinal metaplasia of the esophagus and possibly infiltrating the GEJ from above
Esophagectomy with at least 6 to 8 cm of proximal margin

Type II: Adenocarcinoma of the cardia, arising from cardiac epithelium or short segments with intestinal metaplasia at the GEJ
A proximal gastrectomy and partial esophagectomy.

Type III: Subcardial gastric carcinoma, infiltrating the GEJ and distal esophagus from below.
A total gastrectomy with partial esophagectomy

GEJ tumor: Lt. thoracotomy



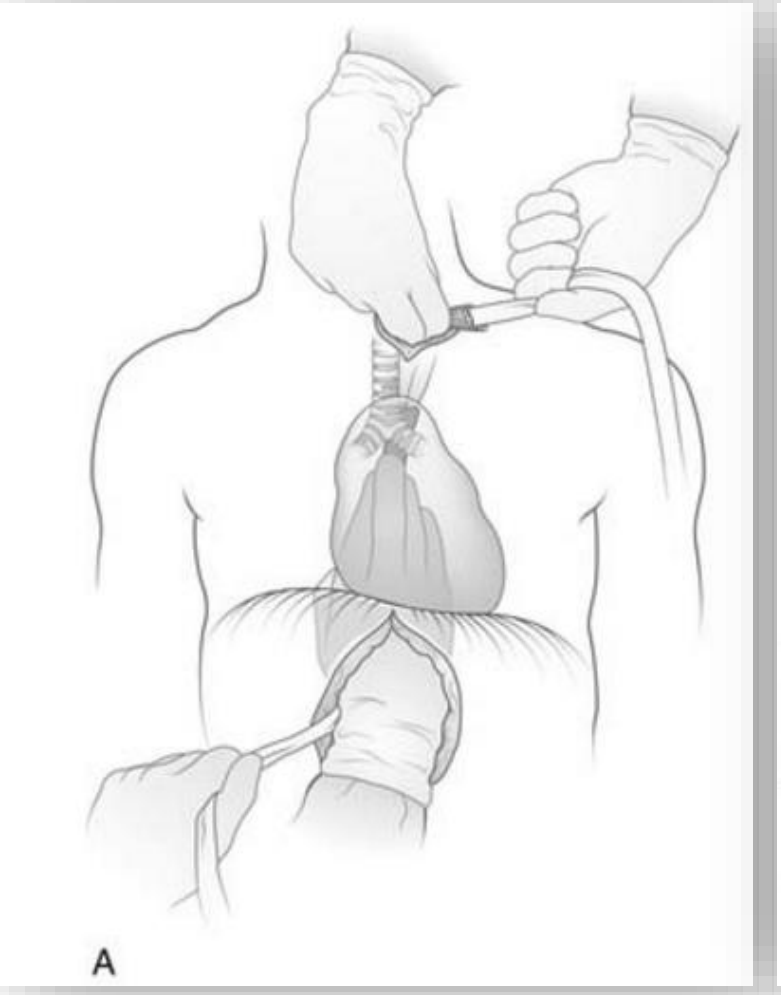


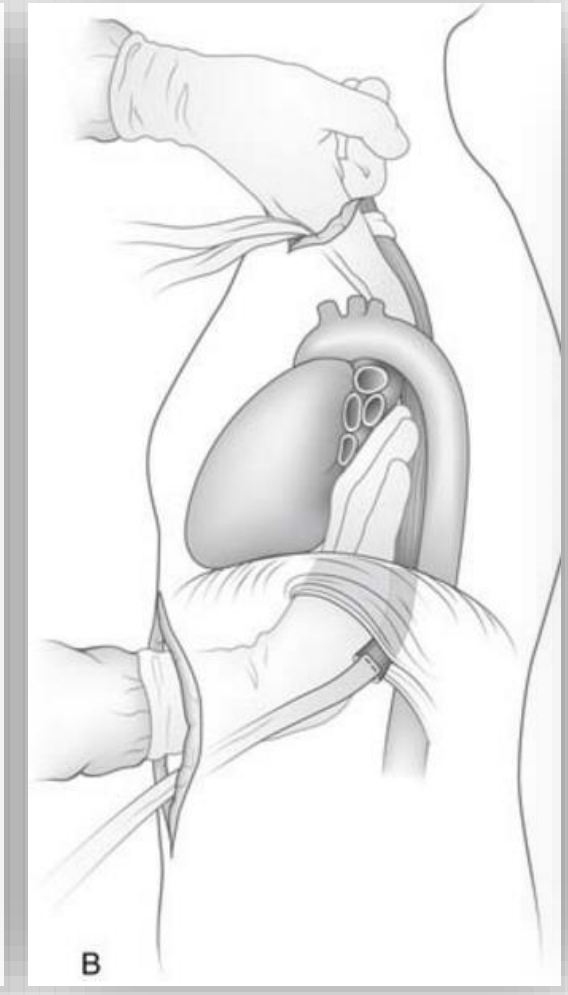
- **Sweet operation** (Lt. thoraco-abdominal Incision) *1980s.*

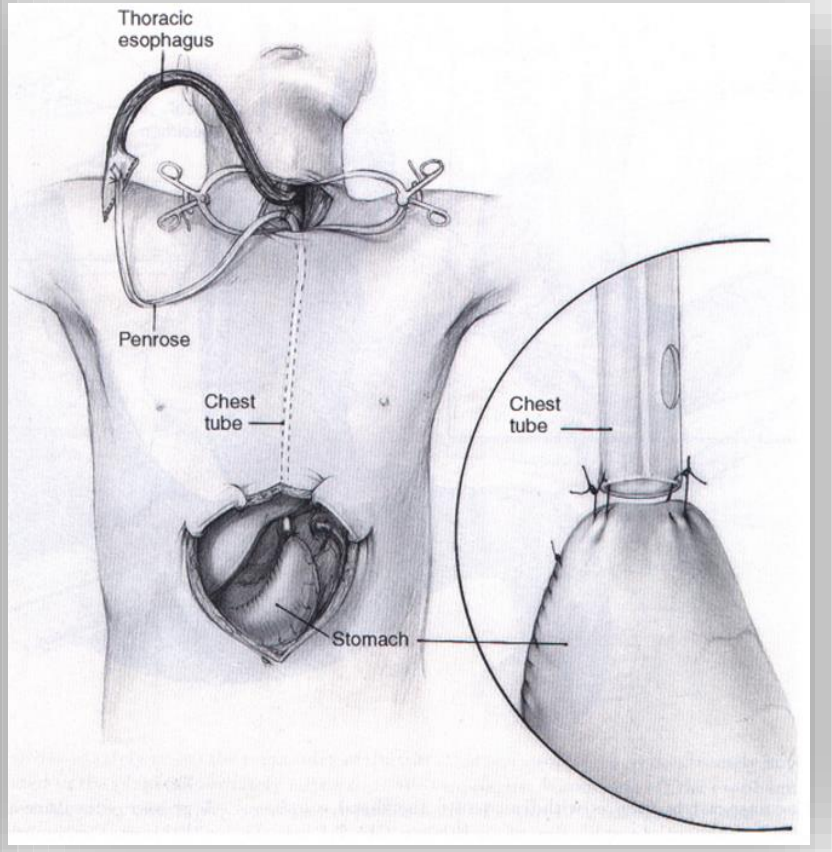
- GEJ tumor, Lower thoracic esophageal cancer
- Inadequate lymphadenectomy in the upper mediastinum

Transhiatal esophagectomy (THE)

w/o Thoracotomy







Transhiatal esophagectomy (THE)

- "Re"-introduced by Mark Orringer in 1978
- Developed over concerns of patients tolerating a laparotomy & thoracotomy

(1970s ~ 1980s Mortality rates 15% ~ 40%)

THE

Avoidance of thoracotomy
- Short operation time
- Minimize postop. pain, pul. Cx.
- GEJ/Lower, Multi-modal Tx

- Poor visualization upper mediastinum
- Leakage, stricture

TTE

- Direct visualization
- Adequate resection margin
- Allow thorough LND

- Thoracotomy, two separate steps
- Longer operation time
- Postop. pain, Pulmonary Cx.

Transhiatal esophagectomy (THE)

Table 2 Randomized trials comparing transthoracic and transhiatal esophagectomy

Meta-analysis	Goldminc *et al*[27]	Chu *et al*[28]	Jacobi *et al*[29]	Hulscher *et al*[30,31]
No. of patients	67	39	32	220
Postoperative mortality (%)				
TT	8.6	0	6	4
TH	6.2	0	6	2
Intraoperative blood loss (mL)				
TT	[1](2.3 units transfused)	671	2270	1900
TH	[1](2.3 units transfused)	724	1000	1000
Hospital stay (d)				
TT	18	27	21	19
TH	20.5	18	23	15
Postoperative pneumonia (%)				
TT	20	0	31	57 (atelectasis included)
TH	19	10	19	27 (atelectasis included)
Cardiac complications (%)				
TT	[1]	15.8	19	26
TH	[1]	15	31	16
Anastomotic leakage (%)				
TT				
TH				
Vocal cord paralysis (%)				
TT				
TH				
Reported survival (%)				
TT	22 at 3 yr	Median survival 13.5 mo	77 at 1 yr	36 at 5 yr
TH	30 at 3 yr	Median survival 16 mo	70 at 1 yr	34 at 5 yr

THE could be performed in selected patients.

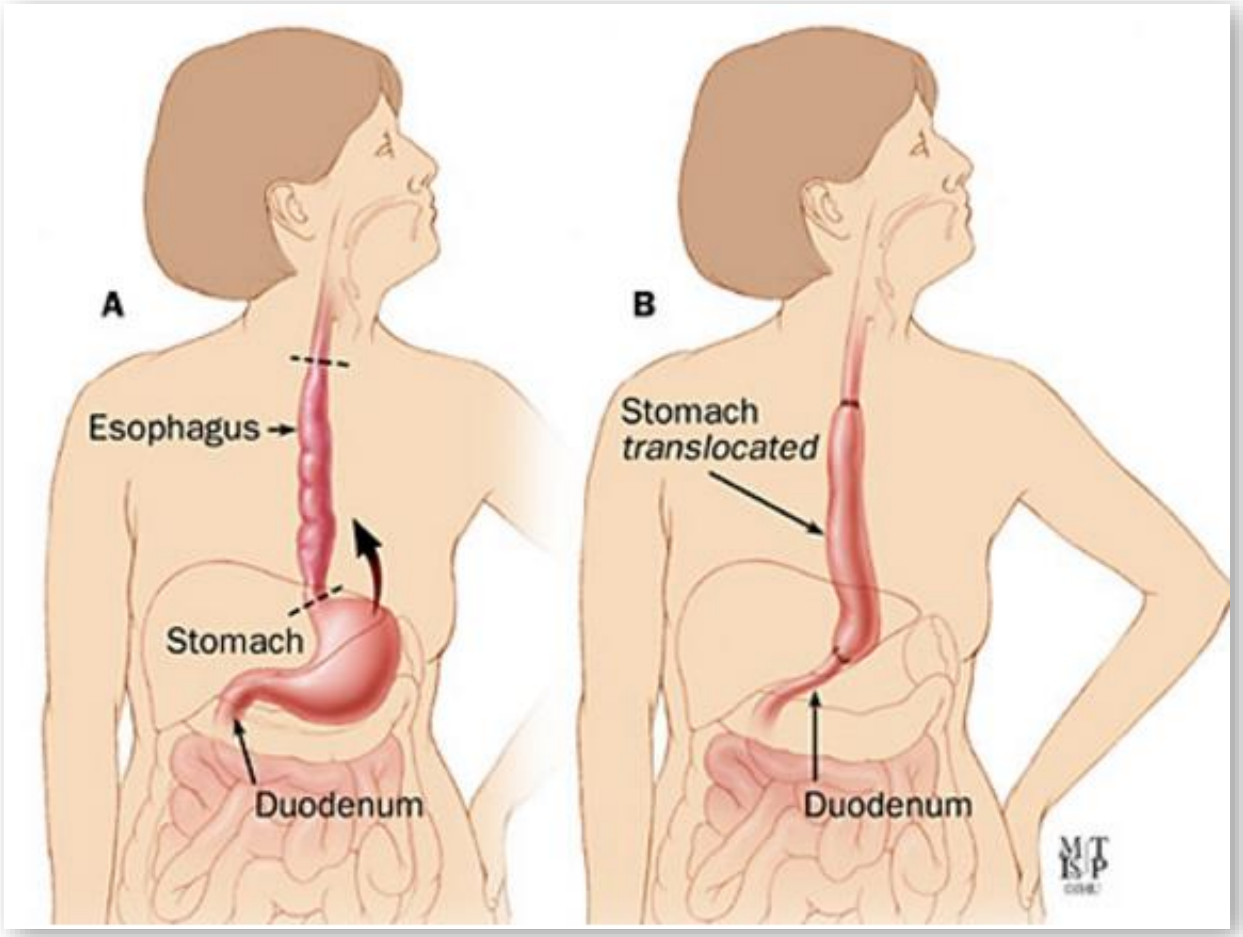
* Early lesion, w/o LN metastasis
* Older, High risk patients
  (prev. thoracotomy, Poor pulmonary function, fibrothorax,...)

