



Minimally Invasive Esophagectomy 2.0

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Introduction: Esophagectomy 2.0

- Review of management of esophageal cancer.
- Overview of esophagectomy techniques.
- Outcomes of minimally invasive esophagectomy.
- Review of the Ohio State experience.



Esophageal Cancer

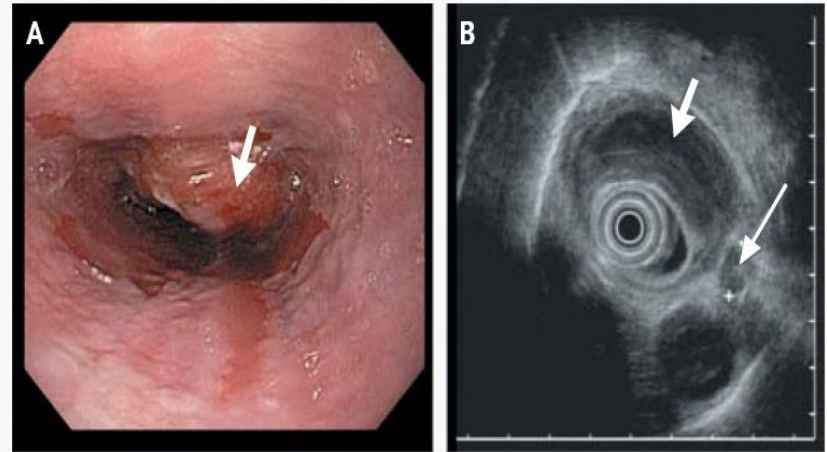
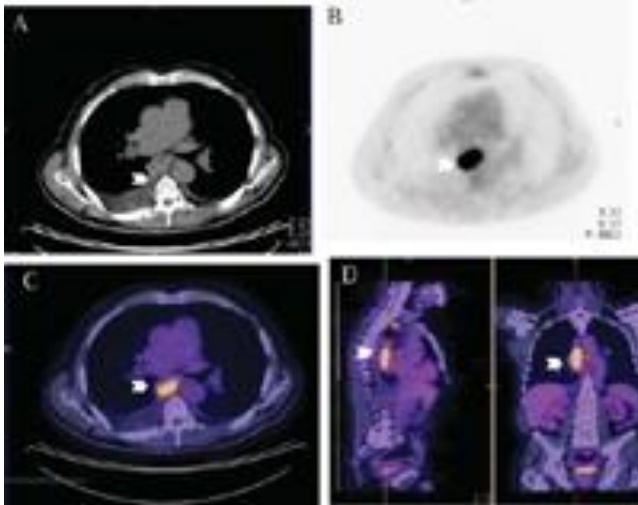
Epidemiology

- Overall incidence is 4.8 cases per 100, 000 persons in the U.S.
- 17, 900 new cases of esophageal cancer in the U.S.
- 17, 000 deaths anticipated each year.
- Squamous-cell carcinoma and adenocarcinoma comprise 90% of all cases.
- More than 50% of esophageal cancers are unresectable at the time of diagnosis.



Esophageal Cancer

TNM Staging



- EUS is 80-90% accurate in detecting T stage and 70-80% accurate in detecting N stage.
- PET CT will upstage 15% of patients with esophageal cancer.



Esophageal Cancer

Survival Data

Table 2. Five-Year Survival Rates for Esophageal Carcinoma, According to the Tumor–Node–Metastasis Classification.*

Stage	Tumor	Node	Metastasis	5-Yr Survival
				%
0	Tis	N0	M0	>95
I	T1	N0	M0	50–80
IIA	T2-3	N0	M0	30–40
IIB	T1-2	N1	M0	10–30
III	T3	N1	M0	10–15
	T4	Any N	M0	
IVA	Any T	Any N	M1a	<5
IVB	Any T	Any N	M1b	<1

N Engl J Med 2003;349:2241-52.



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Esophageal Cancer Management by Stage

- Early Stage Disease- Stage I and II
 - Esophagectomy
 - Endoscopic mucosal resection
- Locally Advanced- Stage III
 - Neoadjuvant Chemoradiation
 - Esophagectomy
 - Definitive Chemoradiation
- Advanced Stage Disease- Stage IV
 - Palliative Chemotherapy and Radiation



