ESOPHAGECTOMY
with
ESOPHAGEAL RECONSTRUCTION

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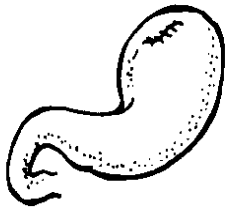
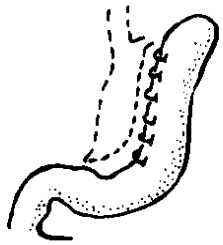
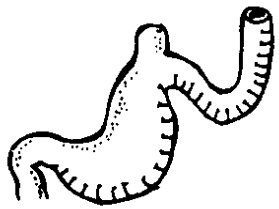
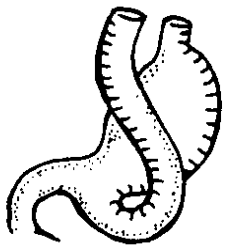
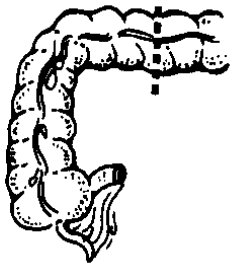
PREOPERATIVE EVALUATION

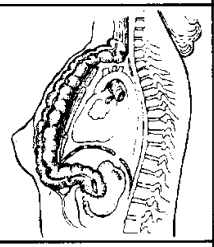
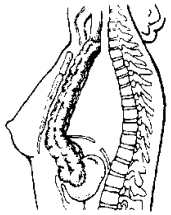
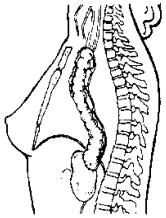
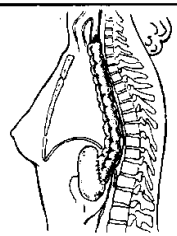
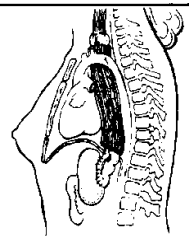
- Upper endoscopy with biopsy
- Barium swallow
- EUS
- Chest and abdomen CT
- PET
- PFT
- ECHO

SURGICAL TREATMENT

- Esophagectomy & reconstruction
- Substitute with what kind organ?
- By what route?
- Anastomosis method?
  - hand-sawn/mechanic(stapling)/semi-mechanic

Organ	Technique	No. of Anastomoses	Inherent Morbidity Difficulty	Upper Level of Usefulness	Disadvantages
Stomach		1	+	Cervical Esophagus and Pharynx	Bulky Reflux Risk
Greater Curvature Tube		1	+	Cervical Esophagus and Pharynx	Reflux Risk
Reversed Gastric Tube		1	+++	Cervical Esophagus and Pharynx	Long Suture Line Limited Blood Supply
Non-reversed Gastric Tube		1	++	Lower Cervical Esophagus	Long Suture Line

Right Colon		3	+++	Lower Cervical Esophagus	Thin-walled Bulky Short Pedicle
Left Colon		3	++++	Most versatile organ for use at any level Lower third to Pharynx	Extensive operation Redundancy over time
Jejunum		2 (Roux Loop) 3 (Interposition)	++	Lower Third	Limited graft length without revision of pedicle or bowel
Free Graft		5 (2 micro-vascular)	+++++	Pharynx and Cervical Esophagus	Microvascular anastomoses required

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.

OPERATIVE TECHNIQUE

1. Ivor-Lewis operation

2. Transhiatal operation (Orringer operation)

3. McKeown operation
   (Lewis-McKeown, 3-hole)

4. Left Thoracoabdominal Esophagectomy

5. Colon Interposition

6. Free Jejunal graft

Preparation

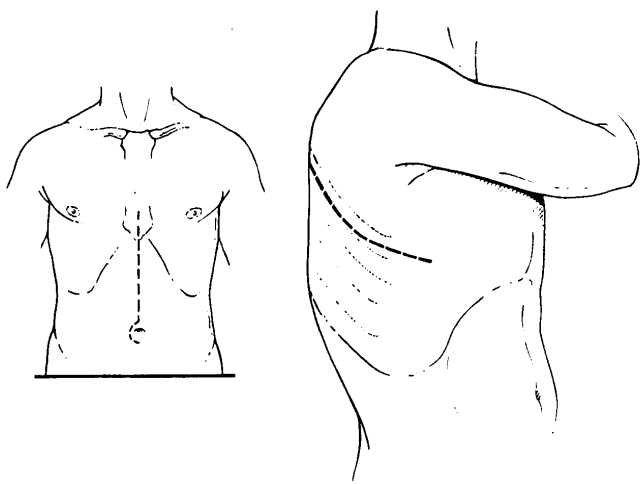
- Quit smoking
- Inspirometry exercise
- Nutritional support
- Bowel preparation

  (1 day for stomach)

IVOR-LEWIS OPERATION

- Indication : lower-two third tumors
  with gastric cardia involvement

- Advantage
  1. Direct vision
  2. Great longitudinal and radial margin
  3. Complete lymphadenectomy

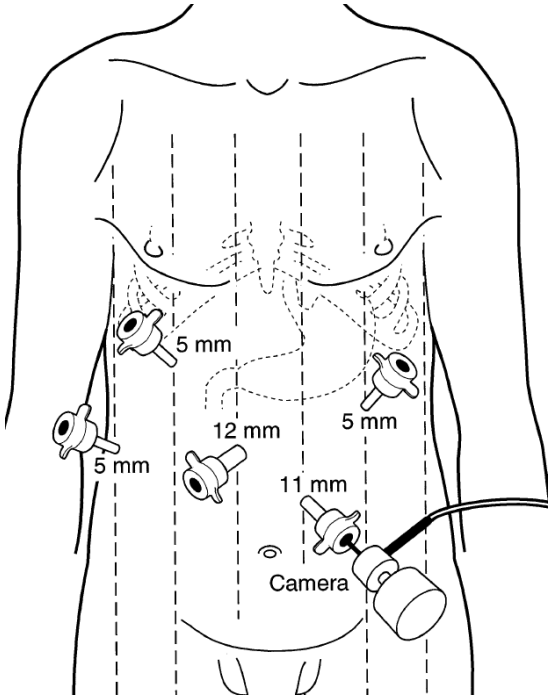


SURGICAL TECHNIQUE

Stage1. Mobilization of the stomach

1. supine position

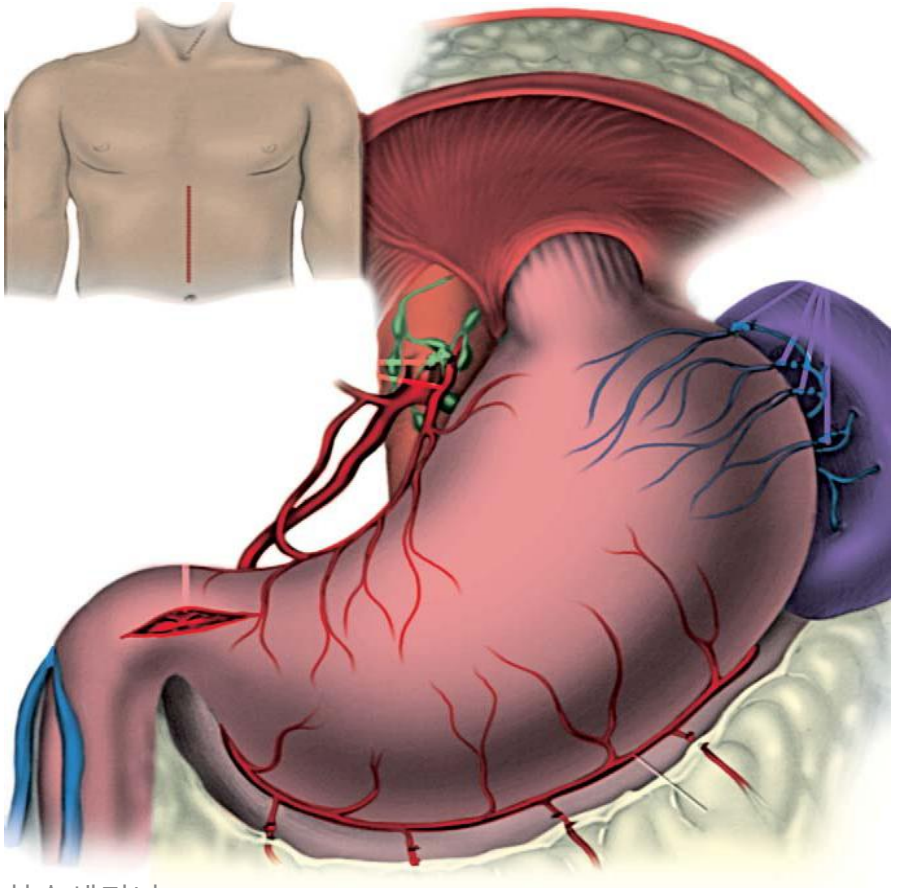
2. Median upper laparotomy/Laparoscopy



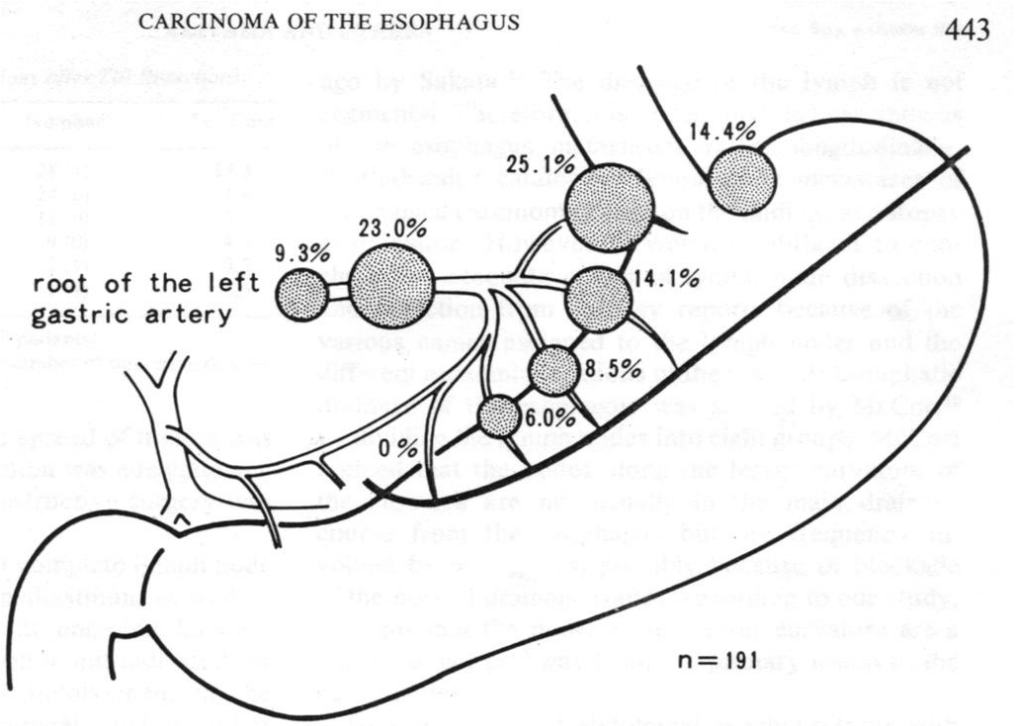
3. Mobilization of the greater curvature of the stomach