World J Gastroenterol 2010;16:3804-10

Reconstruction

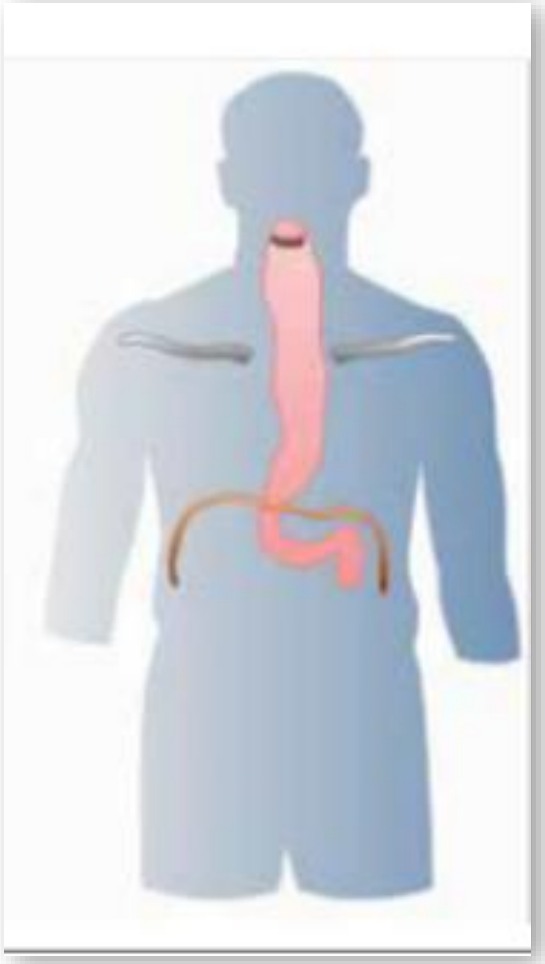
Ivor Lewis operation

1. Abdominal incision: Stomach preparation
2. Rt. Thoracotomy - transthoracic esophagectomy + LND
   - thoracic esophagogastrostomy

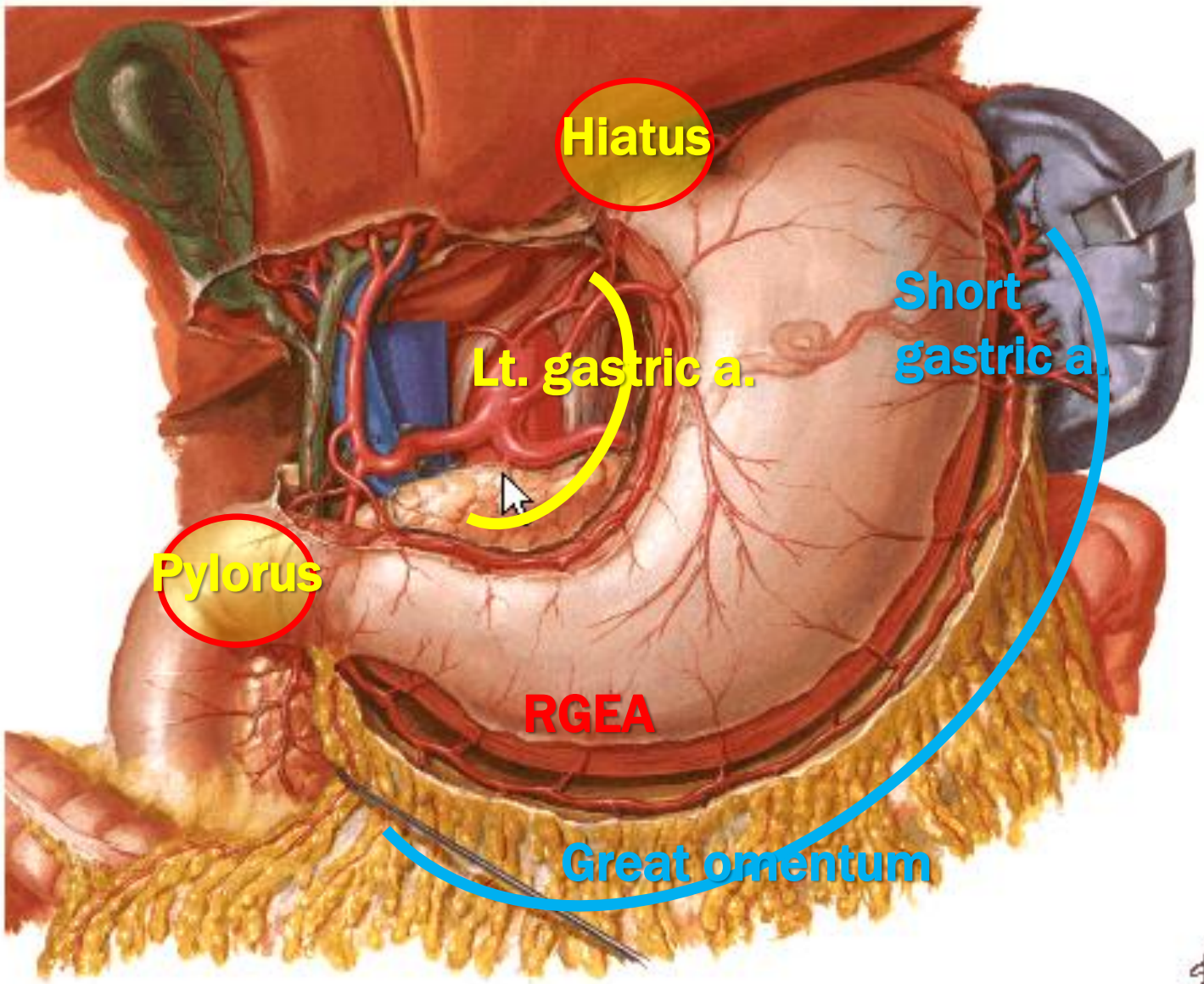


Mckewon op.

- Cervical esophagogastrostomy

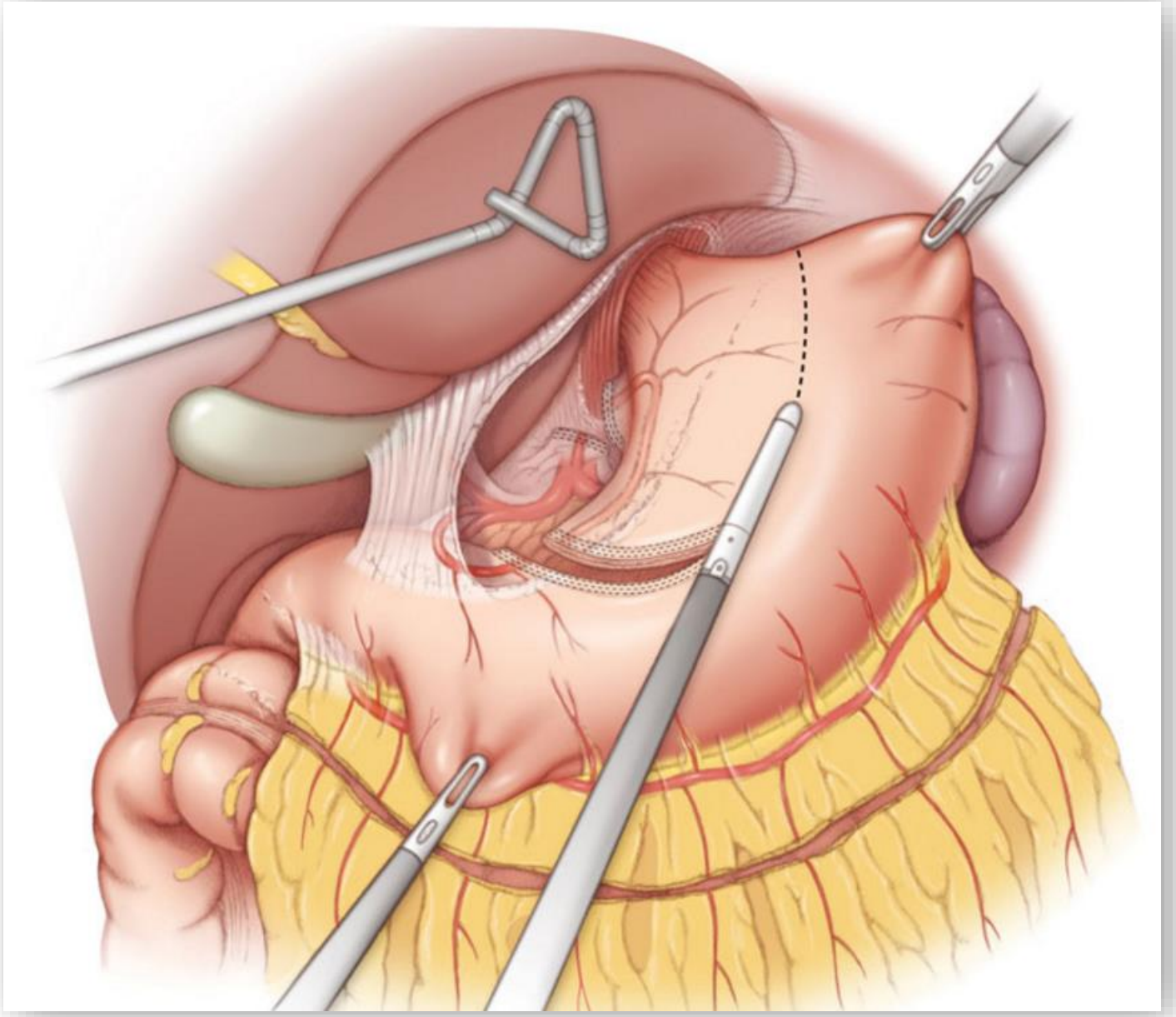


Stomach preparation



- Greater curvature (RGEA)
  - Greater omentum
  - Short gastric arteries
- Lesser curvature
  - Lesser omentum
  - Lt. gastric artery & vein
- Pylorus
  - Kocher maneuver
  - Pylorus drain procedure
- Hiatus
  - Esophagus
  - Hiatus widening

Stomach preparation



Whole Stomach Vs Gastric Tube

PLOS ONE

RESEARCH ARTICLE

Gastric-tube versus whole-stomach esophagectomy for esophageal cancer: A systematic review and meta-analysis

Wenxiong Zhang, Dongliang Yu, Jinhua Peng, Jianjun Xu, Yiping Wei*

Department of Cardiothoracic Surgery, The Second Affiliated Hospital of Nanchang University, Nanchang, China

PLOS One 2017

Whole Stomach Vs Gastric Tube

Study or Subgroup	Gastric Tube Events	Gastric Tube Total	Whole stomach Events	Whole stomach Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Collard 1995	6	112	4	100	19.7%	1.36 [0.37, 4.96]	1995
Peng 2009	6	120	31	120	26.6%	0.15 [0.06, 0.38]	2009
Shu 2013	23	453	44	397	34.7%	0.43 [0.25, 0.72]	2013
Zhang 2015	3	52	11	52	19.0%	0.23 [0.06, 0.87]	2015
Total (95% CI)		**737**		**669**	**100.0%**	**0.36 [0.16, 0.81]**	
Total events	38		90				

Heterogeneity: $Tau^2 = 0.41$; $Chi^2 = 8.38$, df = 3 (P = 0.04); $I^2 = 64\%$
Test for overall effect: Z = 2.49 (P = 0.01)

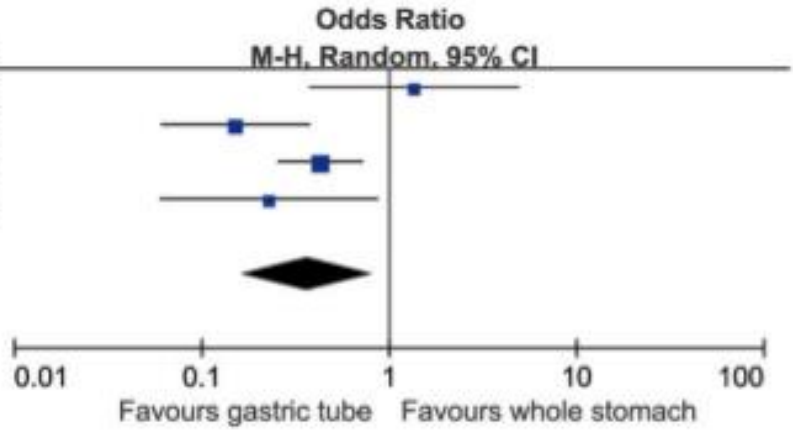


Fig 4. Forest plot of reflux esophagitis in the whole-stomach and gastric-tube groups.