The CROSS Trial

Preoperative Chemoradiotherapy for Esophageal or Junctional Cancer

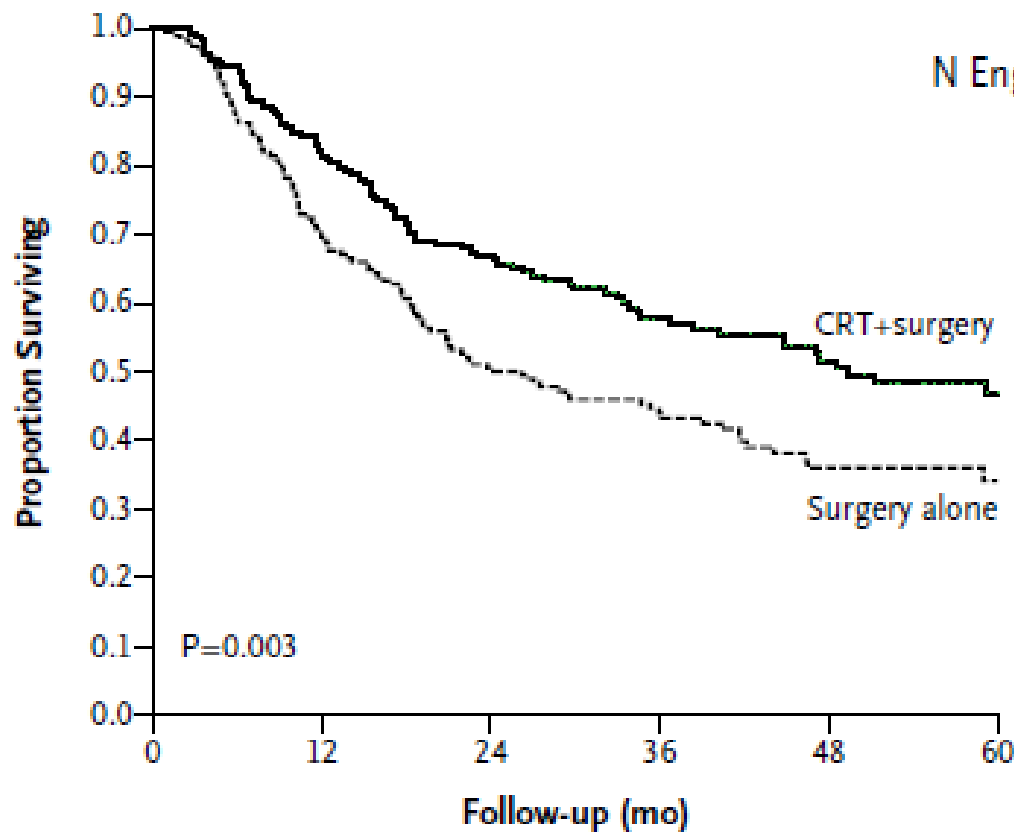
van Hagen, M.C.C.M. Hulshof, J.J.B. van Lanschot, E.W. Steyerberg,
M.I. van Berge Henegouwen, B.P.L. Wijnhoven, D.J. Richel,
A.P. Nieuwenhuijzen, G.A.P. Hospers, J.J. Bonenkamp, M.A. Cuesta,
B. Blaisse, O.R.C. Busch, F.J.W. ten Kate, G.-J. Creemers, C.J.A. Pun
T.M. Plukker, H.M.W. Verheul, E.J. Spillenaar Bilgen, H. van Dekken
M.J.C. van der Sangen, T. Rozema, K. Biermann, J.C. Beukema,
A.H.M. Piet, C.M. van Rij, J.G. Reinders, H.W. Tilanus,
and A. van der Gaast, for the CROSS Group*

N Engl J Med 2012;366:2074-84.



The CROSS Trial

A Survival According to Treatment Group



No. at Risk

CRT+surgery	178	145	119	75	49	28
Surgery alone	188	131	94	62	33	17
Total	366	276	213	137	82	45



Neoadjuvant Chemoradiation and Complications

Variable	Neoadjuvant Therapy N= 54	Esophagectomy Alone N= 84	P-Value
Anastomotic Leak	8/54 (14.8%)	9/84 (10.7%)	0.65
Pneumonia	4/54 (7.4%)	11/84 (13%)	0.45
Respiratory Failure	8/54 (14.8%)	12/84 (14.3%)	0.87
Chylothorax	4/54 (7.4%)	0/84 (0%)	0.04
Pulmonary Embolus	1/54 (1.9%)	3/84 (3.6%)	0.95
Myocardial Infarction	0/54 (0%)	1/84 (1.2%)	0.82
Arrhythmia	6/54 (11.1%)	10/84 (11.9%)	0.90
Total Complications	31/54 (57.4%)	47/84 (56%)	0.98

Merritt RE, et al. Morbidity and Mortality of Esophagectomy after Neoadjuvant Chemoradiation. Ann Thorac Surg 2011;92(6):2034-40.



Esophagectomy Techniques



Invasiveness

Traditional open (Ivor Lewis)

- Right thoracotomy and laparotomy
- Intrathoracic gastric-esophageal anastomosis
- Better lymph node dissection
- Higher respiratory morbidity rate

Transhiatal

- Laparotomy and blunt transabdominal dissection
- Cervical gastric-esophageal anastomosis
- Fewer lymph nodes resected
- Lower respiratory morbidity rate

Thoracoscopic/Laparoscopic



First Report of Total Minimally Invasive ILE

Nguyen NT, et al. Ann Thorac Surg 2001;72:593-6.

- 34 year old male with a T3N0 GE junction tumor
- Total laparoscopic and thoracoscopic approach
- Intrathoracic anastomosis with a 21 mm EEA stapler
- Operative time was 7.5 hours
- Esophagram on POD #6 was negative for leak.
- EBL was 250 mL
- LOS was 8 days



Initial Experience of Total Thoracoscopic and Laparoscopic Ivor Lewis Esophagectomy

Merritt RE. J Laparoendosc Adv Surg Tech 2012;22;214-9.