4. Dividing the
   short gastric artery

5. Dividing the
   Lt. gastric artery



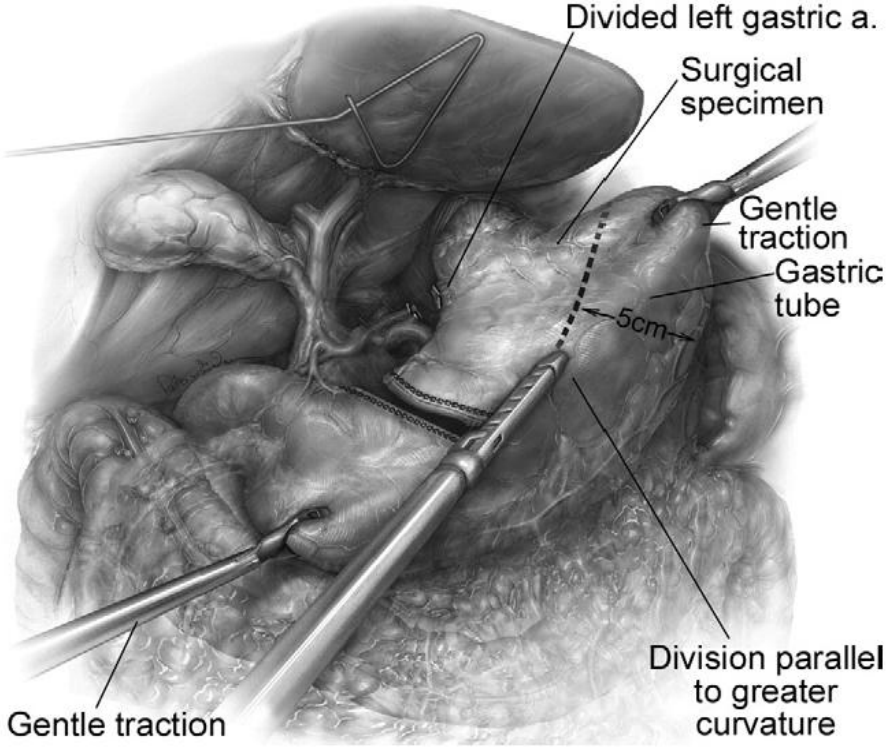
Lt. Gastric a., lesser curve and paracardial LN dissection



Ann Surg 1981 Akiyama Hiroshi

6. Constructing the gastric conduit
   - separating from the surgical specimen
     at the angle of His

7. Dissecting the esophageal
   hiatus circumferentially
   - as high as possible.

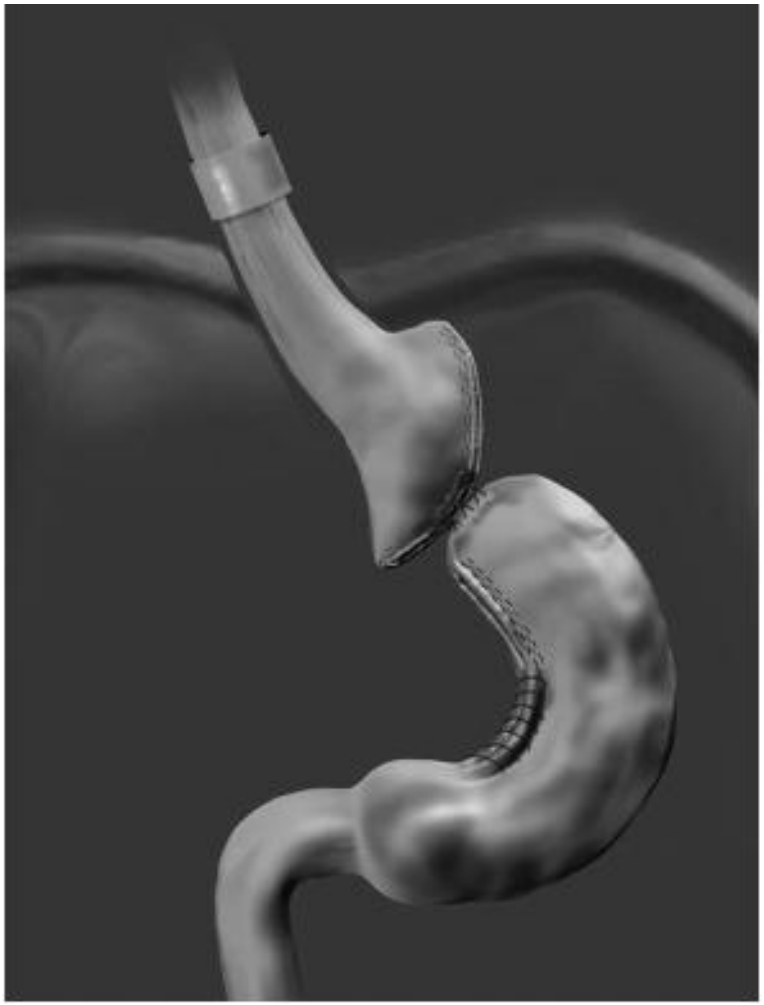


8. Suture

tip of the gastric conduit

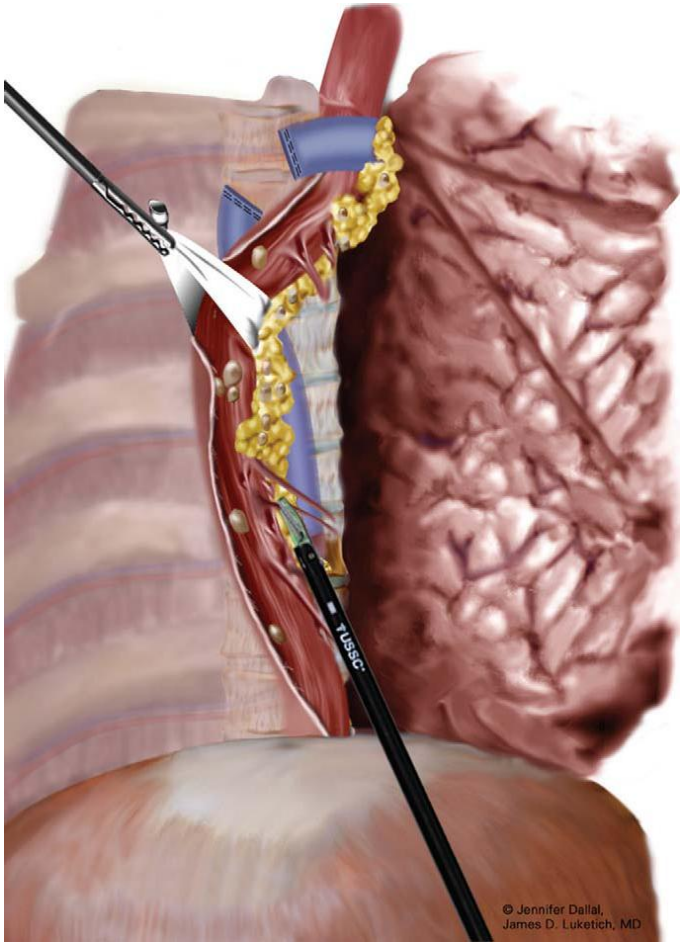
+ esophagus

9. Closure of wound



Stage2. Construction of an intrathoracic anastomosis

1. Lt. lat. decubitus position
2. Posterolateral thoractomy 4,5th ICS / VATS
3. Dividing the azygos vein
4. Dissection of esophagus
5. Dividing the esophagus
   - above the level of the azygos vein



6. Pulling the esophageal specimen and the attached gastric conduit

   - into the Rt. thoracic cavity.

7. Removing the specimen

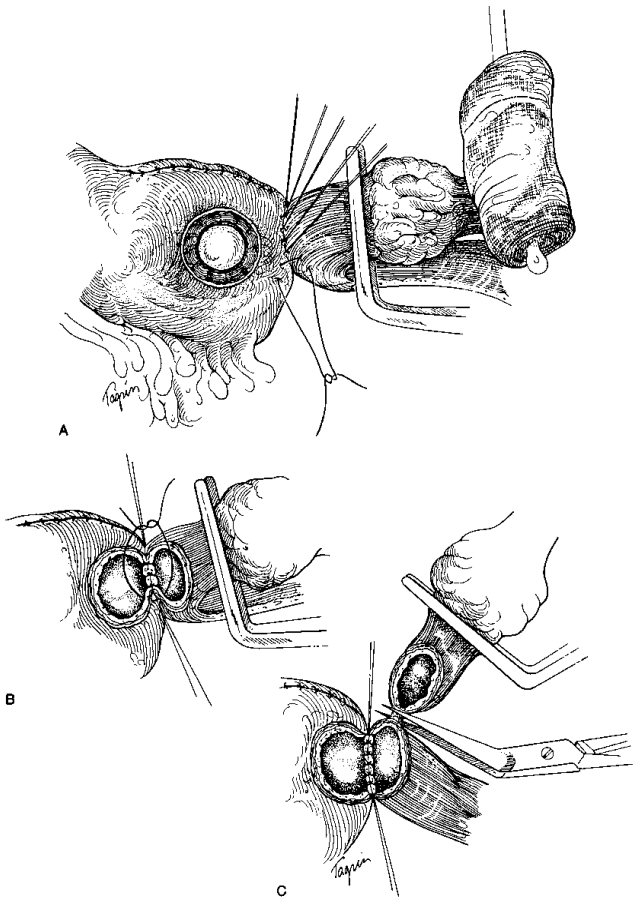
8. Hand-sawn or

   Placing the anvil

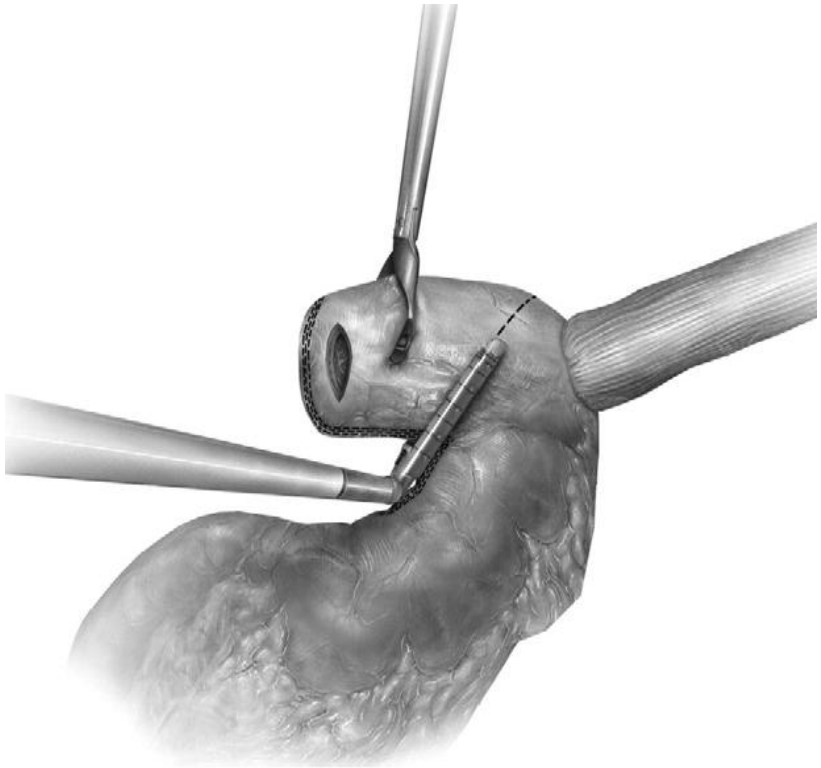
   - within the esophageal stump

9. Gastrotomy

   - at the tip of the gastric conduit



10. Placing the circular stapler
  - into the gastric conduit
11. A circular stapled anastomosis
12. Closing the tip of the gastric conduit
  - linear stapler
13. Close the wound
  - 28-32 Fr chest drain(1ea)