Study or Subgroup	Gastric Tube Events	Gastric Tube Total	Whole stomach Events	Whole stomach Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
Shu 2013	15	453	39	397	92.1%	0.31 [0.17, 0.58]	2013
Zhang 2015	0	52	3	52	7.9%	0.13 [0.01, 2.67]	2015
Total (95% CI)		**505**		**449**	**100.0%**	**0.30 [0.17, 0.55]**	
Total events	15		42				

Heterogeneity: $Chi^2 = 0.30$, df = 1 (P = 0.59); $I^2 = 0\%$
Test for overall effect: Z = 3.95 (P < 0.0001)

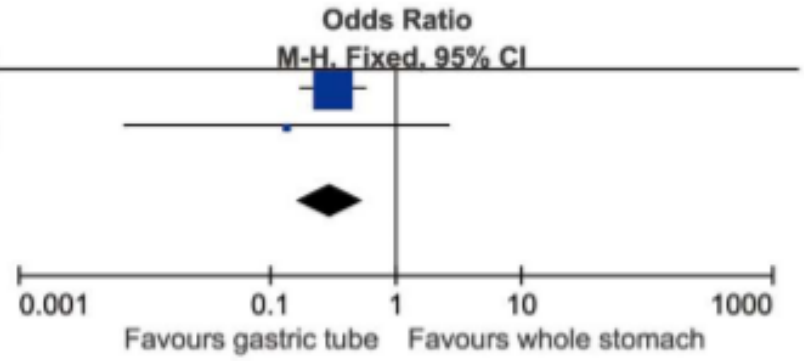
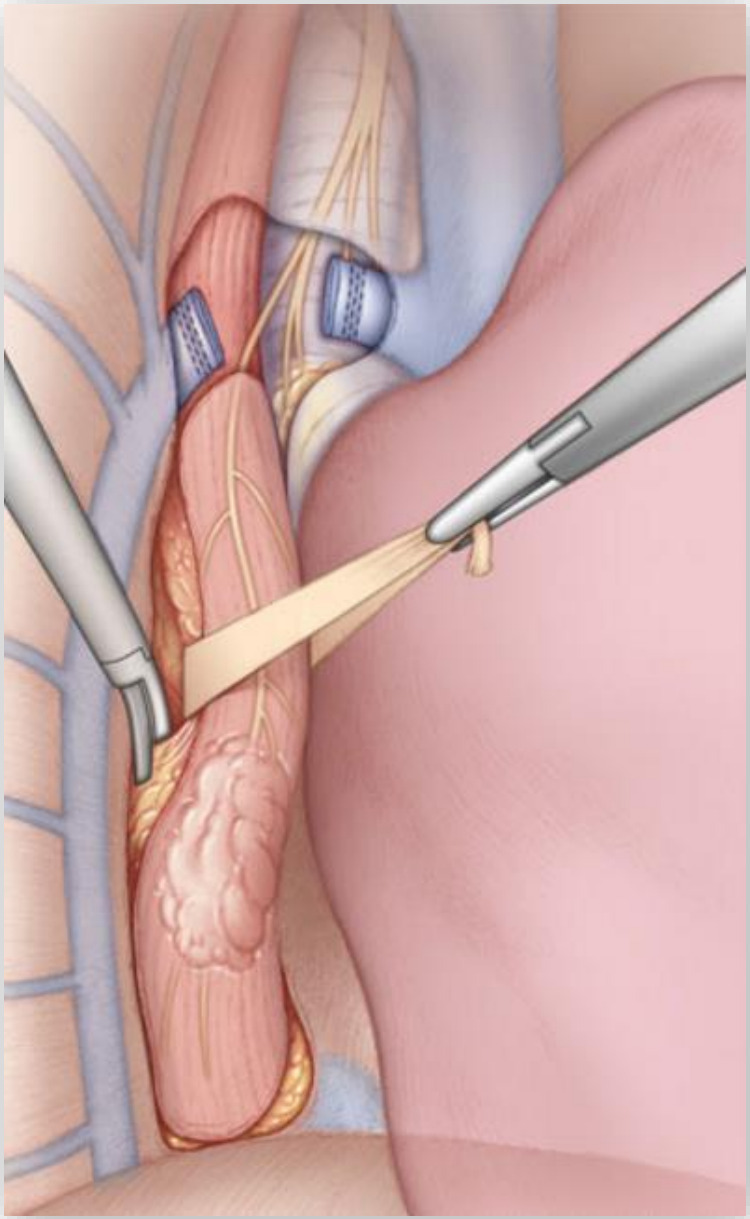
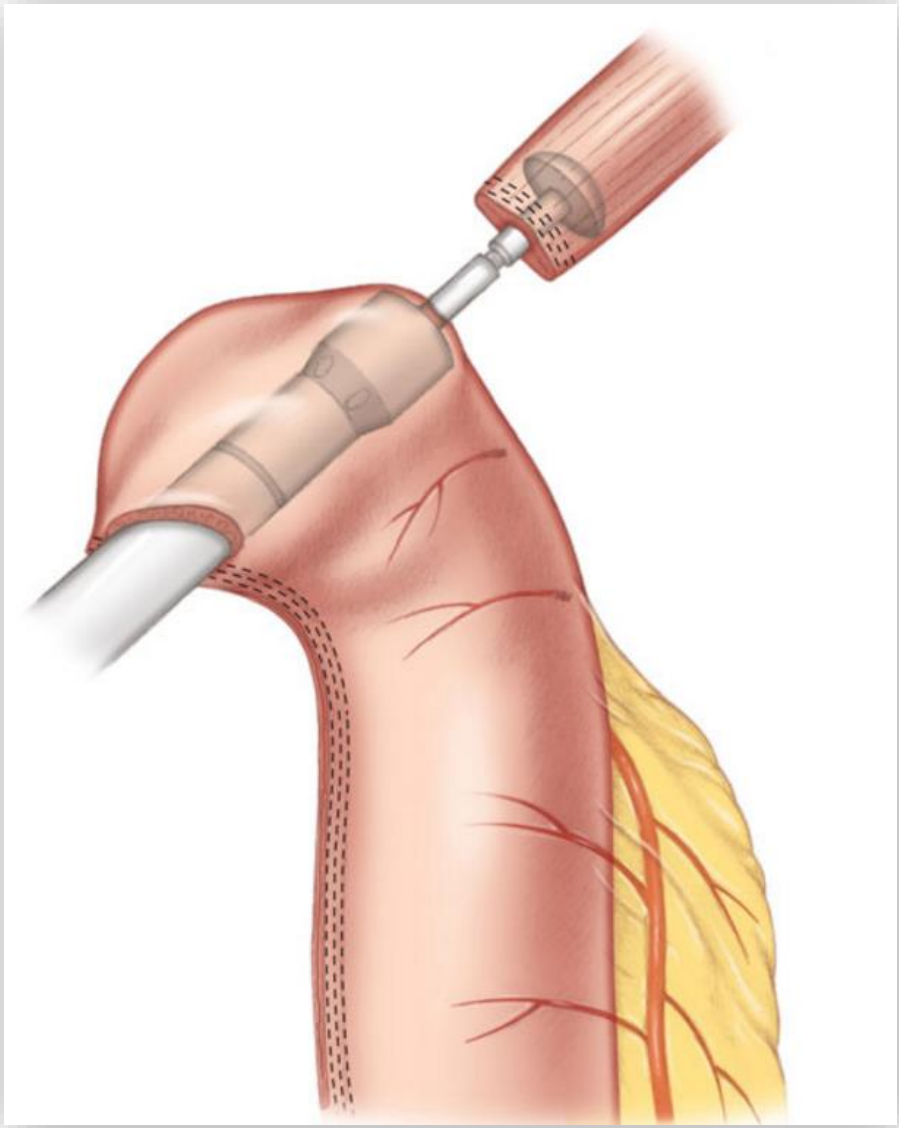


Fig 7. Forest plot of thoracic stomach syndrome in the whole-stomach and gastric-tube groups.

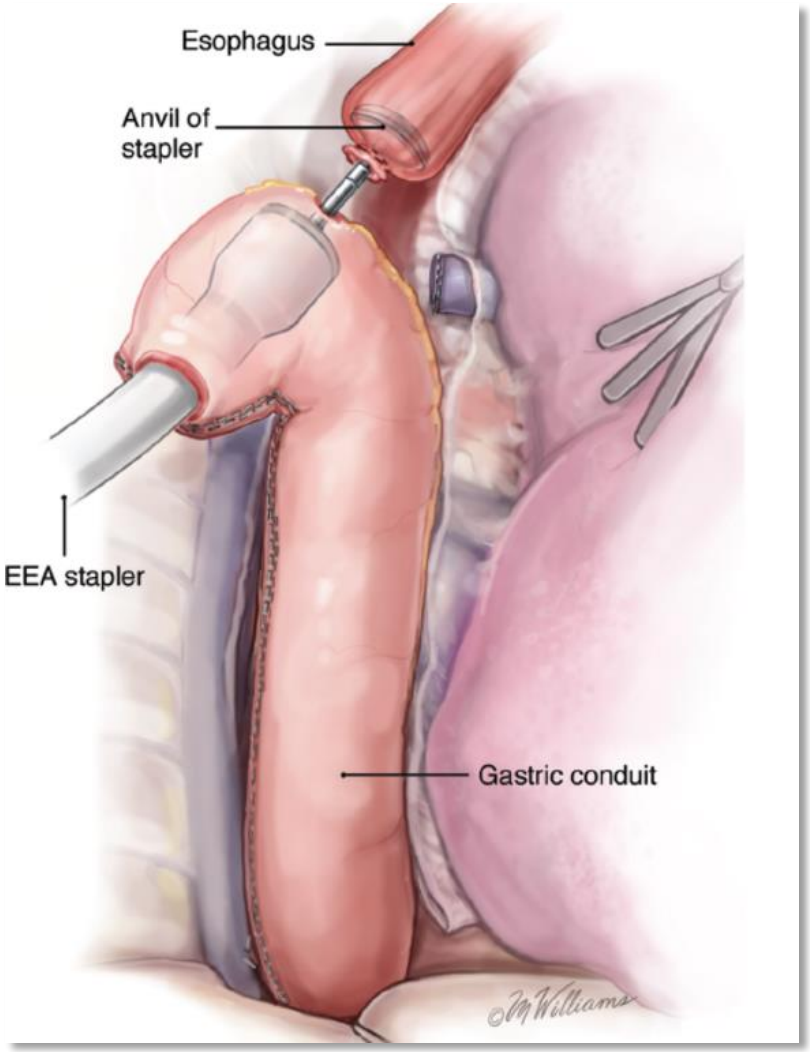
Transthoracic esophagectomy & Esophago-gastrostomy