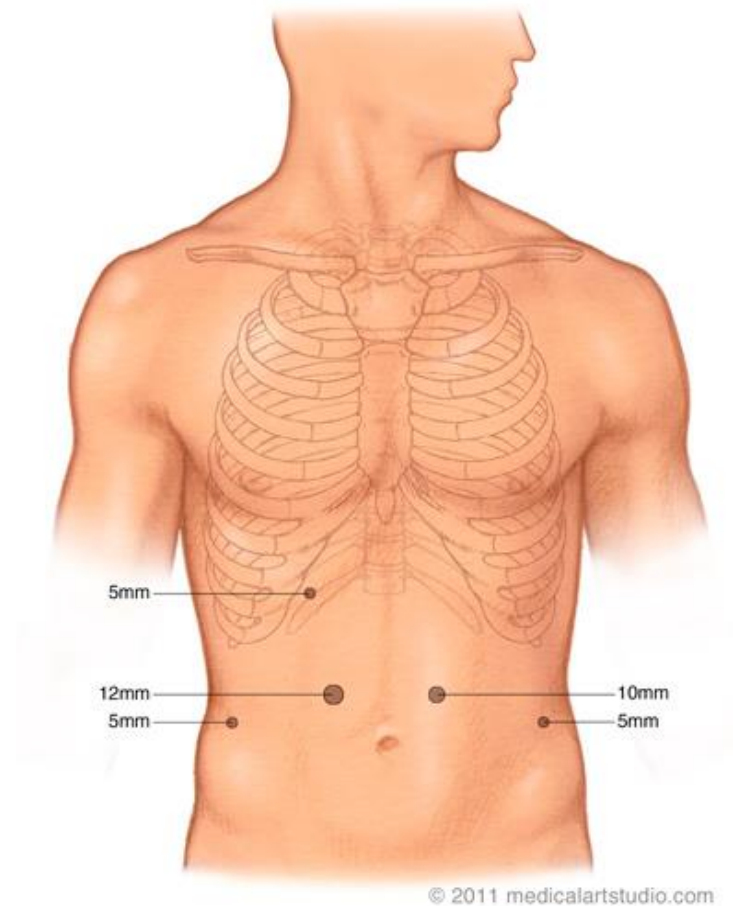
TABLE 4. 30-DAY MAJOR MORBIDITY AND MORTALITY

<i>Variable</i>	<i>Value</i>
Median ICU days	1.0
Median ventilator days	0.0
Median length of stay (days)	10
Anastomotic leak rate	1/15 (6.67%)
Pneumonia rate	0/15 (0%)
Recurrent nerve palsy	0/15 (0%)
Re-intubation	0/15 (0%)
Pulmonary embolus	0/15 (0%)
Acute MI	0/15 (0%)
Chylous effusion	1/15 (6.67%)
Atrial fibrillation	1/15 (6.67%)
Anastomotic stricture	0/15 (0%)
Hemorrhage	0/15 (0%)
Gastric outlet obstruction	0/15 (0%)
Mortality	0/15 (0%)

ICU, intensive care unit; MI, myocardial infarction.



Laparoscopic Port Placement

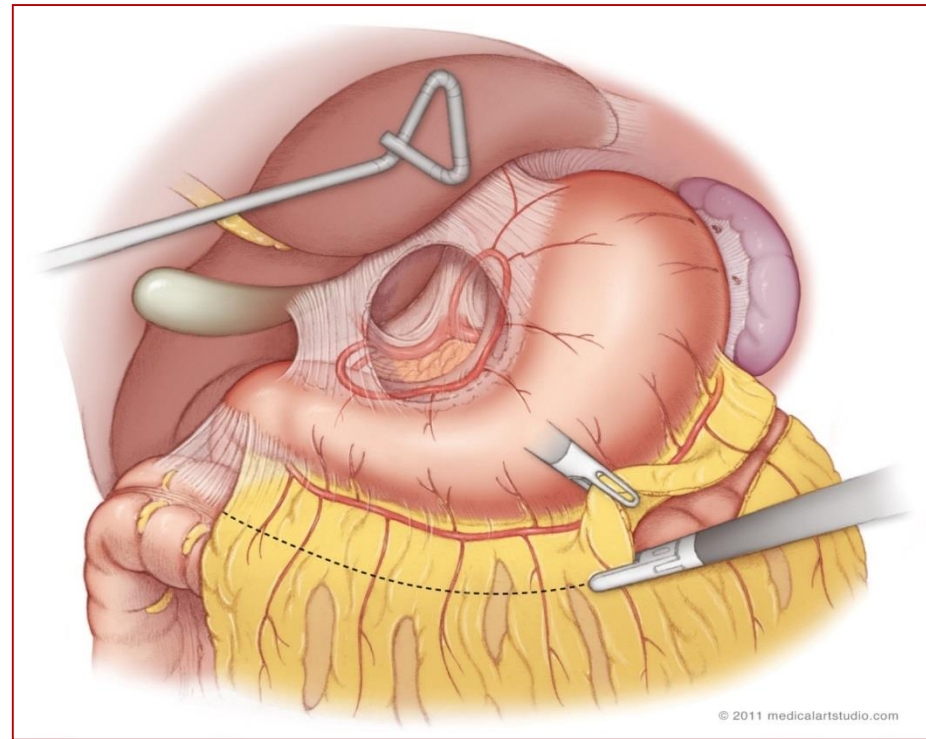
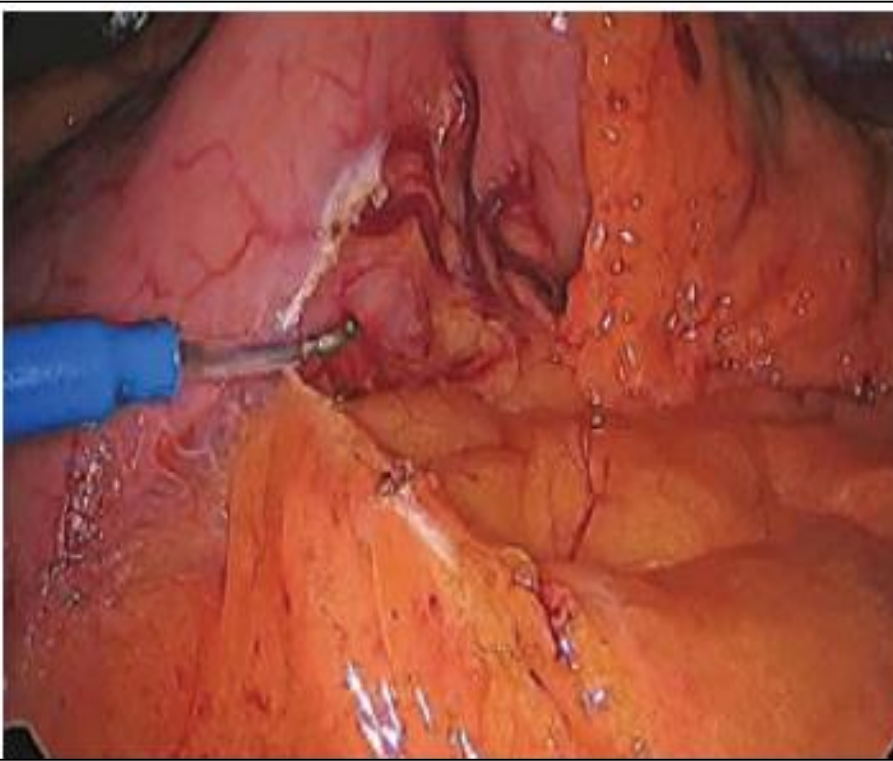