LN dissection in Esophageal cancer

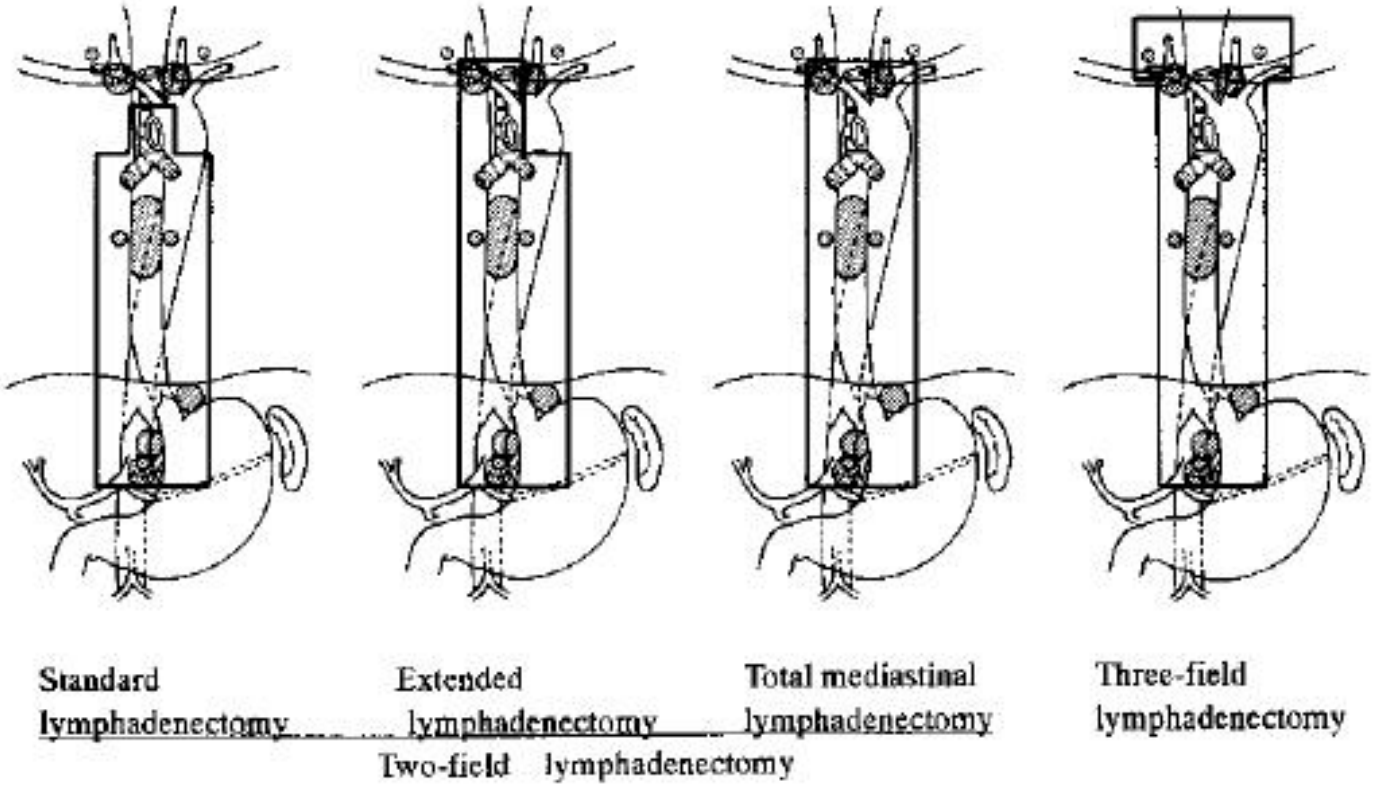


Fig. 1. Extent of radical lymphadenectomy for cancer of the thoracic esophagus (ISDE, 1994).

Mediastinal LN dissection

- Rt. Reccurent laryngeal LN
- Esophageal LN (upper, middle, lower)
- Rt. & Lt. Inferior pulmonary ligament LN
- Rt. and Lt. Diaphragmatic LN
- Subcarinal LN
- Lt. Reccurent laryngeal LN
- Lt. tracheobronchial LN

- Surgical results

mean operative time : 255-544 min

mean blood loss : 175-450 ml

anastomotic leak rate : 0-13.3%

mean hospital stay : 7-30 days

30-day mortality : 0-6%

mean number of LN retrieved : 11-24

TRANSHIATAL OPERATION
(Orringer procedure)

- Indication : lower two third tumors, benign

- Limitation : limited view of the mediastinum

  -> technical difficulty

  performing the mediastinal mobilization

  mediastinal lymphadenectomy

- Advantage :

  1. Repositioning of the patient is not required.
  2. No pain and complication,

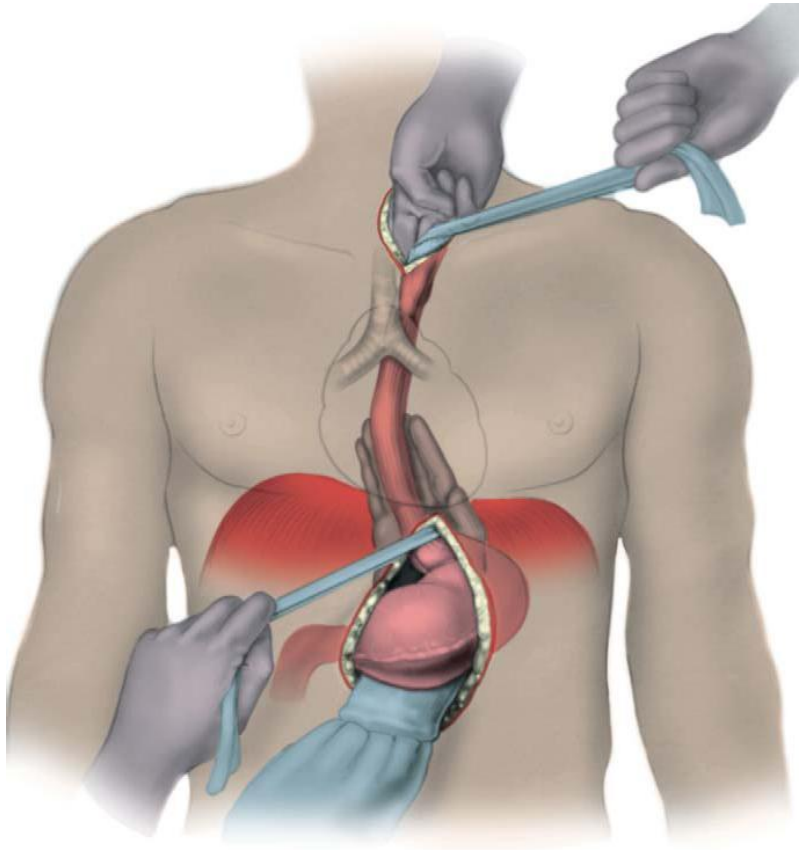
     associated with thoracotomy or thoracoscopy.
  3. double-lumen intubation is not required.

SURGICAL TECHNIQUE

Stage1. Mobilization of the stomach

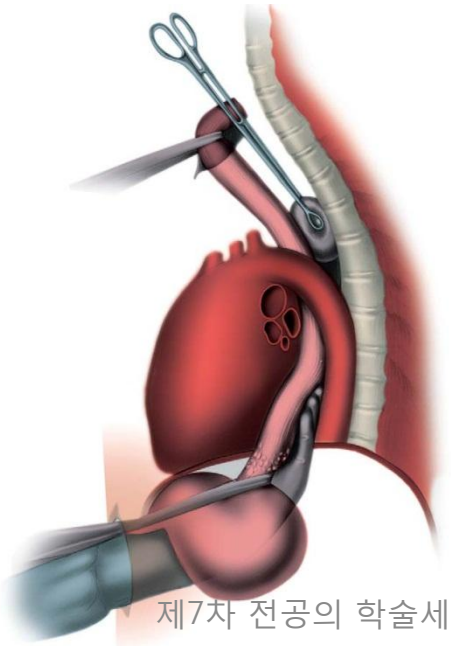
1. supine position

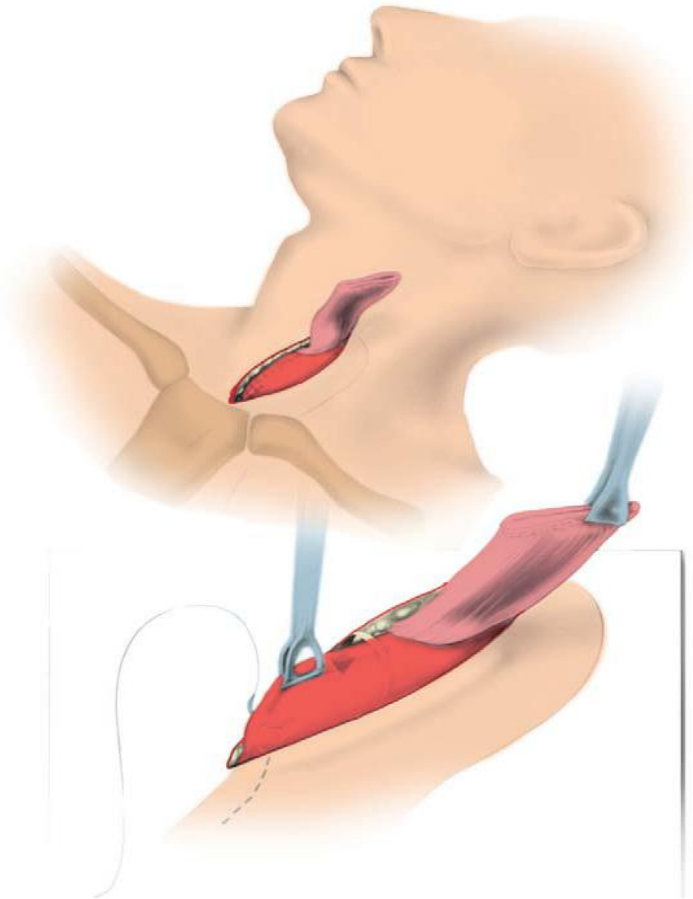
2. same as previously described.



Stage2. Cervical anastomosis

1. left neck incision
2. Encircling the cervical esophagus
3. Blunt dissection
   - inferiorly to join the dissection plain