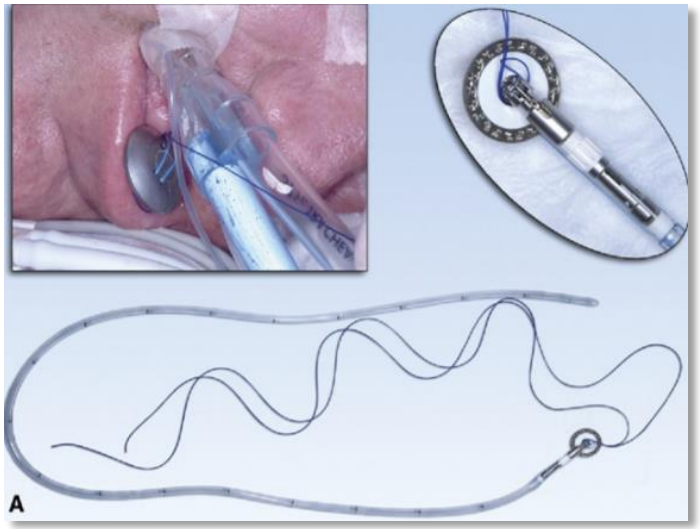


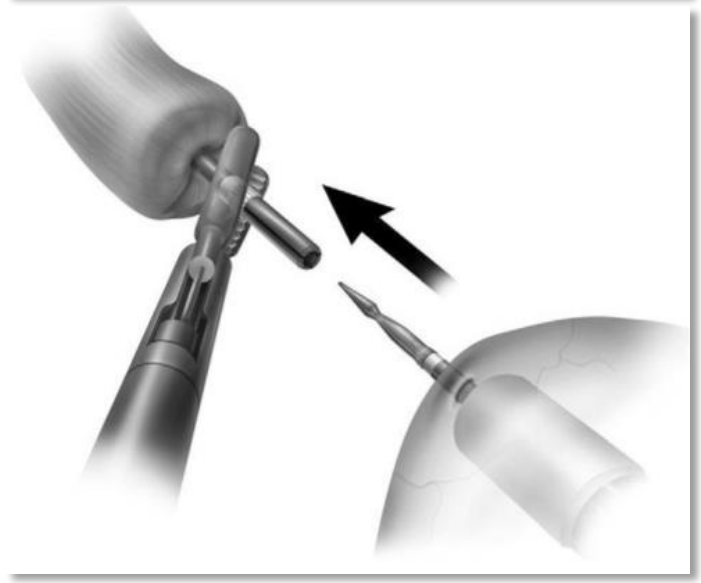
Esophago-gastrostomy (EEA & Orvil)

Transthoracic EEA



Transoral OrVil EEA

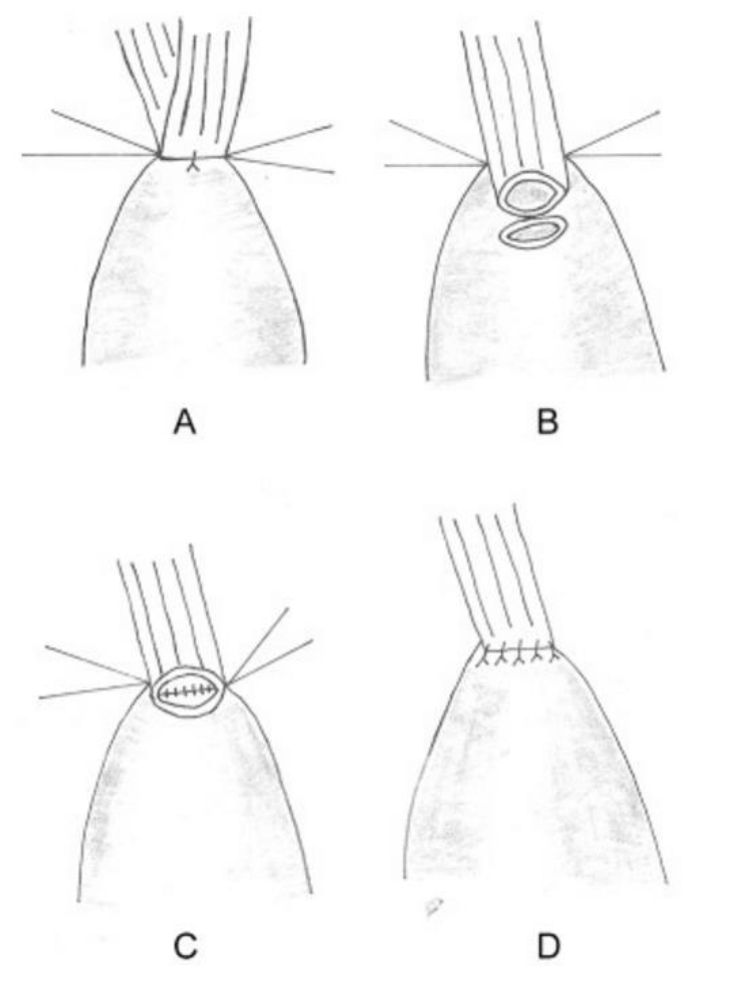




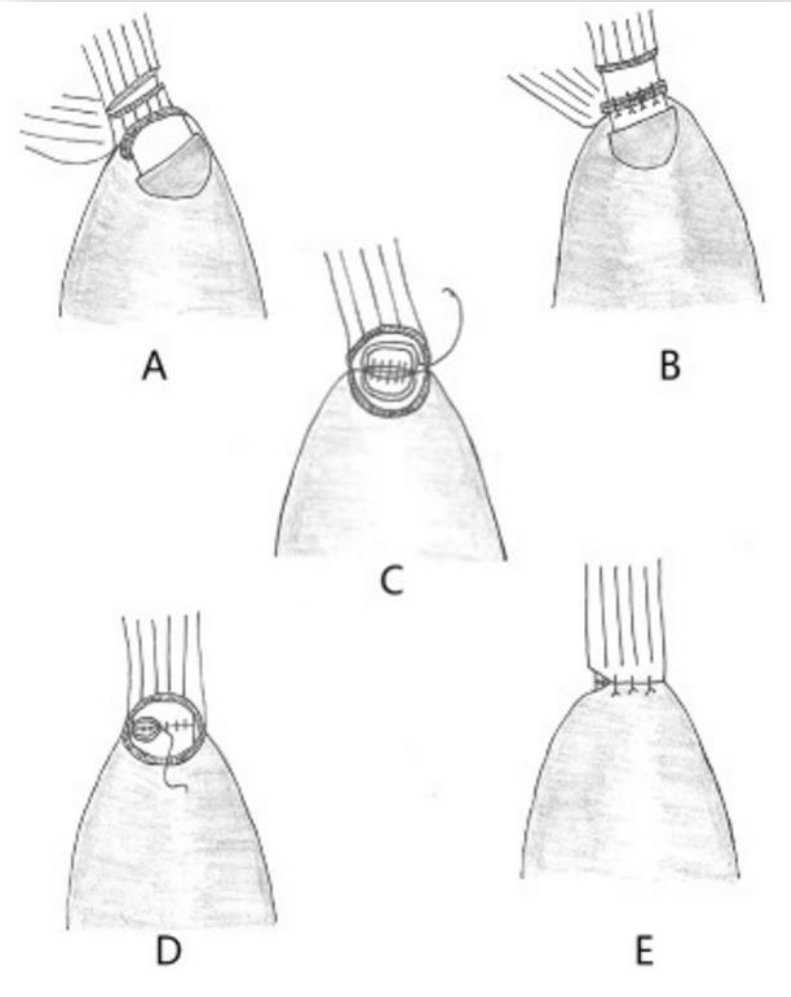
Ann Thorac Surg 2011;92:1862–9

Esophago-gastrostomy (hand-sewing)

One layer

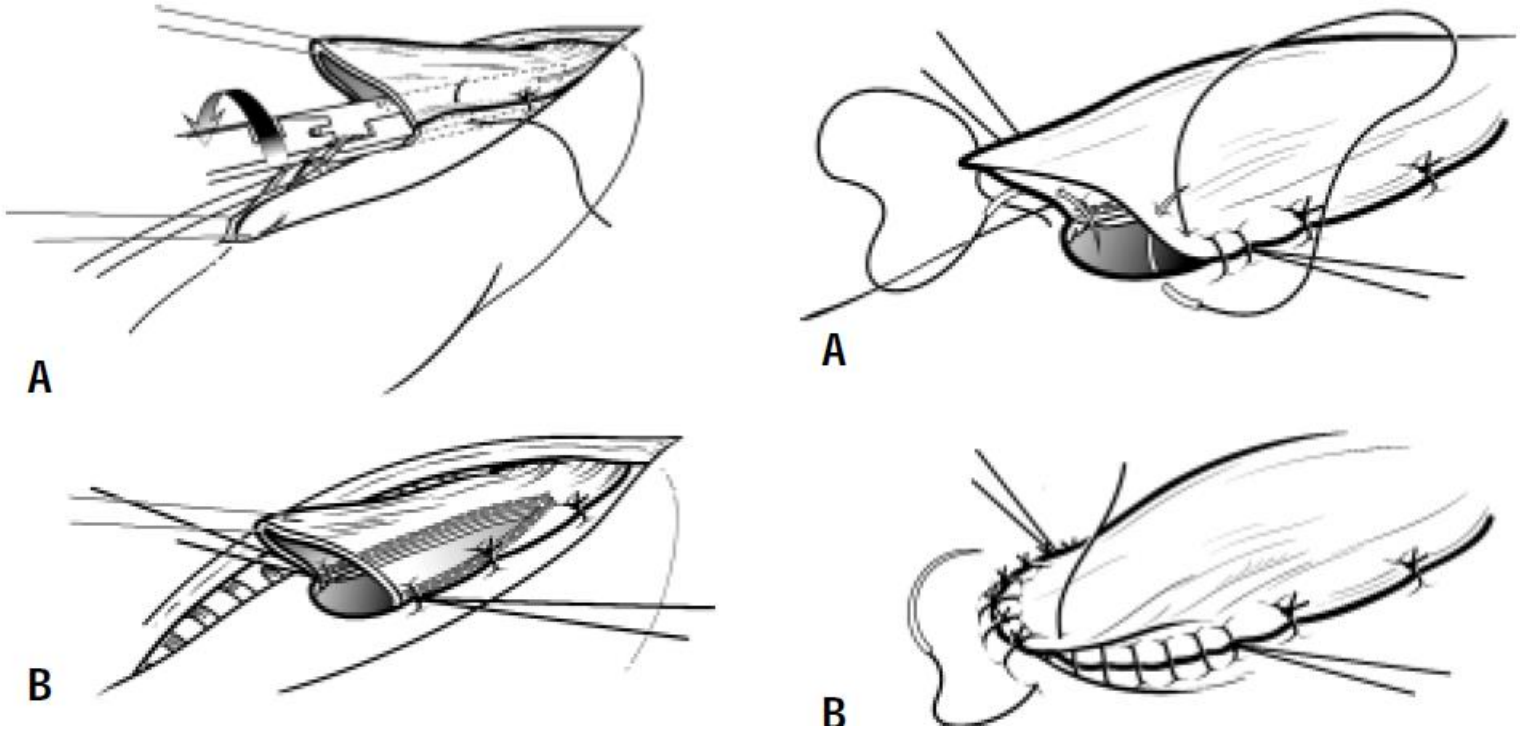


Two layer



Esophago-gastrostomy (Stapling)