Merritt RE. J Laparoendosc Adv Surg Tech 2012;22;214-9



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Division of the Gastro-colic Ligament

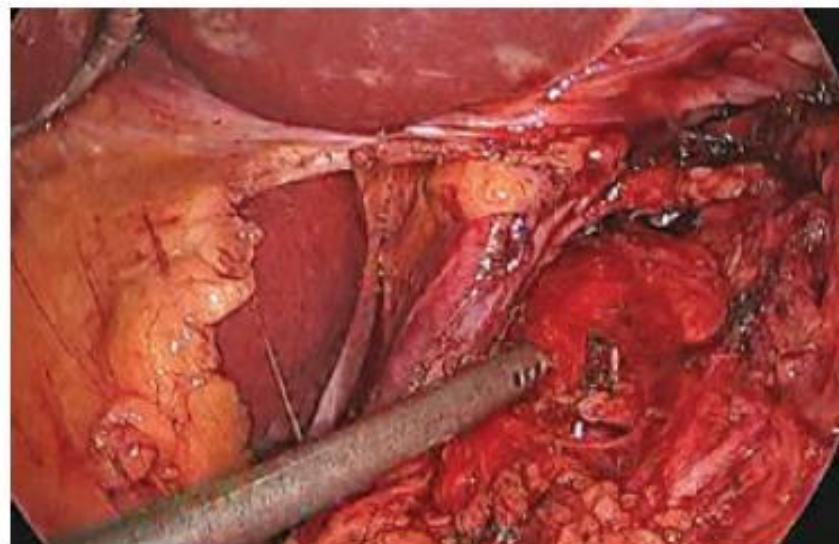
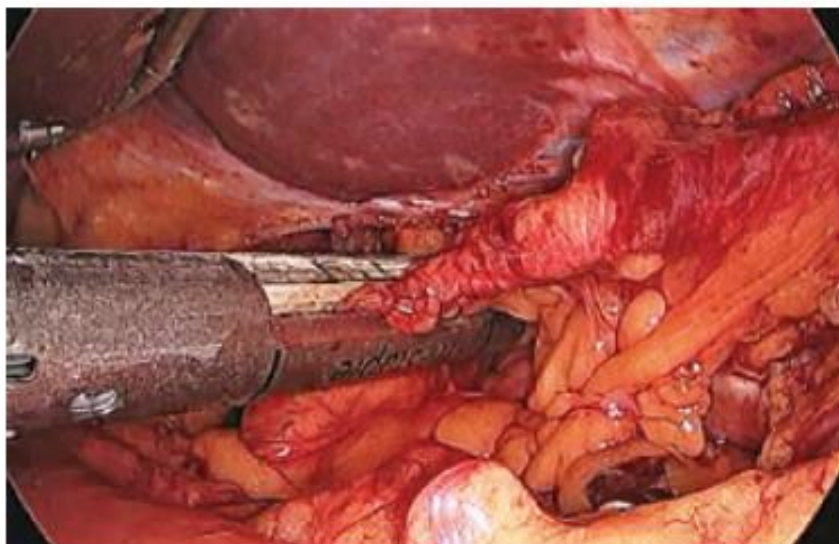


Merritt RE. J Laparoendosc Adv Surg Tech 2012;22;214-9



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Division of the Left Gastric Artery and Hiatal Dissection