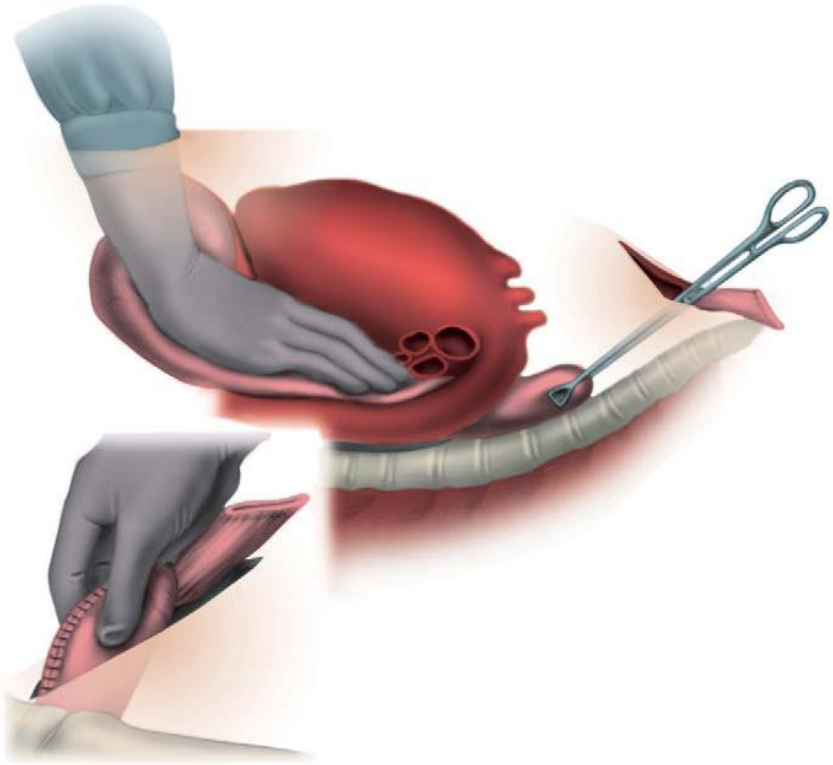




4. Removing the esophageal specimen

- through the cervical incision

  with the gastric conduit

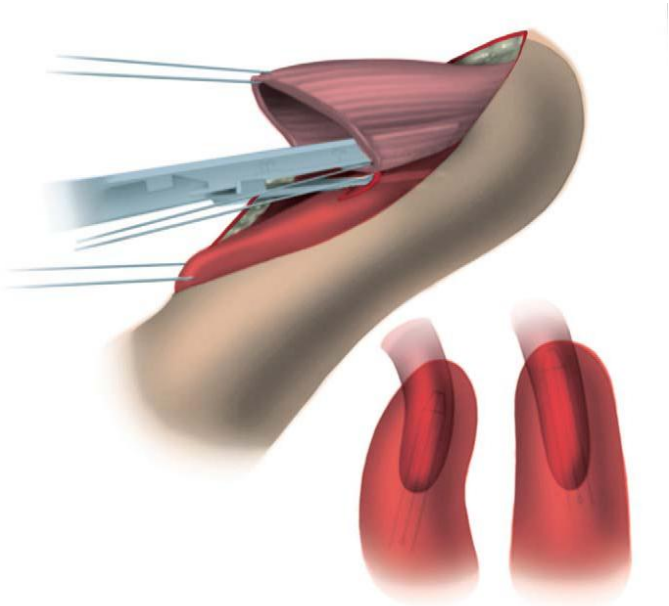


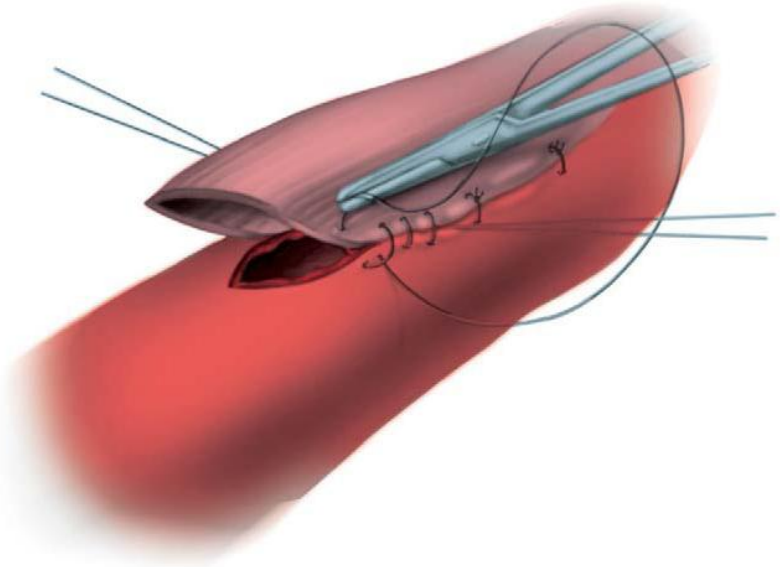
5. Esophagotomy + Gastrotomy

6. Esophagogastric anastomosis

   - GIA stapler 30-3.5 + hand-sawn

7. Closure the wound





- Surgical results

mean operative time : 160-390 min

mean blood loss : 220-400 ml

anastomotic leak rate : 0-8.3%

mean hospital stay : 6.4-12.1 days

30-day mortality : 0-13.6%

mean number of LN retrieved : 8-14

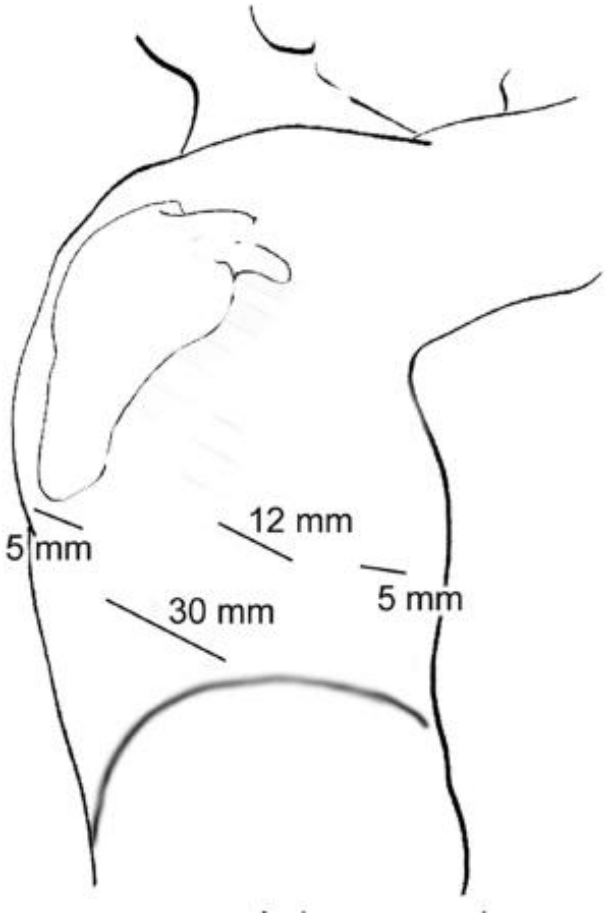
McKeown operation
(Lewis-McKeown, 3-hole)

SURGICAL TECHNIQUE

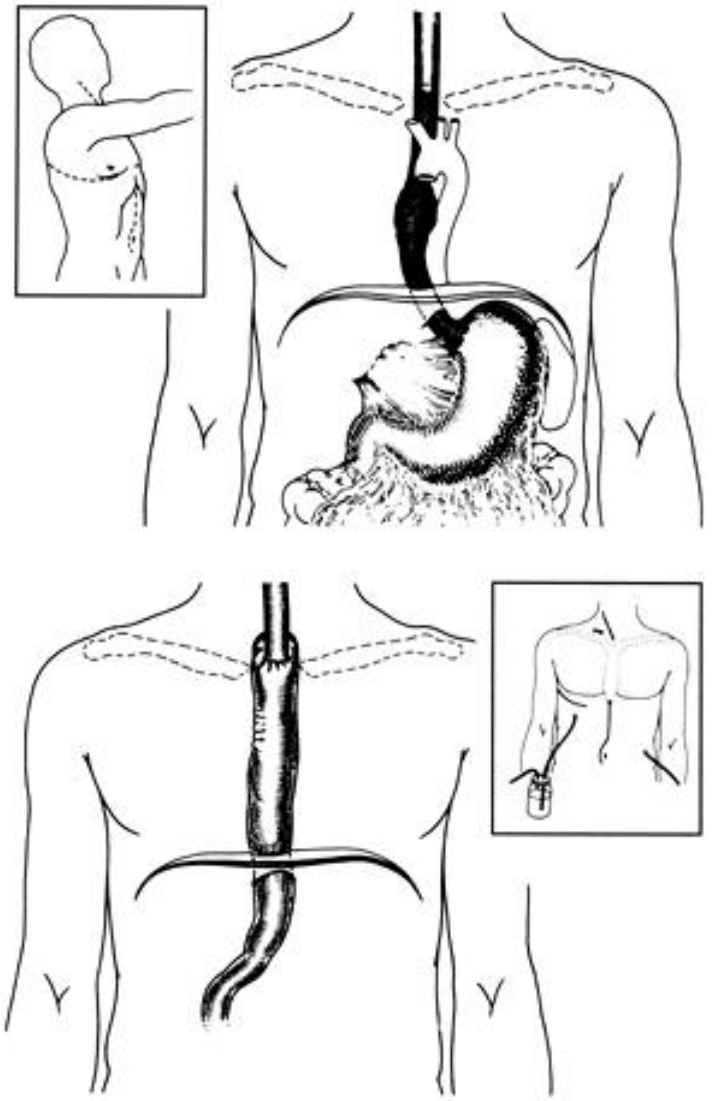
Stage1. Mobilization of the esophagus

1. Lt. lat. decubitus position

2. Posterolateral Thoracotomy 4,5th ICS /VATS



3. Dividing the azygos vein
4. Dissection the esophagus
   - circumferentially mobilized from the esophageal hiatus up to the thoracic inlet
7. Close the wound
   - 28-32 Fr chest drain(1ea)

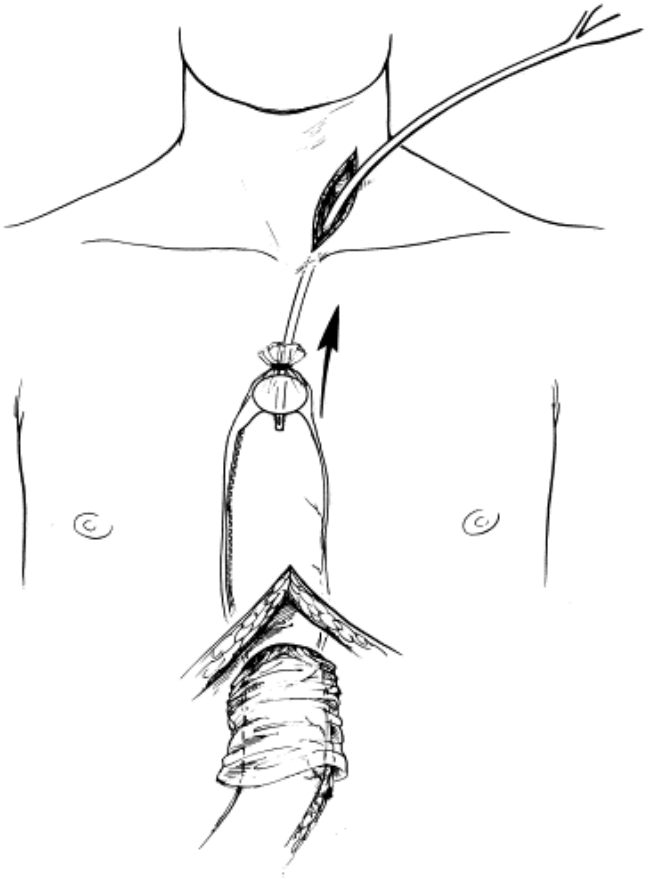


Prone position for the thoracoscopic dissection

- more easily delivered from the mediastinum
- bleeding do not pool in the surgical area

Stage2. Mobilization of the stomach

1. supine position
2. same as previously described.



Stage3. Cervical anastomosis

1. left neck incision
2. same as previously described.