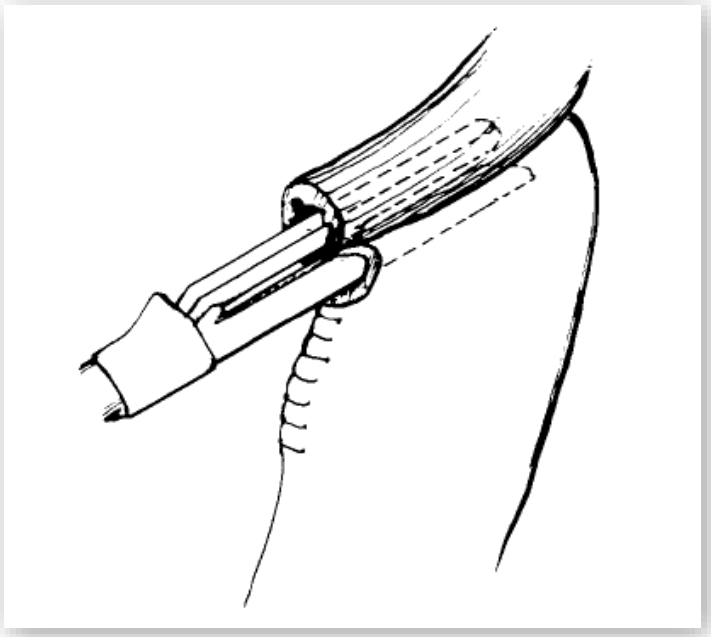
Side-To-Side

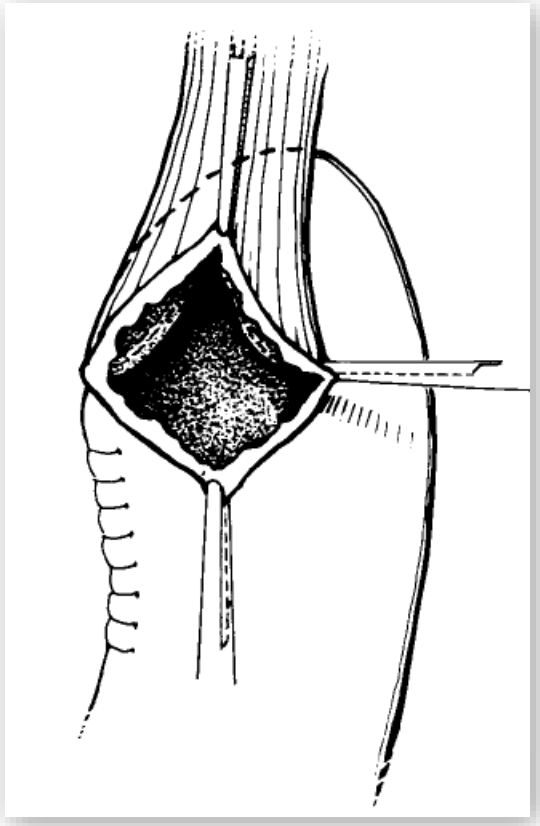


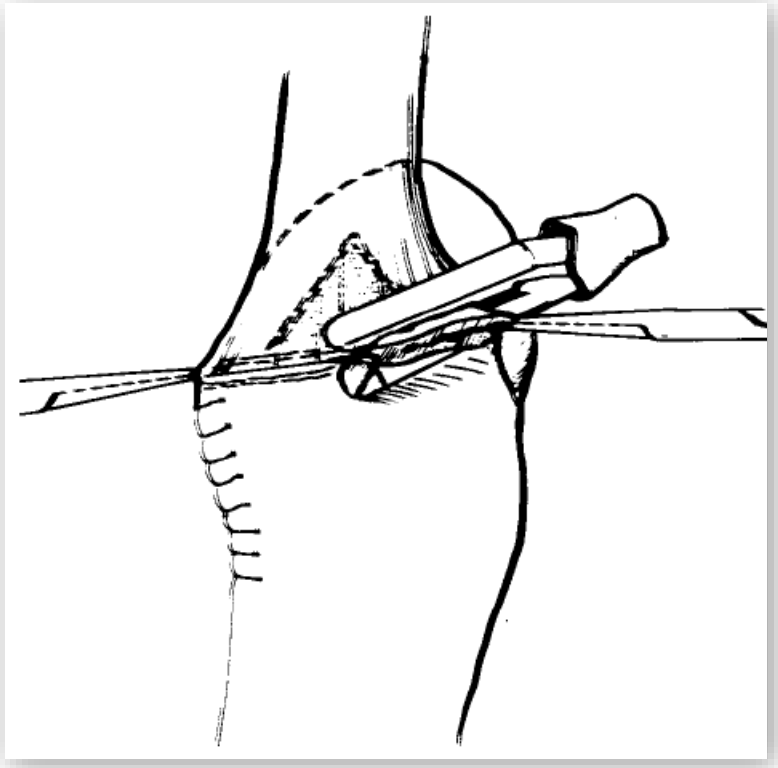
Orringer MB, et al. J Thorac Cardiovasc Surg 2000;119:277-88

Esophago-gastrostomy (Stapling)

Triangulating stapling technique



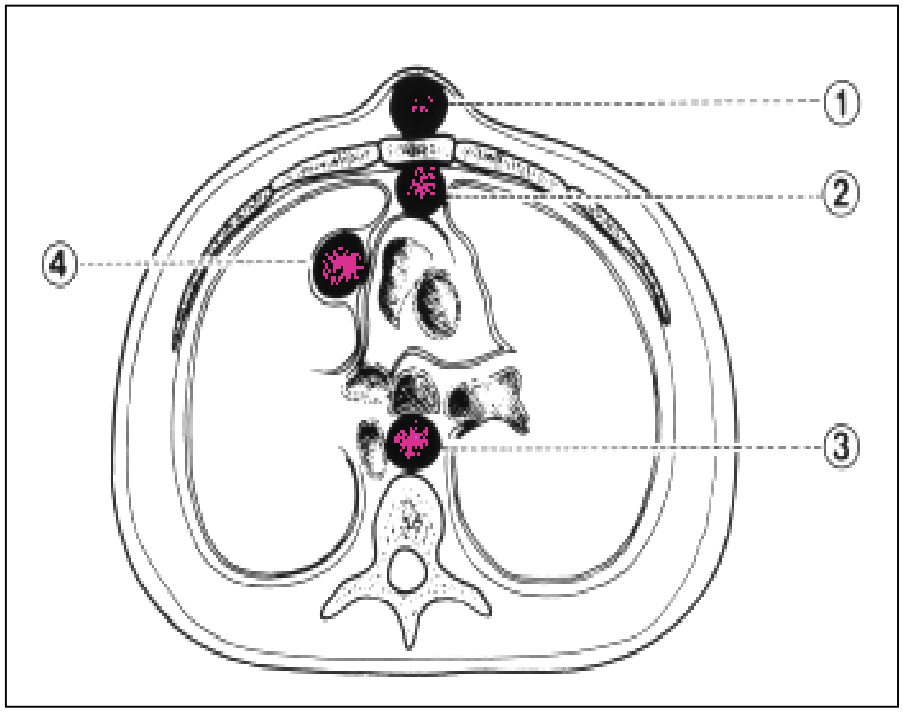


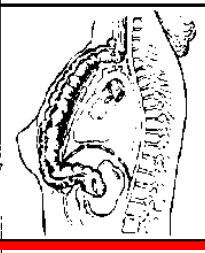
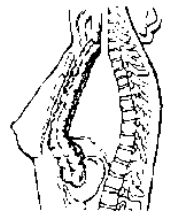
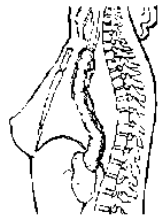
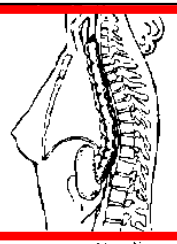
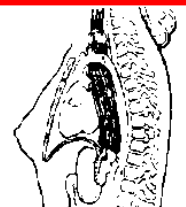


Surgeon's preference and proficiency !!!

Singh D, et al. Ann Thorac Surg 2001;71:419 –24

Routes



Route	Procedure	Advantages	Disadvantages
Sub-cutaneous		Ease of construction. Avoids encroachment on heart or lungs. Facilitates early detection of graft failure.	Cosmetically far from ideal. Longest course of any route.
Substernal		Ease of construction. Useful when mediastinum is unavailable.	Long route. Graft angulation. Cardiac surgery concerns (past or proposed).
Transpleural		Convenient from left thoracic approach.	Displaces lung.
Posterior Mediastinal		Short and direct.	Mediastinum may be unavailable if inflamed, scarred, or involved with cancer.
Endo-esophageal		Lessened risk of bleeding. Short and direct. Promotes a straight lie of the viscus.	? Compromise of cancer operation. ? Possibility for constriction.

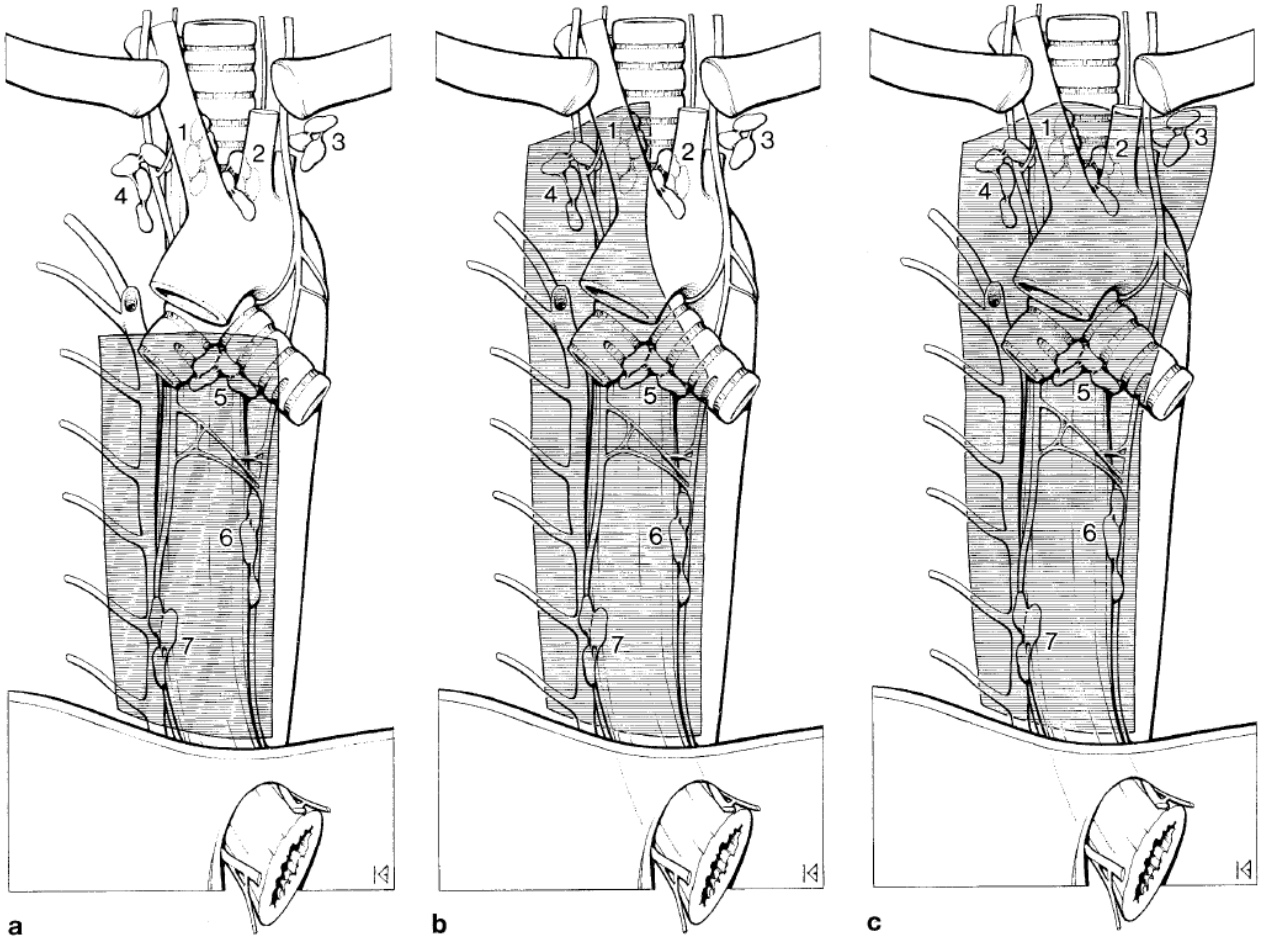
Surgeon's preference and proficiency !!!