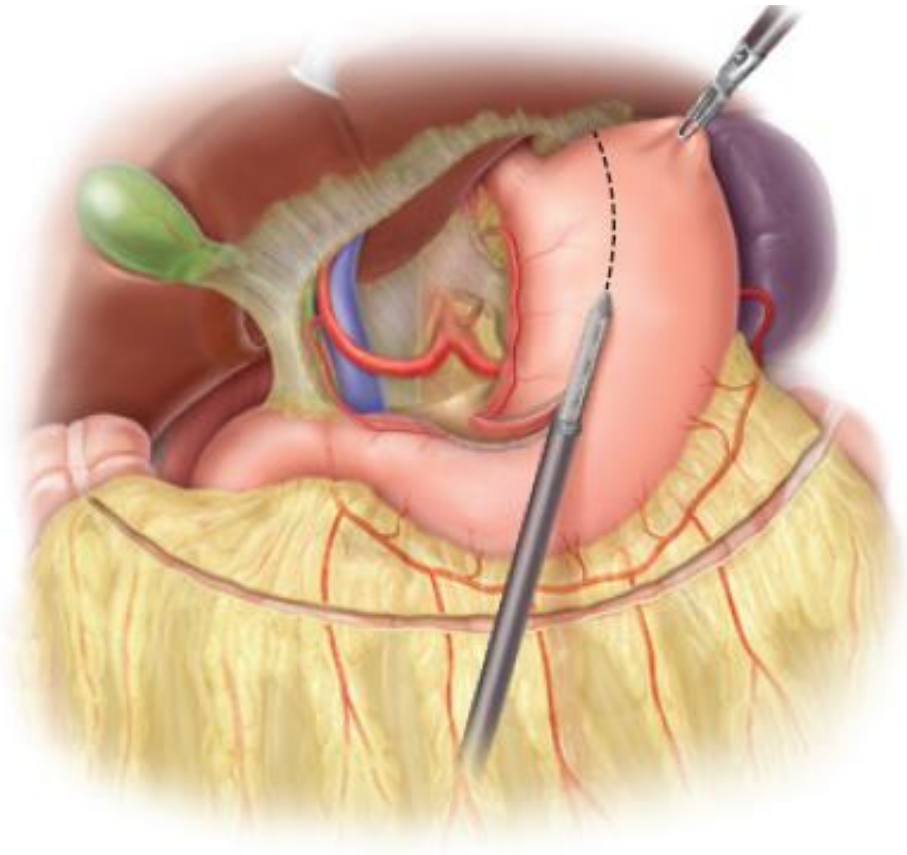
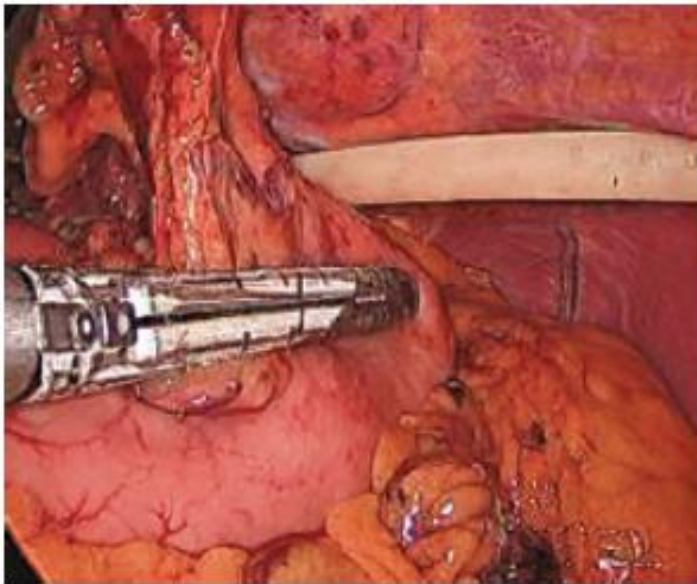