- Surgical results

mean operative time : 265-350 min

mean blood loss : 200-300 ml

anastomotic leak rate : 8-28.5%

mean hospital stay : 7-12 days

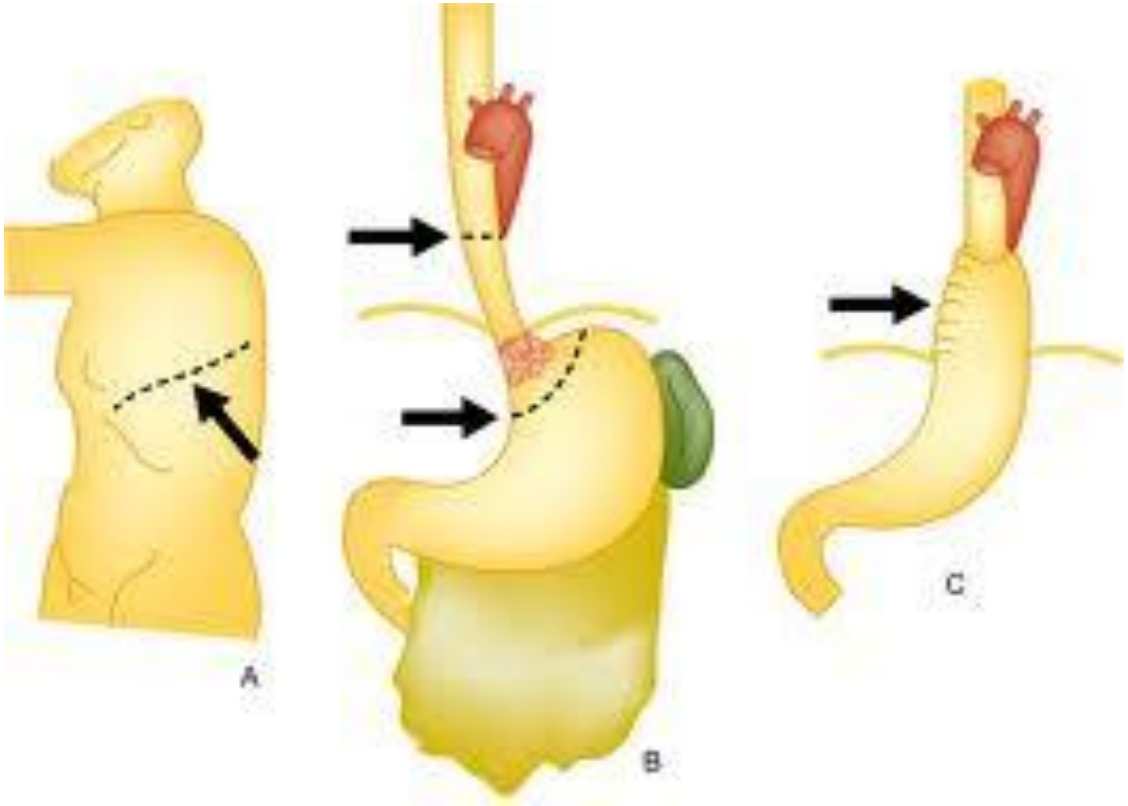
30-day mortality : 0-4.3%

mean number of LN retrieved : 9-17

Left Thoracoabdominal Esophagectomy

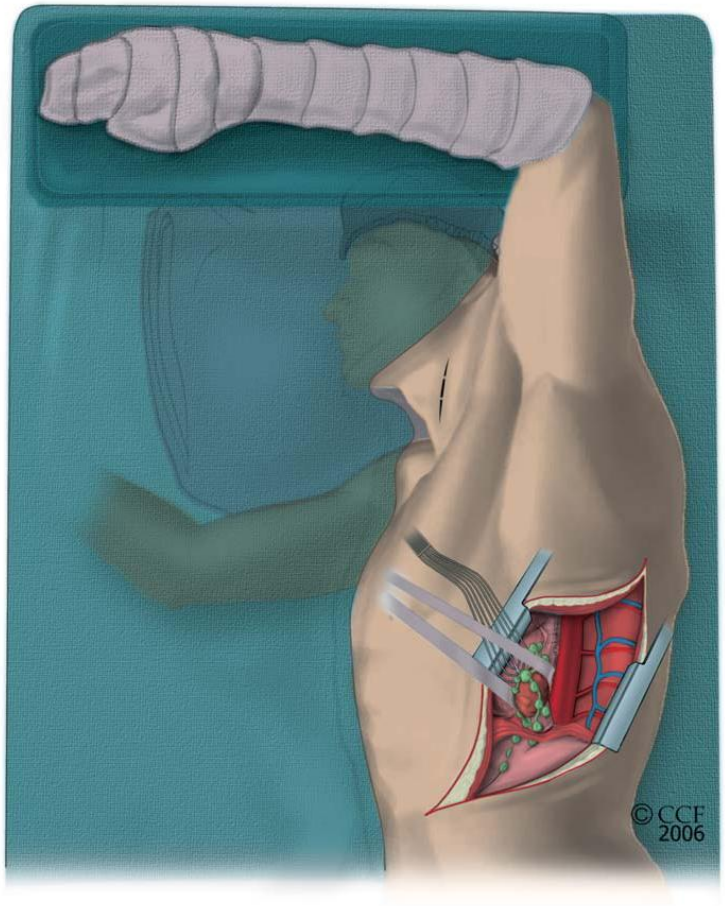
- Indication : lower-third tumors
  with gastric cardia involvement

- Advantage
  1. Single sterile preparation and drapping



SURGICAL TECHNIQUE

1. Thoracoabdominal incision - 7th ICS
2. Dividing the diaphragm
3. Mobilization of the stomach and the esophagus
   - same as previously described.
4. Distal esophagectomy
5. Esophagogastric anastomosis
6. Diaphragm repair
7. Close the wound
   - 28-32 Fr chest drain(1ea)

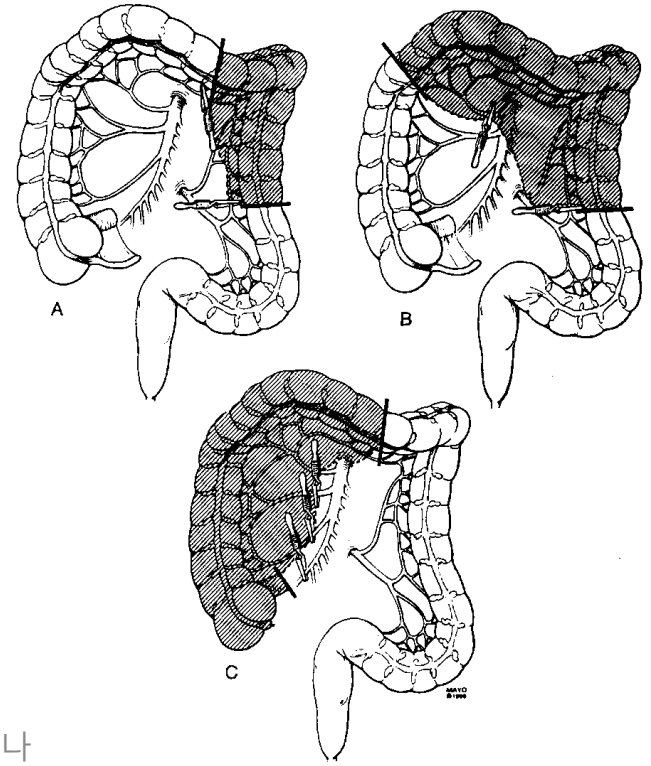


Colon Interposition (Esophago-colo-gastrostomy)

- Indication : unavailable stomach

- Angiography to examine the colonic vasculature,
  Colonoscope

- Preoperative colon preparation
  - 4L Colite + oral neomycin
    + oral metronidazole



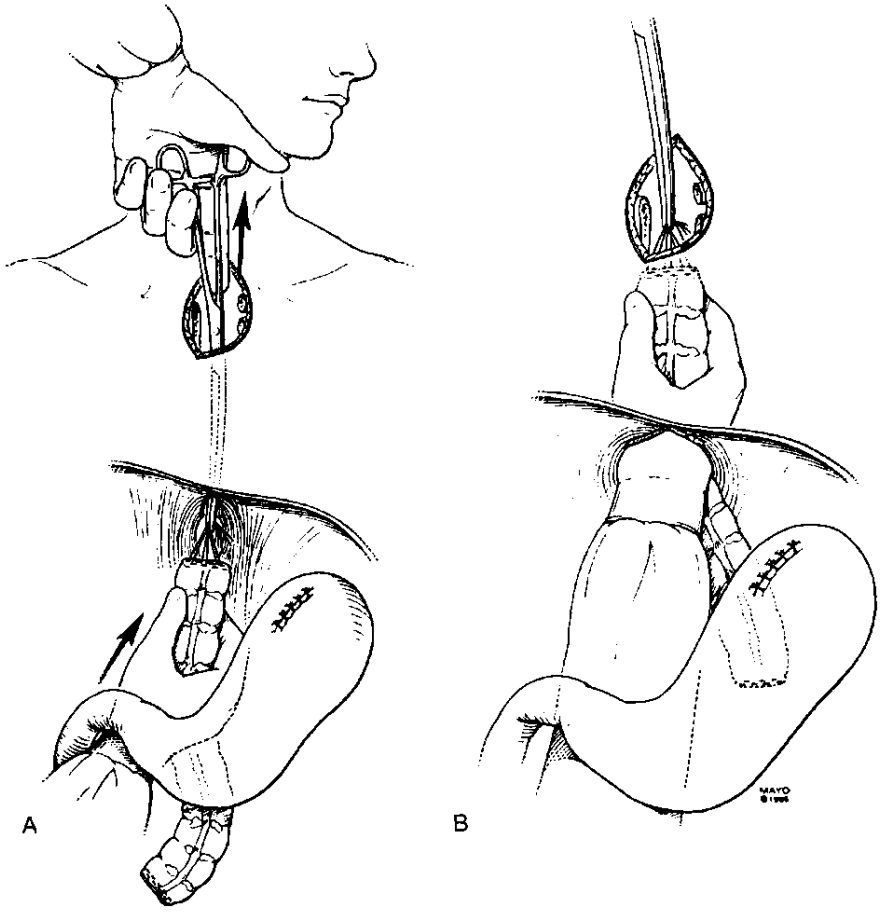
SURGICAL TECHNIQUE

Stage1. Mobilization of the colon

1. supine position
2. median laparotomy
3. mobilization of the colon

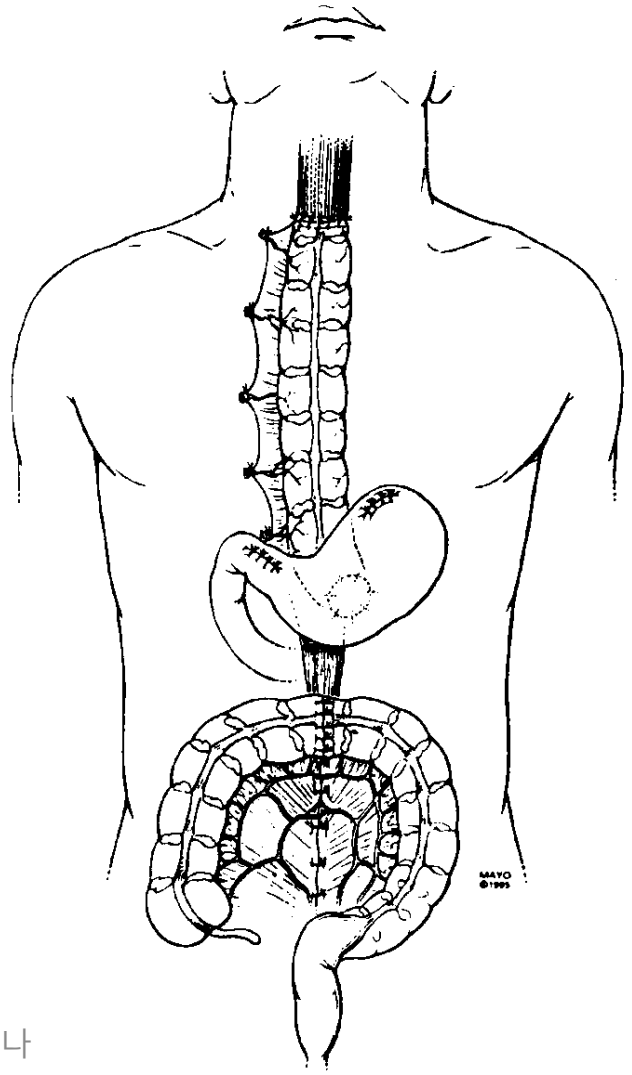
Stage2. Mobilization of the esophagus

1. left neck incision
2. same as previously described



Stage3. Anastomosis

1. Esophago-colostomy
2. Colo-gastrostomy
3. Colo-colostomy
   - end-to-end fashion
   - hand-sawn



Prevalence and Risk Factors for Ischemia, Leak, and Stricture of Esophageal Anastomosis: Gastric Pull-up Versus Colon Interposition