Lymphadenectomy

Extent of lymphadenectomy

- Transhiatal esophagectomy
- One-field lymphadenectomy
- Two-field lymphadenectomy
  - Standard two-field lymphadenectomy
  - Extended two-field lymphadenectomy
  - Total two-field lymphadenectomy
- Three-field lymphadenectomy

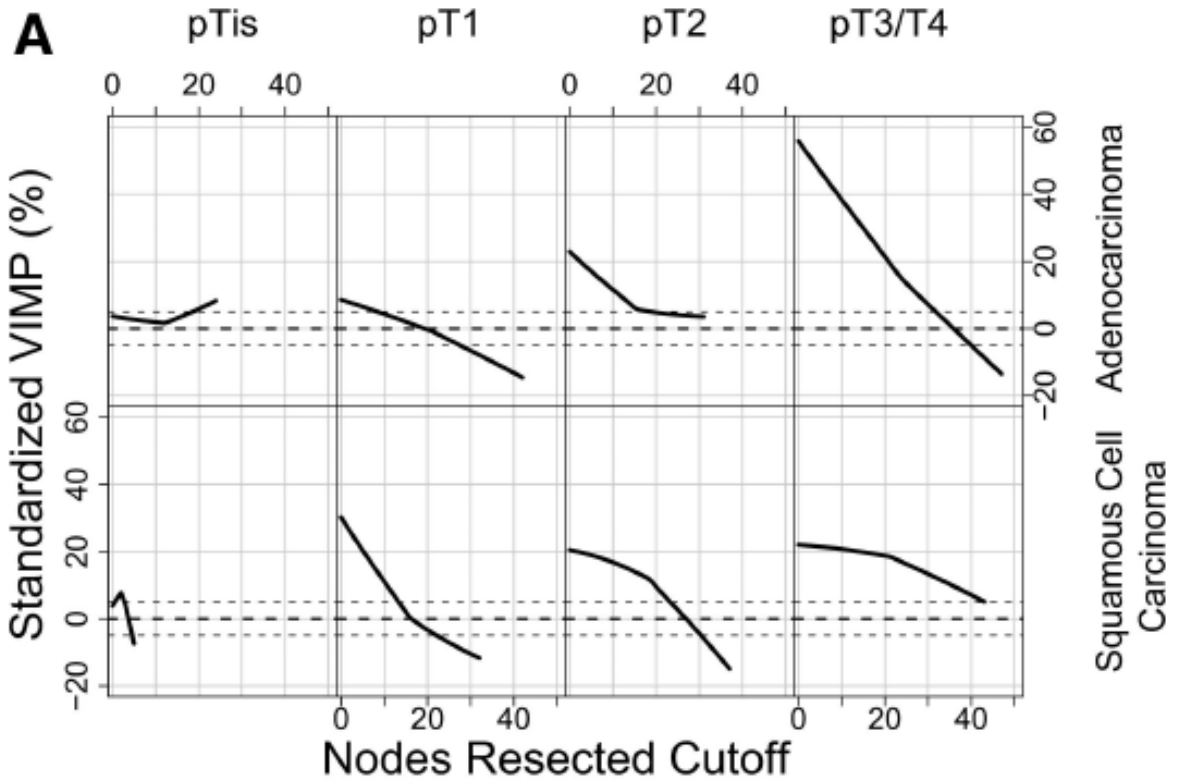
ISDE classification of lymphadenectomy



Standard **Extended** **Total**

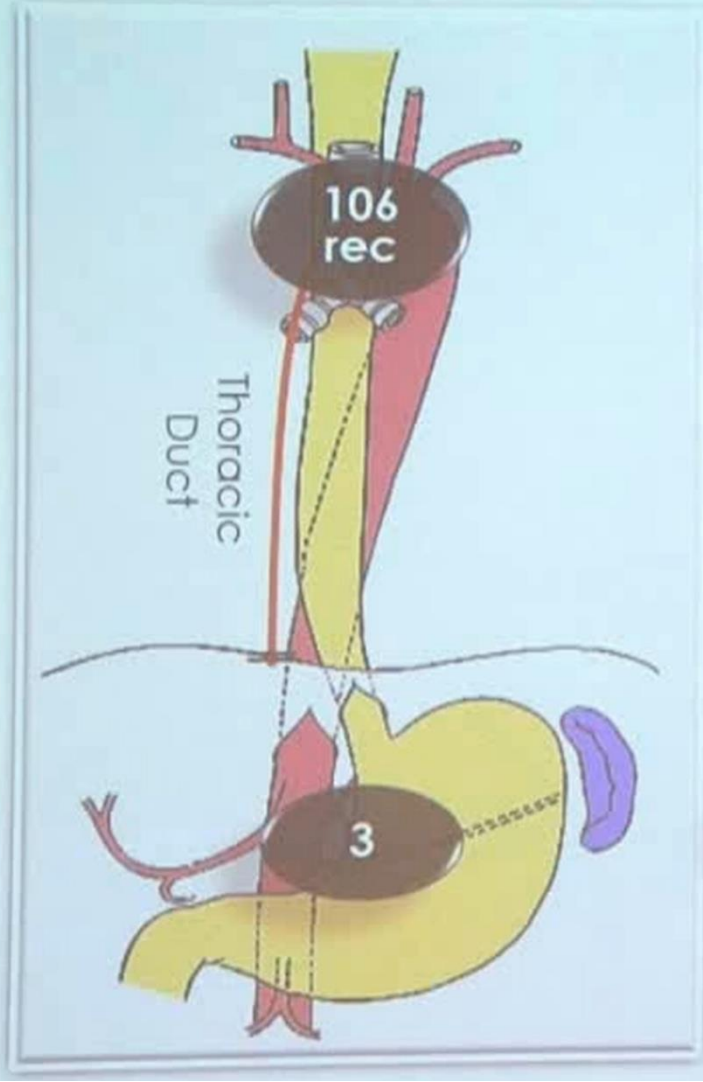
Recommendation

- WECC data
- N=4,627
- T1 more than 10
- T2 more than 20
- T3 more than 30



Rizk NP, et al. Ann Surg 2010;251:46-50.

Frequent Sites of LN Met.

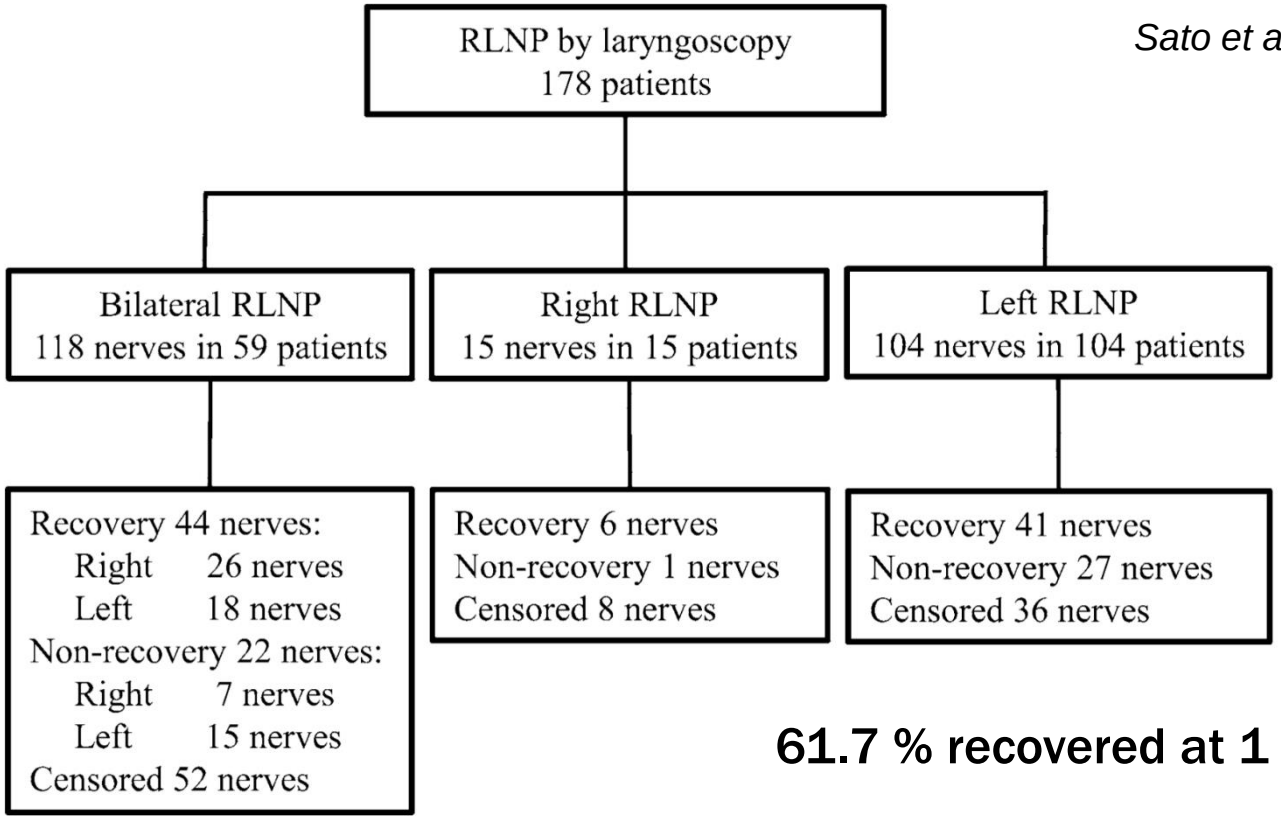


No.106rec
(34.4%)

No.3
(24.6%)

Recurrent laryngeal nerve palsy

RLNP	Total ($n = 299$)	THE ($n = 93$)	TTE and VATS-E ($n = 206$)
Absent	121 (40.5 %)	53 (57.0 %)	68 (33.0 %)
Present	178 (59.5 %)	40 (43.0 %)	138 (67.0 %)
Right	74	4	70
Left	163	38	125



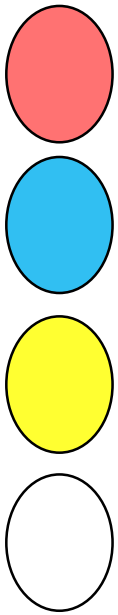
Sato et al. World J Surg 2016;40:129–136

61.7 % recovered at 1 year after op.

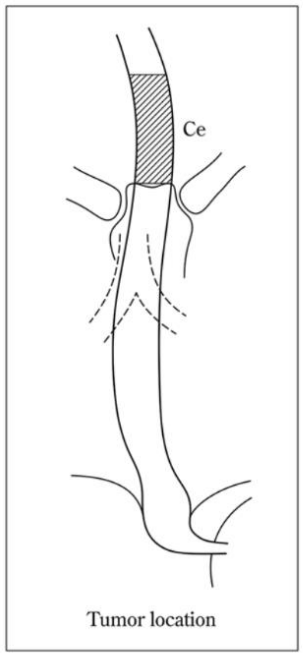
Efficacy Index (EI) Calculation

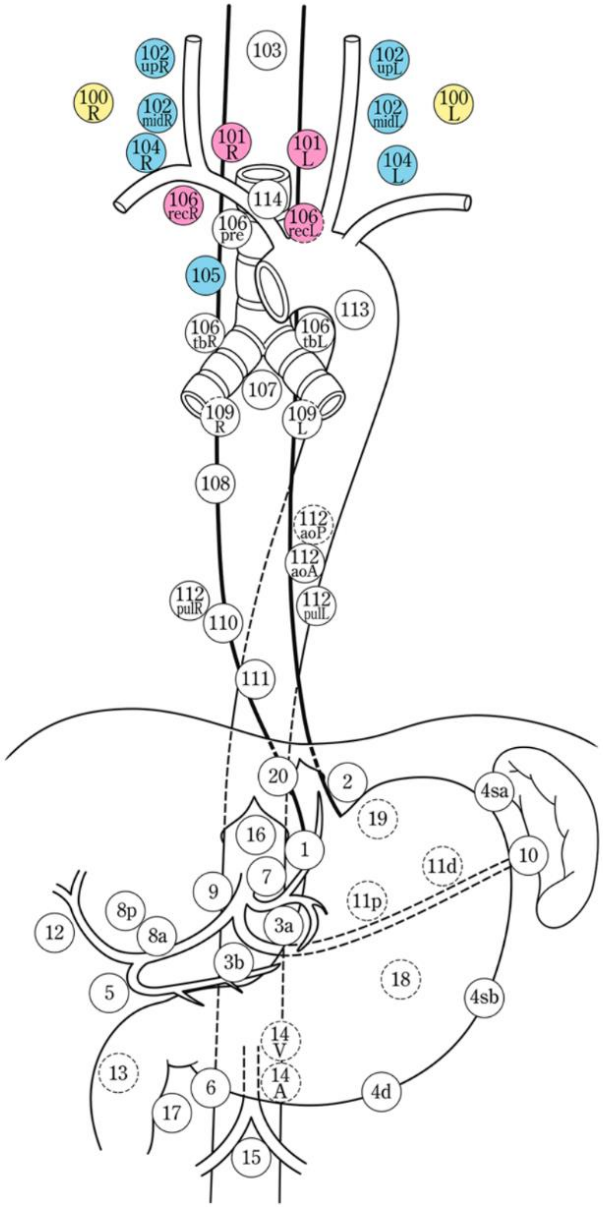
- Efficacy Index (EI) =
  Incidence of metastasis to a region (%) x 5-year survival rate (%) of patients with metastasis to that region/100