Merritt RE. J Laparoendosc Adv Surg Tech 2012;22;214-9

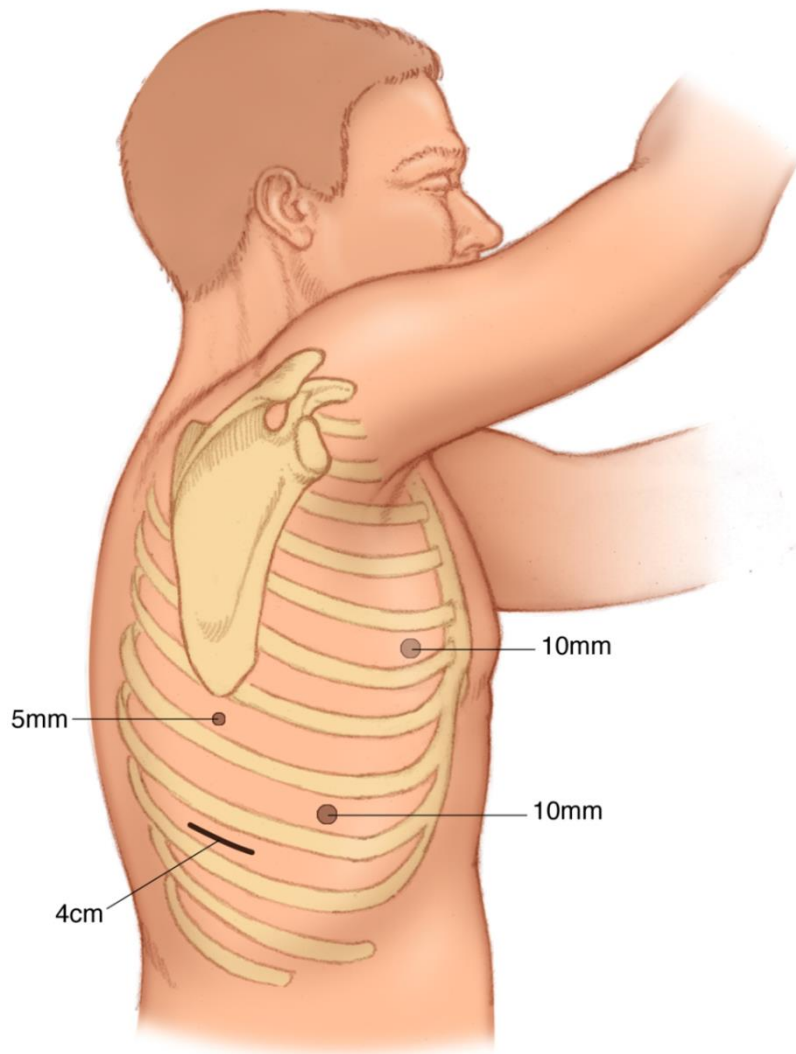


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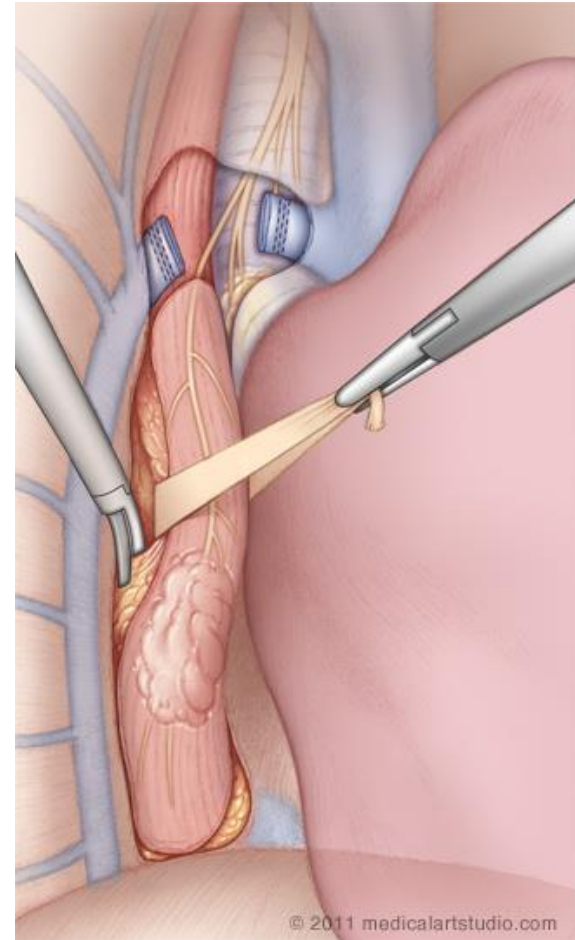
Formation of the Gastric Conduit



Thoracoscopic Access Incisions



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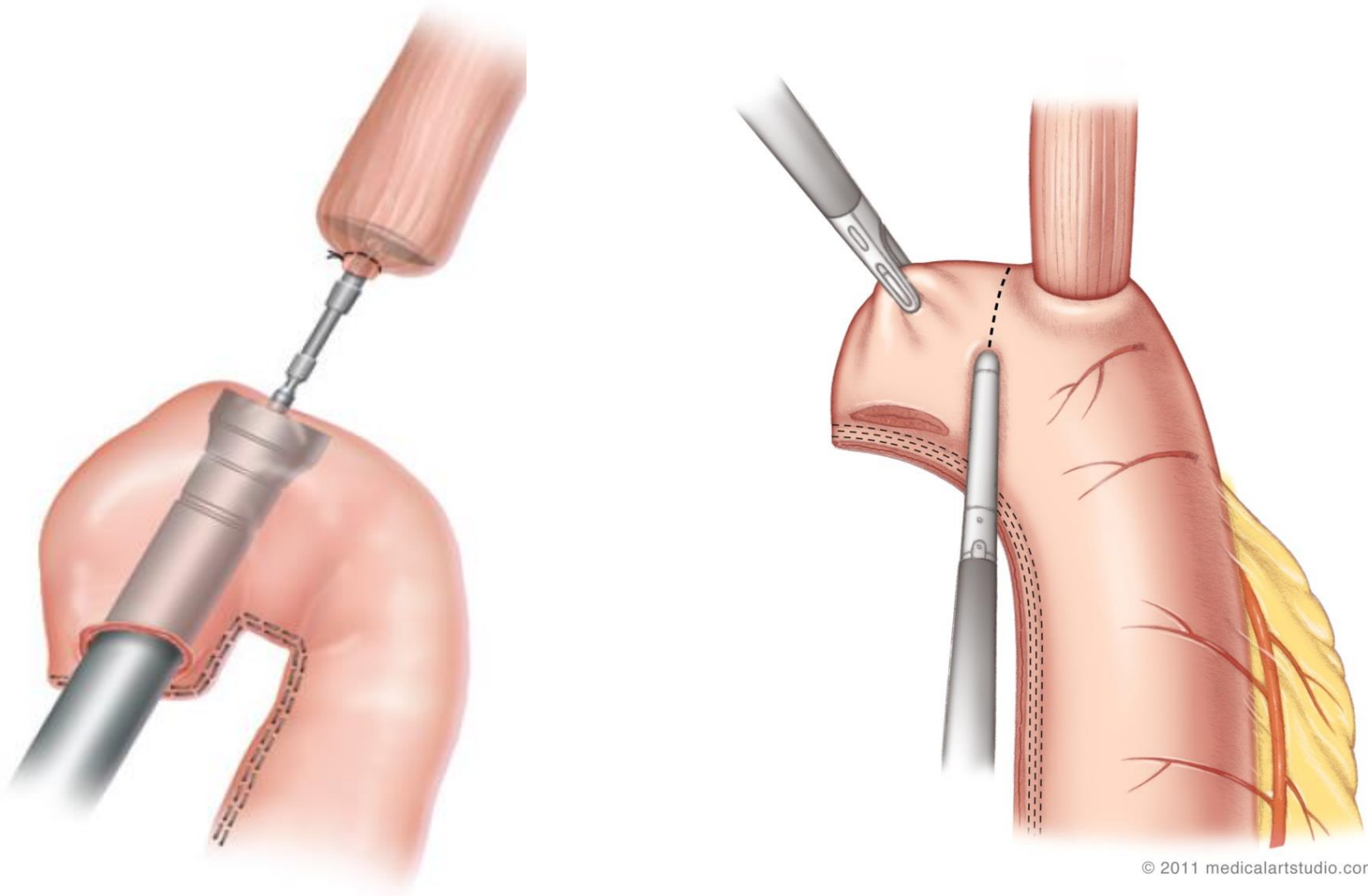