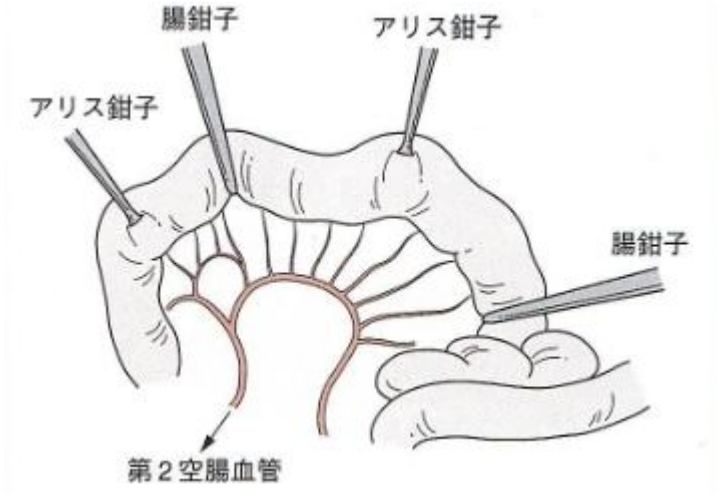
John W Briel, MD, PhD, Anand P Tamhankar, MS, FRCS, Jeffrey A Hagen, MD, FACS, Steven R DeMeester, MD, Jan Johansson, MD, Emmanouel Choustoulakis, MD, Jeffrey H Peters, MD, Cedric G Bremner, MD, FACS, Tom R DeMeester, MD, FACS

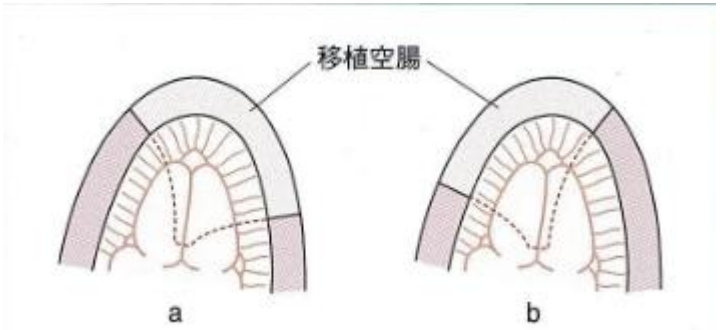
J Am Coll Surg;2004(198):536-541

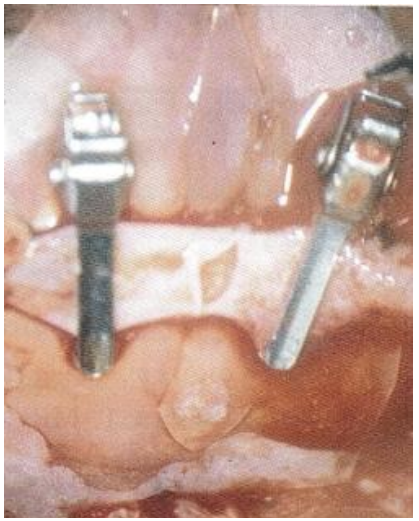
	Colon Interposition	Gastric Pull-up	p-value
Mortality	4.7	4.3	
Morbidity			
Ischemia	7.4	10.4	0.375
Leak	6.1	14.3	0.013
Stricture	8.7	31.3	<0.0001