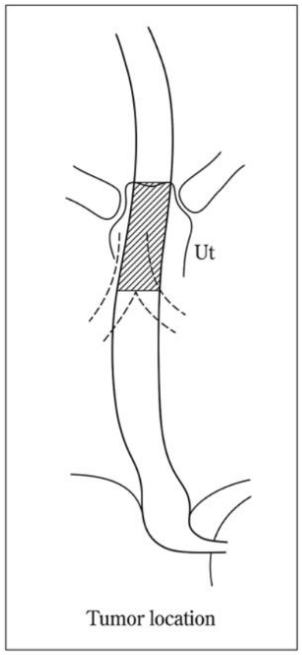
- Group 1 : 2 <
- Group 2 : 1 ~2
- Group 3 : 0.5 ~1
- Group 4 : ~ 0.5

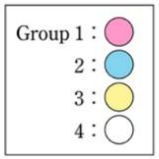


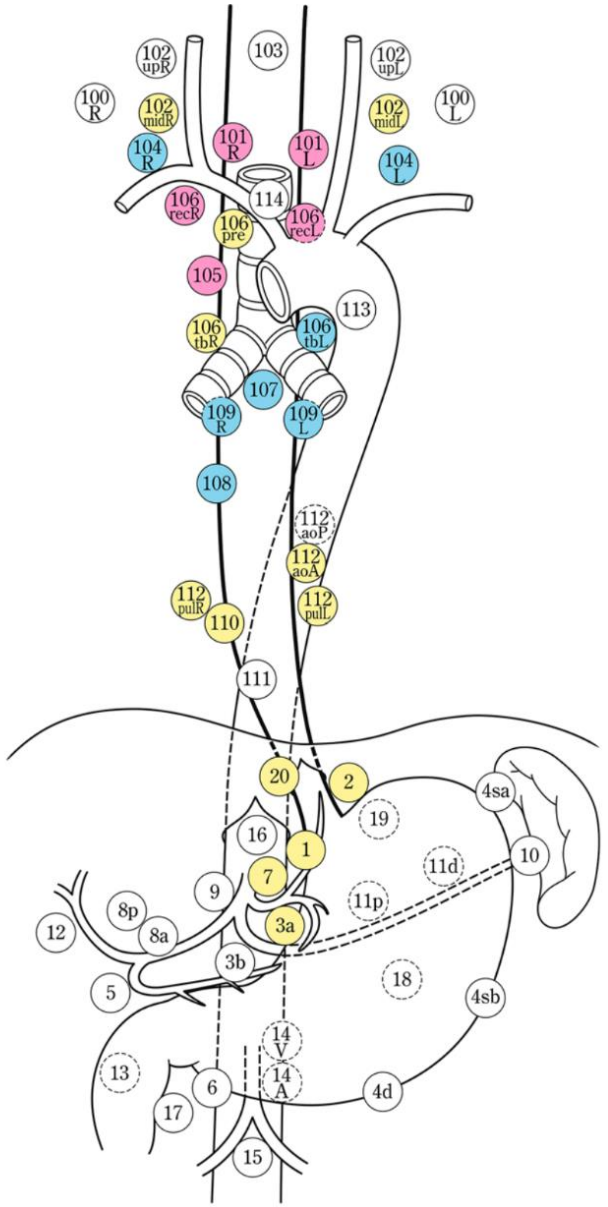
Japanese Classification of Esophageal Cancer, 11th ed



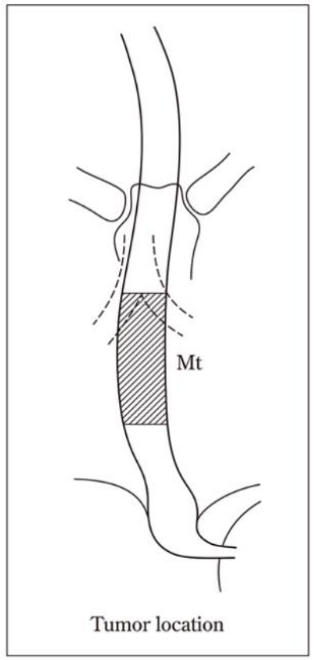


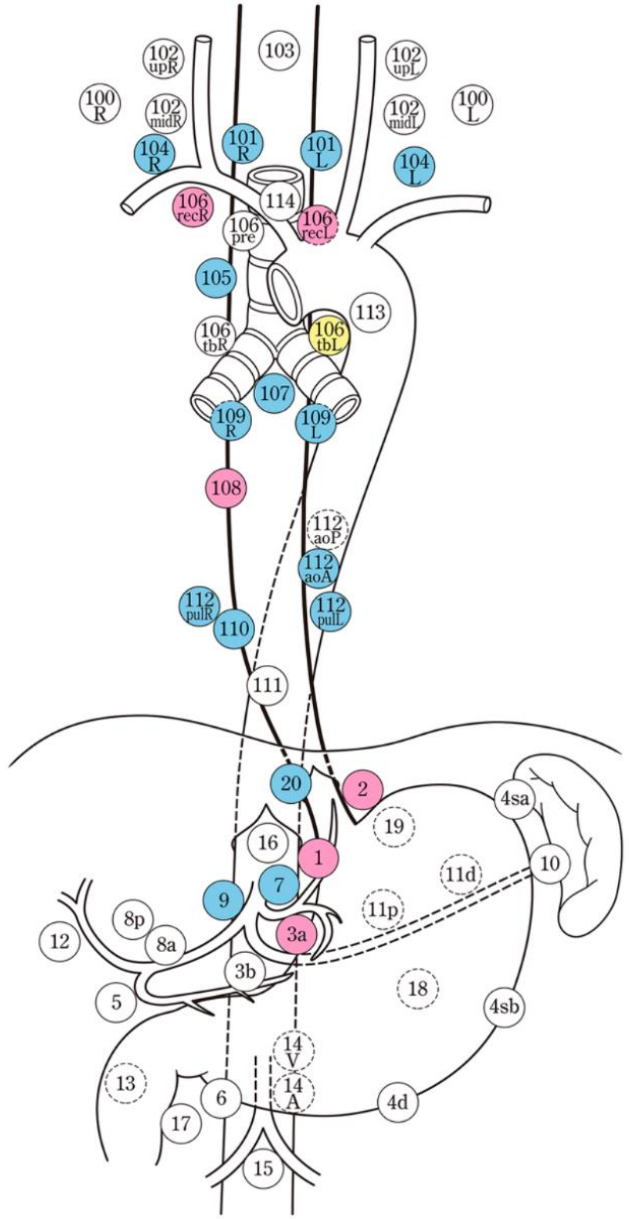


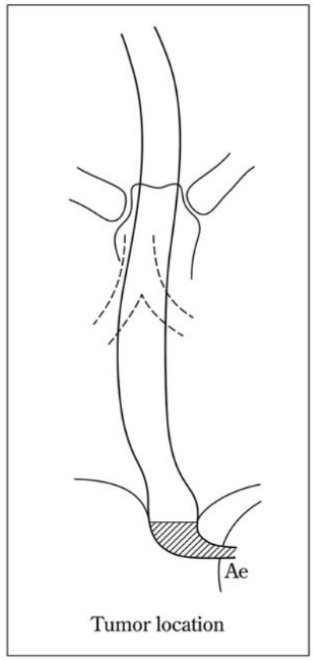


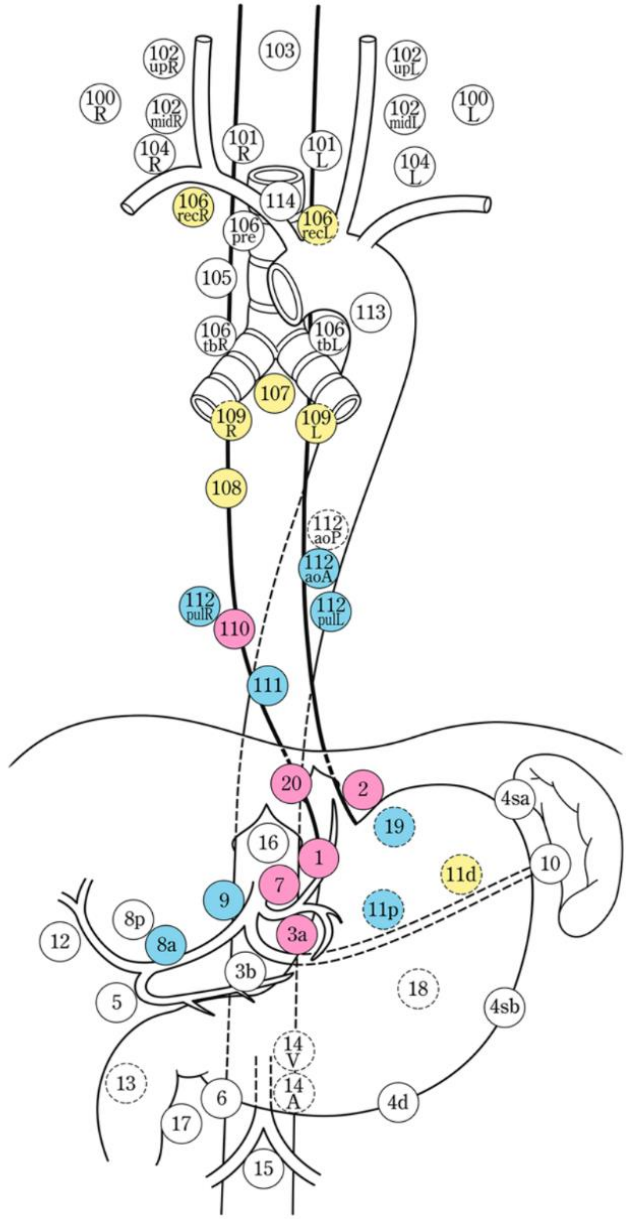


Japanese Classification of Esophageal Cancer, 11th ed





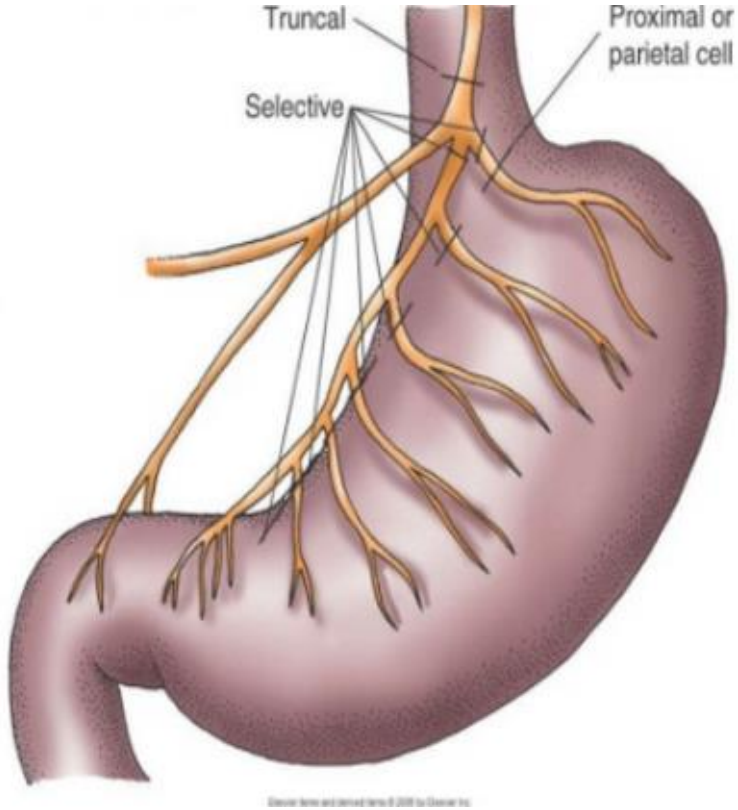




Others

Pylorus drainage procedure

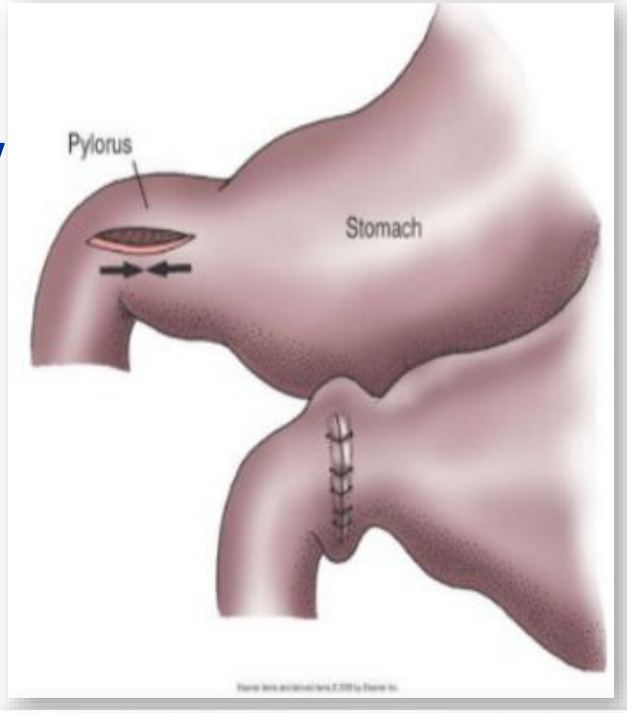
- Vagotomy
  - Cuts vagus nerve
  - Eliminates acid-secretion stimulus