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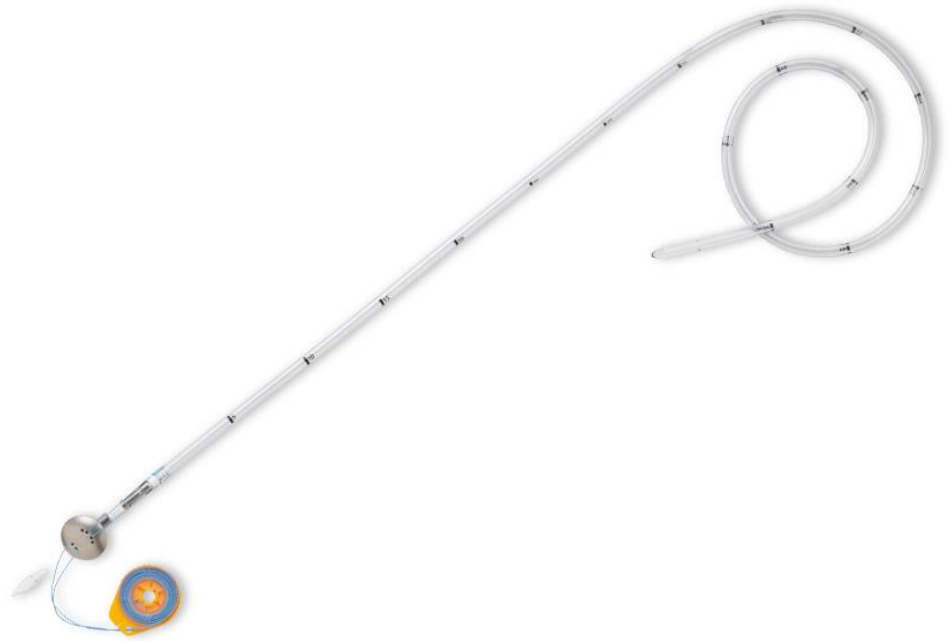
Esophago-gastric Anastomosis