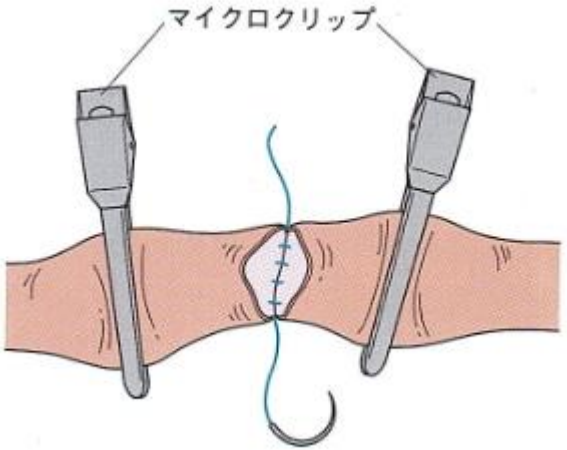
Free Jejunal graft


上甲状腺動脈
総頸動脈
内頸静脈

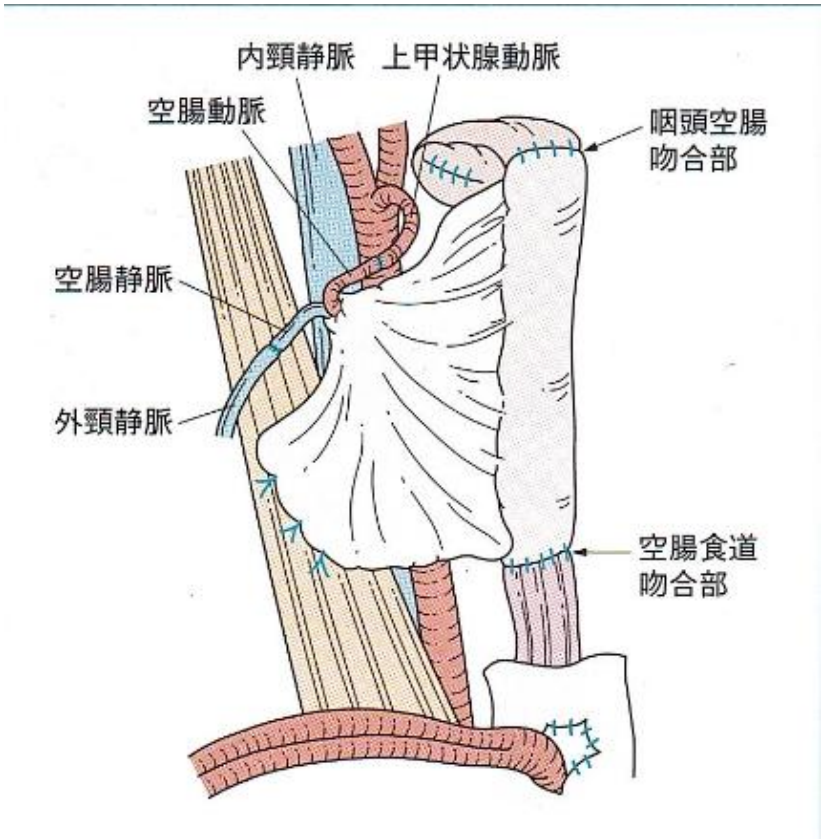

腸鉗子
アリス鉗子
アリス鉗子
腸鉗子
第２空腸血管


移植空腸
a
b




マイクロクリップ

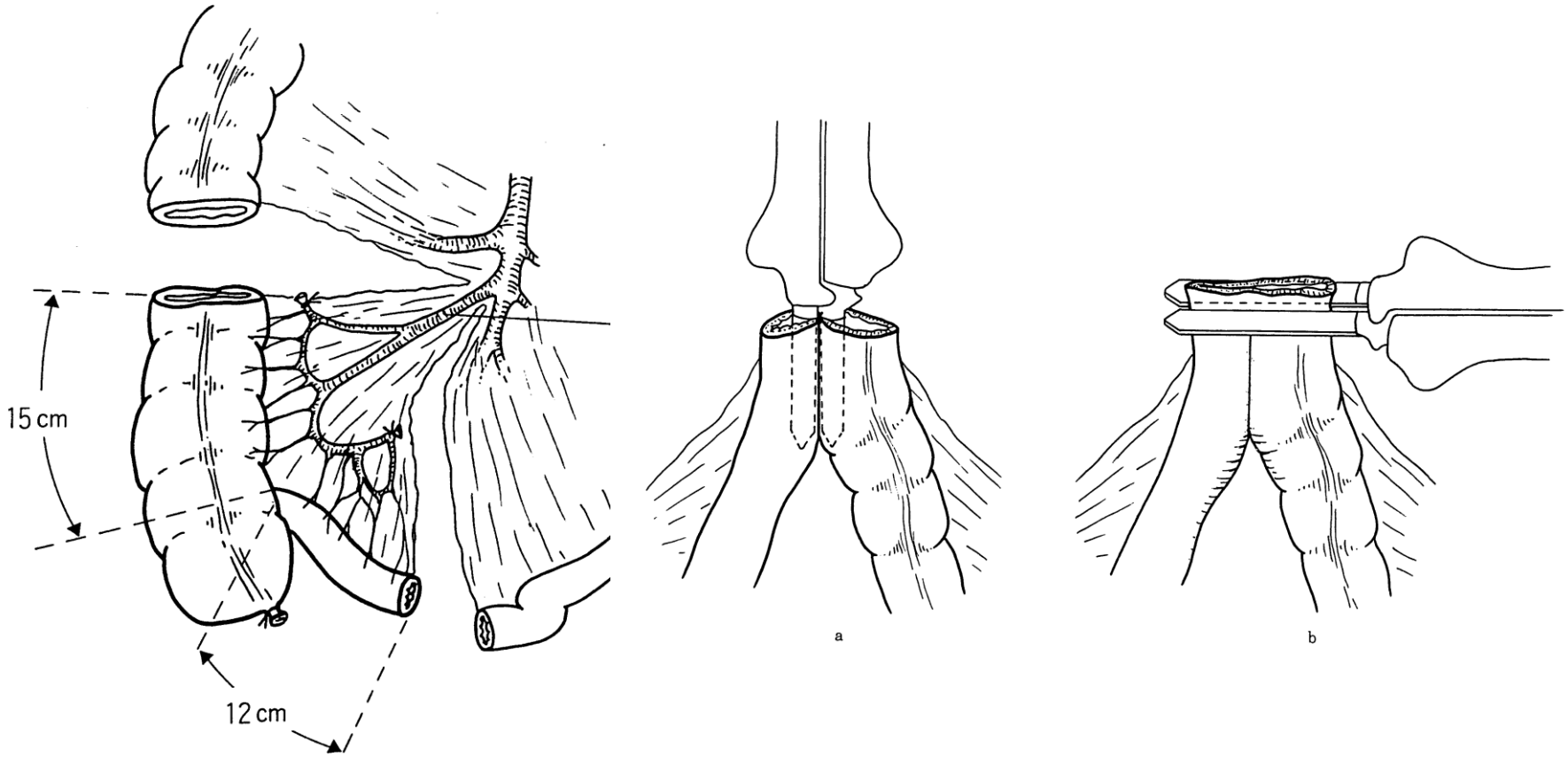

マイクロ
クリップ
腸鉗子

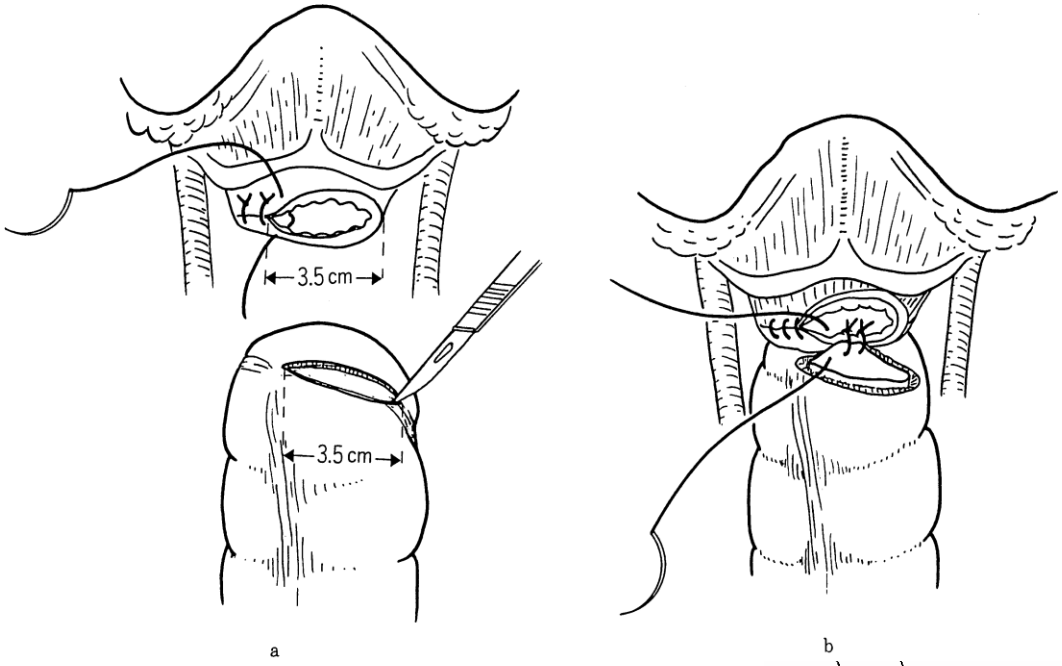

内頸静脈
上甲状腺動脈
空腸動脈
咽頭空腸
吻合部
空腸静脈
外頸静脈
空腸食道
吻合部

Free Ileocolic graft

Surgical voice restoration with a free ileocolic graft

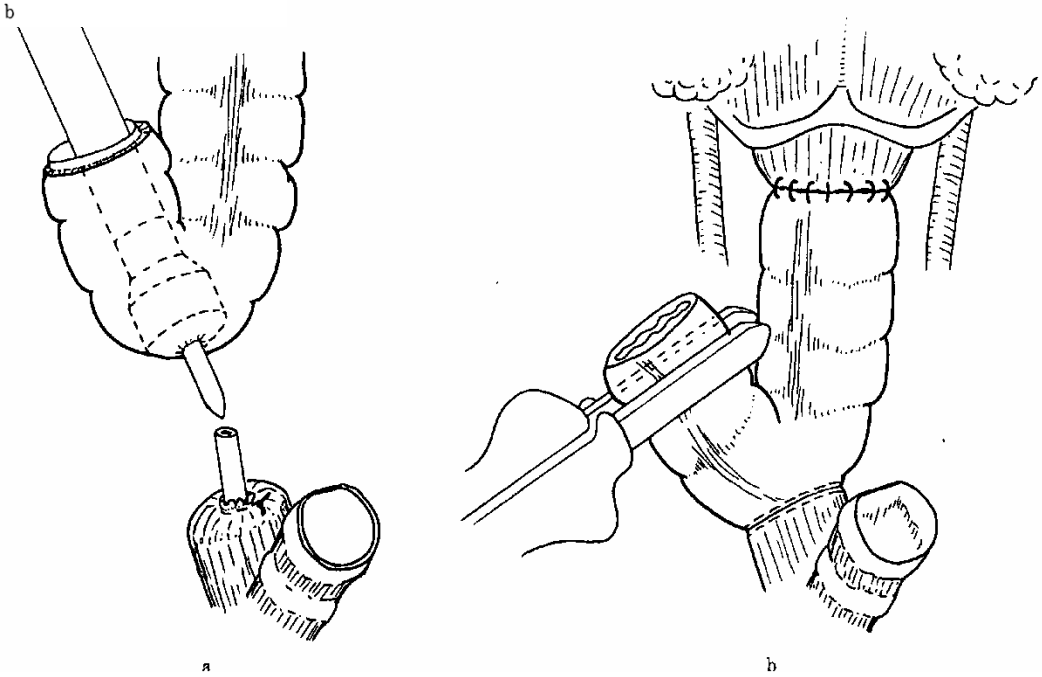
- Hideyuki Kawahara - 1999.