Pylorus drainage procedure

; Widens the pylorus to guarantee stomach emptying even w/o vagus nerve stimulation

Pyloroplasty

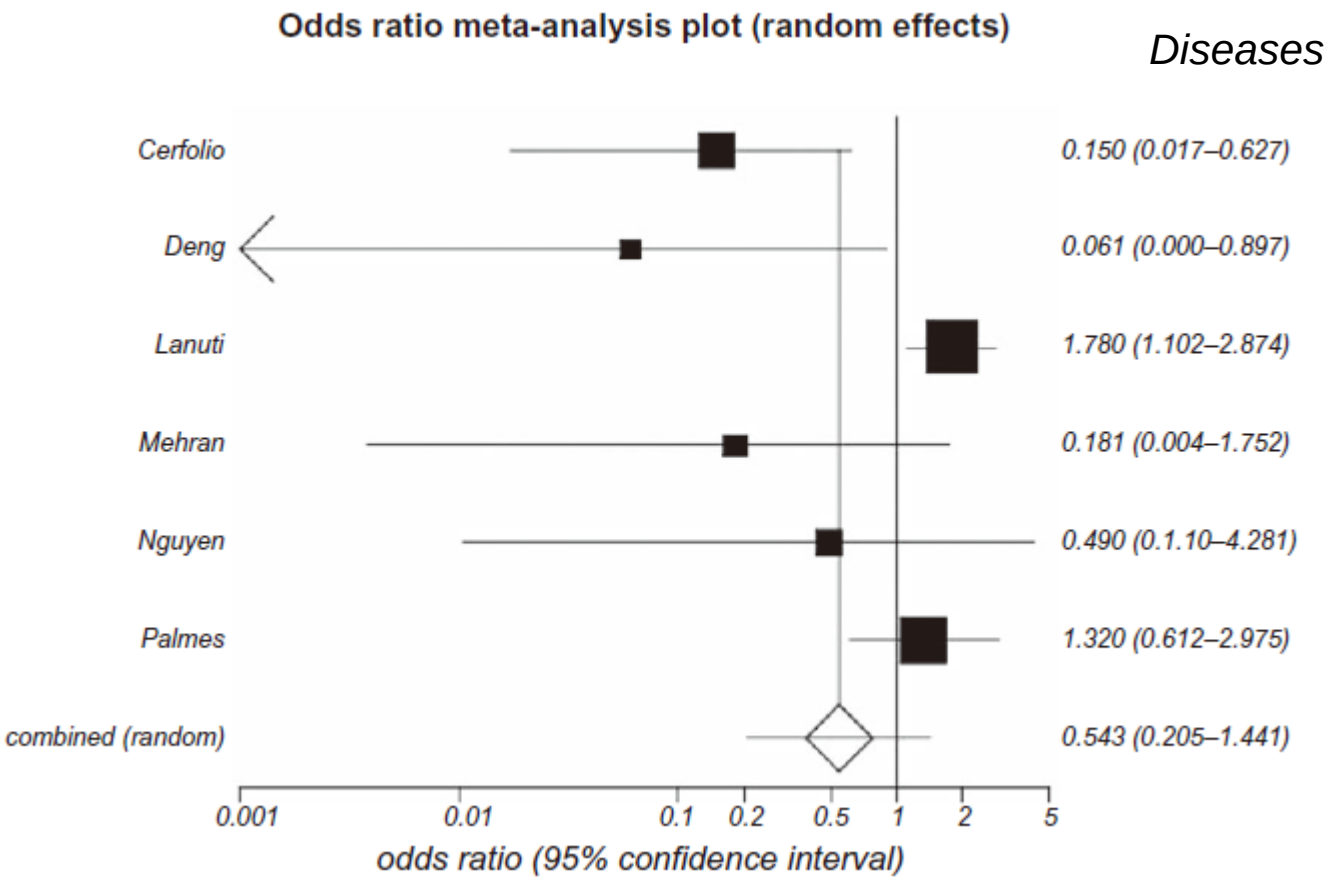


Myotomy

Finger fracture

Botox injection

Pylorus drainage procedure; systemic review



Diseases of the Esophagus 2015;28:326–335

; **Pyloric drainage procedures showed a *non-significant trend* toward fewer anastomotic leaks, pulmonary complications, and reduced gastric stasis**

Minimally invasive esophagectomy (MIE)

Minimally invasive versus open oesophagectomy for patients with oesophageal cancer: a multicentre, open-label, randomised controlled trial

Surya S A Y Biere, Mark I van Berge Henegouwen, Kirsten W Maas, Luigi Bonavina, Camiel Rosman, Josep Roig Garcia, Suzanne S Gisbertz, Jean H G Klinkenbijl, Markus W Hollmann, Elly S M de Lange, H Jaap Bonjer, Donald L van der Peet, Miguel A Cuesta

Lancet 2012; 379: 1887–92

RANDOMIZED CONTROLLED TRIAL

Minimally Invasive Versus Open Esophageal Resection

Three-year Follow-up of the Previously Reported Randomized Controlled Trial: the TIME Trial

Jennifer Straatman, MD, PhD, Nicole van der Wielen, MD,* Miguel A. Cuesta, MD, PhD,* Freek Daams, MD, PhD,* Josep Roig Garcia, MD, PhD,† Luigi Bonavina, MD, PhD,‡ Camiel Rosman, MD, PhD,§ Mark I. van Berge Henegouwen, MD, PhD,¶ Suzanne S. Gisbertz, MD, PhD,¶ and Donald L. van der Peet, MD, PhD**

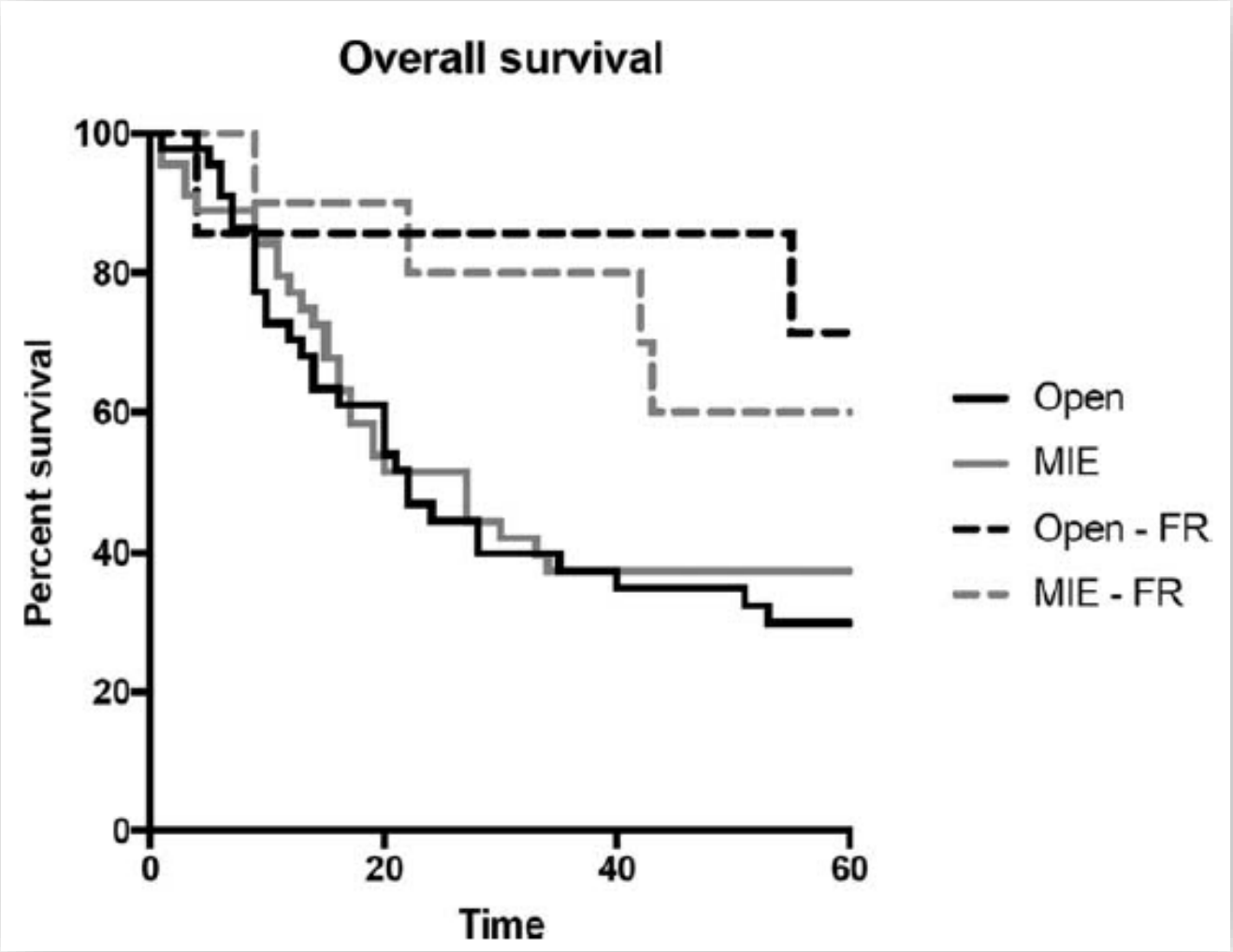
Ann Surg 2017

Minimally invasive esophagectomy (MIE)

	OO (N=56)	MIO (N=59)	p value
Primary outcomes			
Pulmonary infection within 2 weeks	16 (29%)	5 (9%)	0·005
Pulmonary infection in-hospital	19 (34%)	7 (12%)	0·005
Secondary outcomes			
Hospital stay (days)*	14 (1–120)	11 (7–80)	0·044
Short-term quality of life†			
SF 36†			
Physical component summary	36 (6; 34–39)	42 (8; 39–46)	0·007
Mental component summary	45 (11; 40–50)	46 (10; 41–50)	0·806
EORTC C30†			
Global health	51 (21; 44–58)	61 (18; 56–67)	0·020
OES 18‡			
Talking	37 (39; 25–49)	18 (26; 10–26)	0·008
Pain	19 (21; 13–26)	8 (11; 5–11)	0·002

Lancet 2012; 379: 1887–92

Minimally invasive esophagectomy (MIE)



Ann Surg 2017

FU duration (median) : 22 months [IQR 10 – 59]
3y OS MIE:42.9%, OE:41.2% p = 0.633

Minimally invasive esophagectomy (MIE)

- The study presented here depicted no differences in disease-free and overall 3-year survival for open and MIE.

- These results, together with short-term results (***superior outcomes in MIE group***), further support the use of minimally invasive surgical techniques in the treatment of esophageal cancer.