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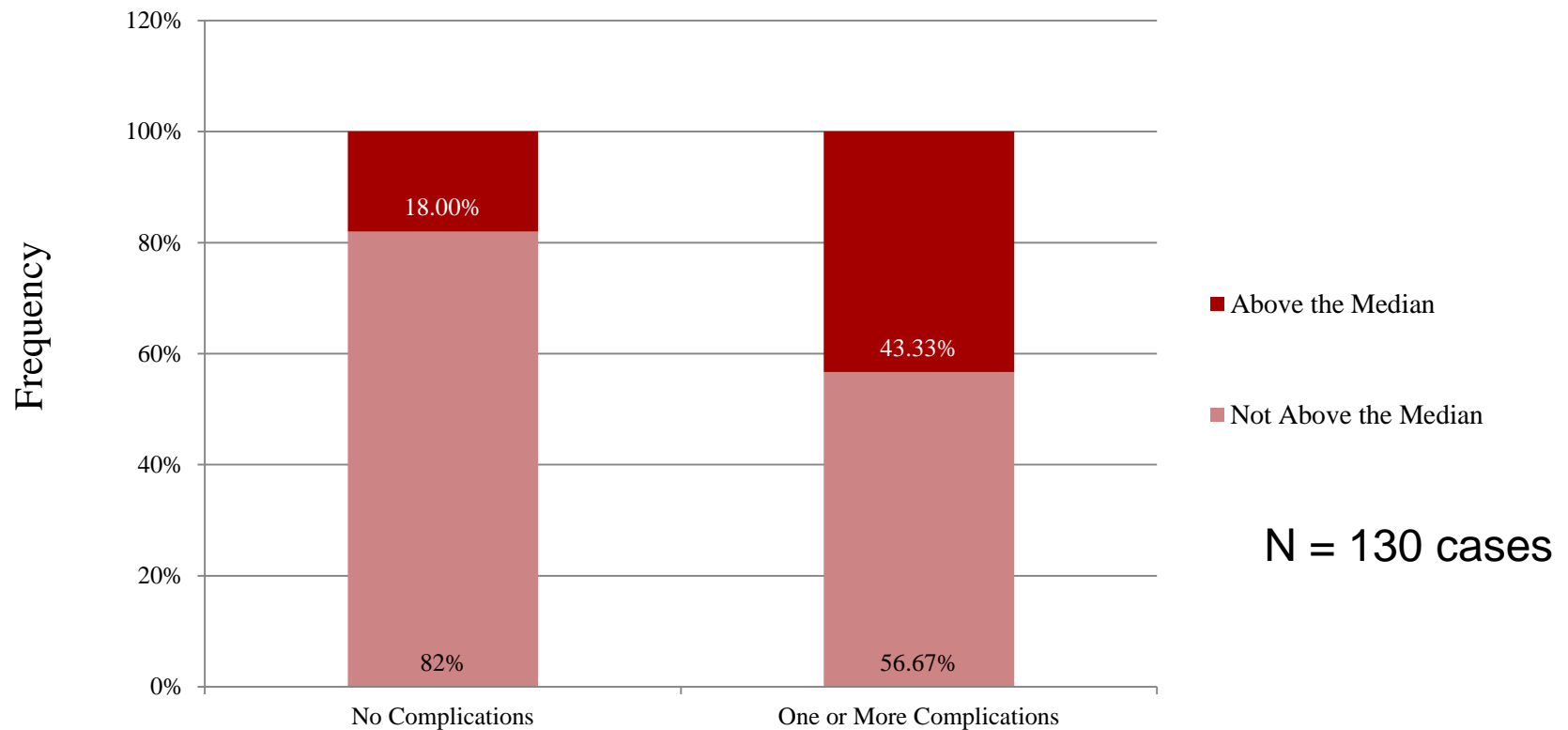


Current Series of Minimally Invasive Ivor Lewis Esophagectomy

Author	N	LOS (days)	Mortality (%)	Leak (%)
Bizekis 2002	35	9	6	6
Nyguyen 2003	3	8	4.3	8.7
Merritt 2012	15	10	0	6.7
Tapias 2012	40	7	2.5	0
Luketich 2012	530	7	0.9	4.3
OSUMC 2020	130	8	0.8	3.1



Frequencies Above and Below the Median for Length of Stay





STS General Thoracic Surgery Database Esophagectomy Composite Quality Rating

Duke Clinical Research Institute

Participant 40178

STS Period Ending 12/31/2017

Table 3: Esophagectomy Composite Quality Rating

Quality Domain	Participant Score (95% CI)	STS Mean Participant Score	Participant Rating ¹	Quality Domain	Eligible Procedures	Detail	Count	Percent ²
Jan 2015 - Dec 2017 Overall	94.9% (92.32 , 96.89)	89.7%	★★★	Jan 2015 - Dec 2017 Absence of Mortality	112	Operative Mortality	1	
<p>● - STS Mean Participant Score</p> <p>Participant</p> <p>Not Favorable Min 80.84 25th 88.39 Median 89.96 75th 91.16 Max 95.53 Favorable</p>				Jan 2015 - Dec 2017 Absence of Major Complication	112	Major Complication	13	
Jan 2015 - Dec 2017 Absence of Mortality	97.2% (94.44 , 99.02)	96.3%	★★			Unexpected Return to OR	3	23.1%
<p>● - STS Mean Participant Score</p> <p>Participant</p> <p>Not Favorable Min 92.35 25th 95.95 Median 96.40 75th 96.76 Max 97.87 Favorable</p>						Anastomotic Leak Req. Med Rx only	0	0.0%
						Reintub./Resp. Failure	1	7.7%
						Initial Vent Support >48hrs	0	0.0%
						Pneumonia	4	30.8%
						New Renal Failure per RIFLE criteria	0	0.0%
						Recurrent laryngeal nerve paresis	0	0.0%
						Multiple Complications (more than 1 of the above)	5	38.5%
Jan 2015 - Dec 2017 Absence of Major Complication ³	83.0% (75.80 , 88.97)	69.1%	★★★					
<p>● - STS Mean Participant Score</p> <p>Participant</p> <p>Not Favorable Min 53.35 25th 66.08 Median 68.13 75th 71.94 Max 85.87 Favorable</p>								

² Percentages represent the proportion that the specific complication contributed to the total number of patients with a major complication
This information is intended to facilitate and focus process and quality improvement initiatives by providers

¹ Participants must have at least 30 eligible procedures to be rated

* = Participant performance is significantly lower than the STS mean based on 97.5% Bayesian probability

** = Participant performance is not significantly different than the STS mean based on 97.5% Bayesian probability

*** = Participant performance is significantly higher than the STS mean based on 97.5% Bayesian probability

³ Defined as one or more of any of the following: Unexpected return to OR, Anastomotic leak req. medical Rx, Reintubation/Respiratory failure Initial vent support > 48 hrs, Pneumonia, New renal failure per RIFLE criteria, Recurrent laryngeal nerve paresis.



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