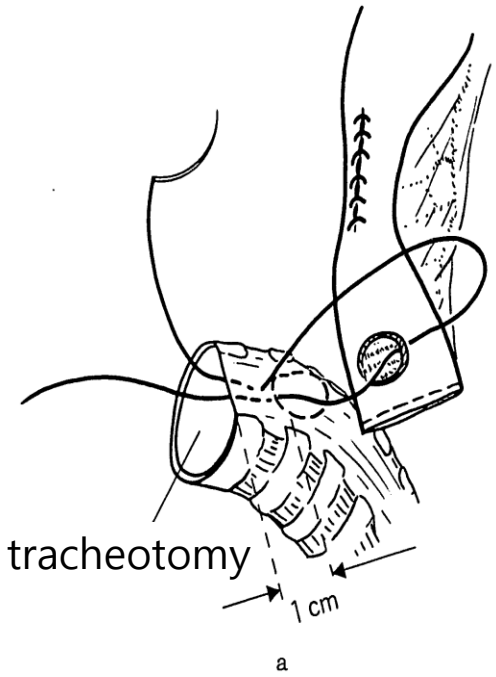


Coloesophagostomy

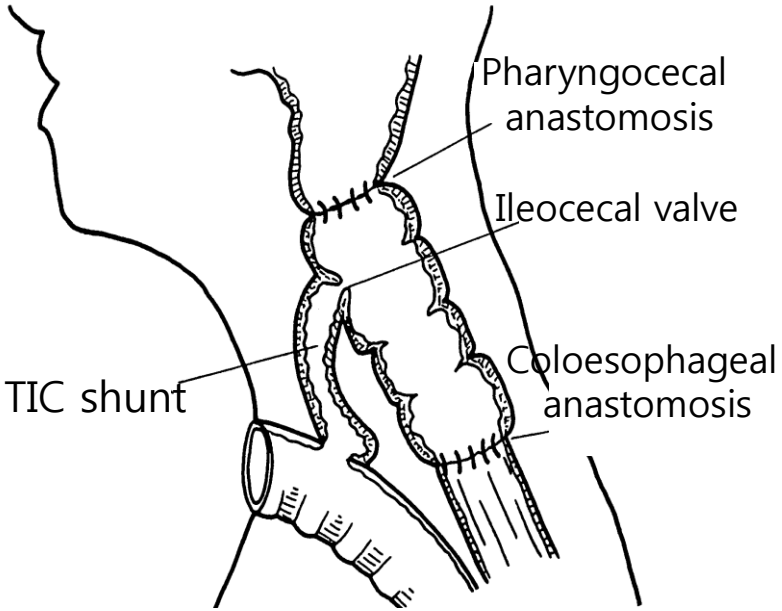
pharyngocecostomy

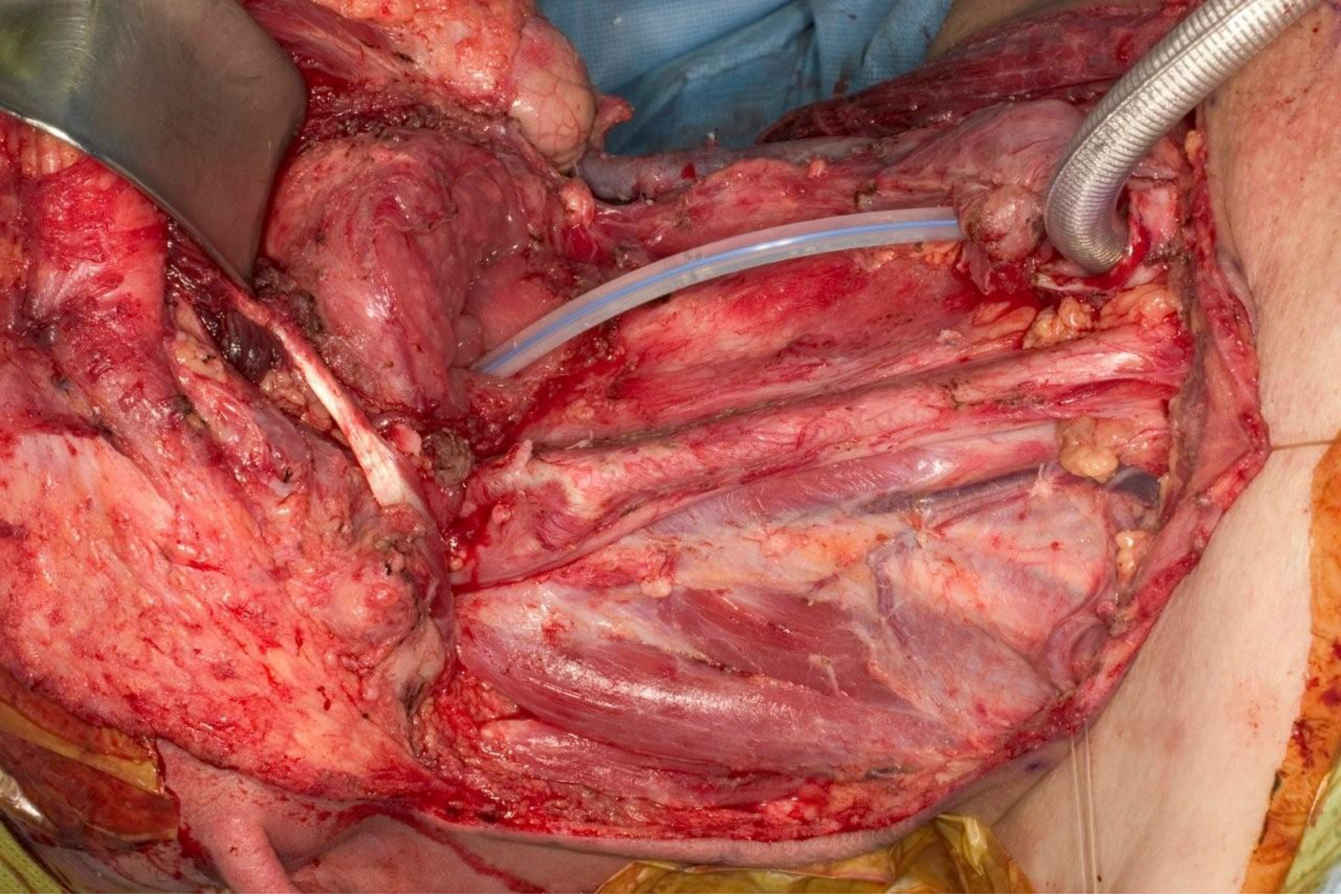


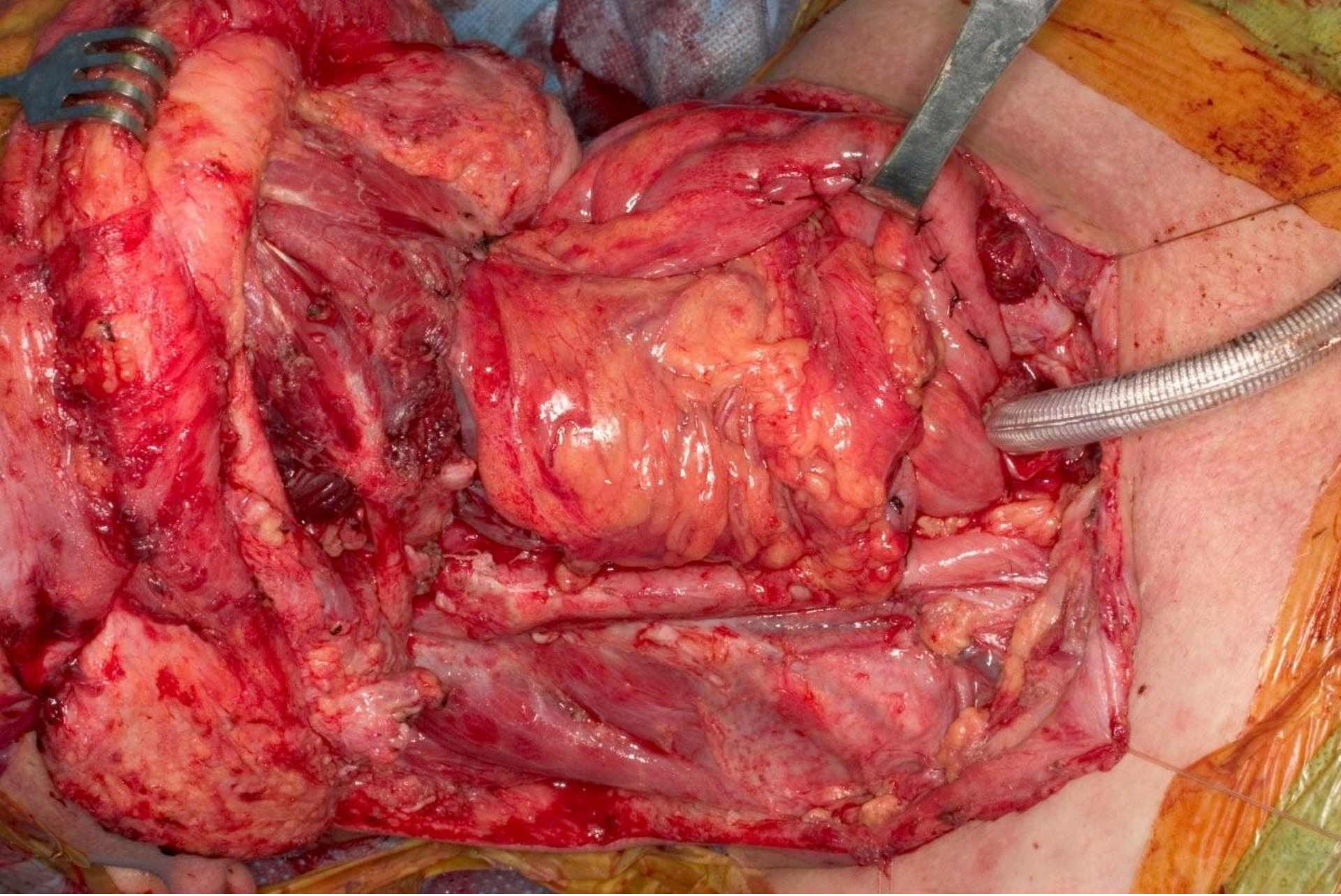
Ileotracheostomy



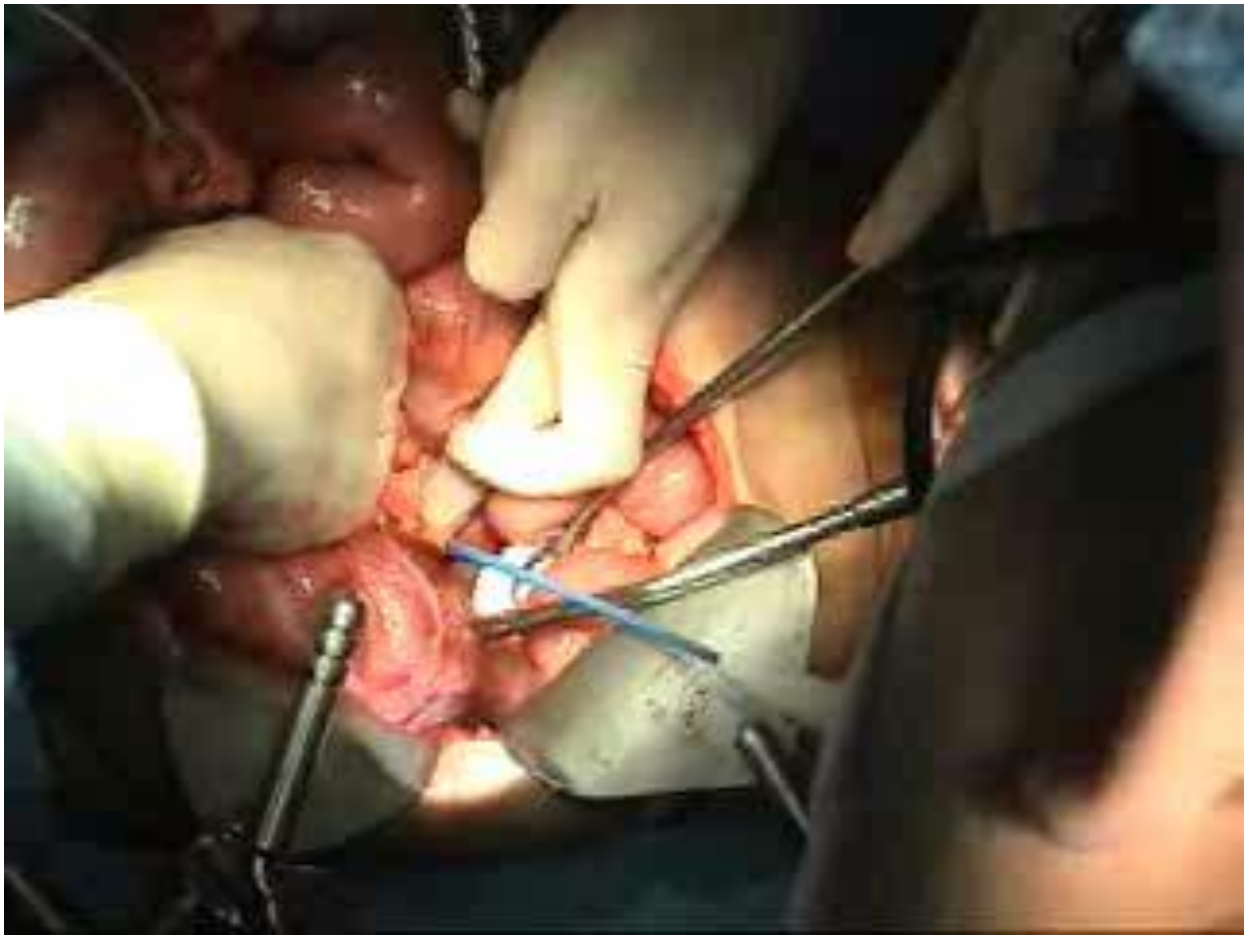
TIC shunt







수술동영상



제7차 전공의 학술세미나

제7차 전공의 학술세미나

WHICH OPERATION?

- Distal esophagus cancer + gastric cardia
  - Ivor-Lewis esophagectomy
  - Lt thoracoabdominal esophagectomy

- Upper- to mid-third esophagus cancer
  - Ivor-Lewis esophagectomy
  - Transhiatal esophagectomy
  - McKeown

- Distal-third esophagus cancer
  - Ivor-Lewis esophagectomy
  - Transhiatal esophagectomy
  - McKeown
  - Lt thoracoabdominal esophagectomy

- Esophagus cancer(early/palliative) / Benign esophageal disease with low pulmonary function
  - Transhiatal esophagectomy
  - Colon Interposition

- Distal esophagus cancer with previous Rt. thoracotomy
  - Transhiatal esophagectomy
  - Lt thoracoabdominal esophagectomy

- Unavailable stomach
  - Colon Interposition

Minimally Invasive Esophagectomy

Lessons Learned From 104 Operations

Ninh T. Nguyen, MD, FACS, Marcelo W. Hinojosa, MD,* Brian R. Smith, MD,* Kenneth J. Chang, MD,† James Gray, BS,* and David Hoyt, MD, FACS**

Objectives: To review the outcomes of 104 consecutive minimally invasive esophagectomy (MIE) procedures for the treatment of benign and malignant esophageal disease.

Summary Background Data: Although minimally invasive surgical approaches to esophagectomy have been reported since 1992, MIE is still considered investigational at most institutions.

Methods: This prospective study evaluates 104 MIE procedures performed between August 1998 and September 2007. Main outcome measures include operative techniques, operative times, blood loss, length of stay, conversion rates, morbidities, and mortalities.

Results: Indications for surgery were esophageal cancer (n = 80), Barrett esophagus with high-grade dysplasia (n = 6), recalcitrant stricture (n = 8), gastrointestinal stromal tumor (n = 3), and gastric cardia cancer (n = 7). Surgical approaches included thoracoscopic/laparoscopic esophagectomy with a cervical anastomosis (n = 47), minimally invasive Ivor Lewis esophagectomy (n = 51), laparoscopic hand-assisted blunt transhiatal esophagectomy (n = 5), and laparoscopic proximal gastrectomy (n = 1). There were 77 males. The mean age was 65 years. Three patients (2.9%) required conversion to a laparotomy. The median ICU and hospital stays were 2 and 8 days, respectively. Major complications occurred in 12.5% of patients and minor complications in 15.4% of patients. The incidence of leak was 9.6% and of anastomotic stricture was 26%. The 30-day mortality was 1.9% with an in-hospital mortality of 2.9%. The mean number of lymph nodes retrieved was 13.8.

Conclusions: Minimally invasive esophagectomy is feasible with a low conversion rate, acceptable morbidity, and low mortality. Our preferred operative approach is the laparoscopic\thoracoscopic Ivor Lewis resection, which provides a tension-free intrathoracic anastomosis.

(*Ann Surg* 2008;248: 1081–1091)

Robotic-Assisted Thoracoscopic Surgery (RATS) for Benign and Malignant Esophageal Tumors

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Background. Robotic surgical systems are most effective for operations in areas that are small and difficult to reach. Ideal indications for this new technology have yet to be established. The esophagus possesses attributes that are interesting for general thoracic robotic surgeons.

Methods. Robotic-assisted thoracoscopic surgery (RATS) using the da Vinci system (Intuitive Surgical, Inc, Mountain View, CA) was performed in six patients with esophageal tumors. This comprised the dissection of the intrathoracic esophagus including lymph node dissection in four patients suffering from esophageal cancer and the extirpation of a benign lesion (one leiomyoma and one foregut cyst) in the remaining two patients.

Results. All procedures were completed successfully with the robot. The median overall operating time was 173 (160–190) minutes in the oncologic cases and 121 minutes in the benign cases, including the robotic act of 147 (135–160) minutes and 94 minutes, respectively. There were no intraoperative complications. One patient had to undergo a redo thoracoscopy because of a persistent lymph fistula. One cancer patient died after 12 months due to tumor progression and another patient had to be stented due to local tumor recurrence 19 months postoperatively.

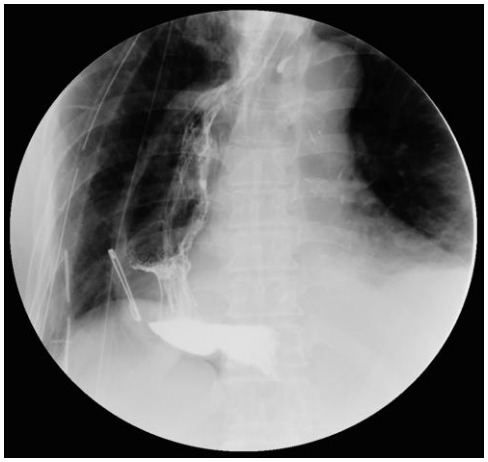
Conclusions. This first small series of various esophageal pathologies treated by robotic-assisted thoracoscopic surgery supports the impression that the esophagus is an ideal organ for a robotic approach. The potential of the da Vinci system, especially for oncologic indications, remains to be proven in future clinical trials.

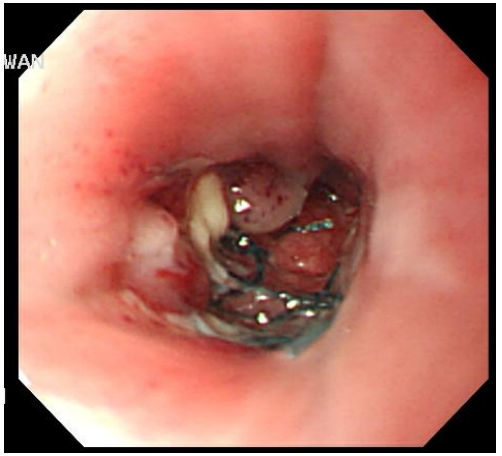
(Ann Thorac Surg 2005;80:1202–6)

POSTOPERATIVE CARE/FOLLOW-UP

- ICU care at immediate post-operation(ventilator?)
- NPO + TPN/Feeding Jejunostomy(intraoperative)
- Gastrografin contrast study at POD 3-7

- CT of chest and abdomen at yearly
- Endoscopic dilatation if narrowed esophagogastric anastomosis





COMPLICATION

- Respiratory

  - pneumonia, pneumonitis(aspiration), pleural effusion

- Anastomotic

  - leak, stricture

- Recurrent laryngeal N. injury

- Cardiovascular

  - arrhythmia(A.fib), MI

- Chylothorax

- Wound complication