



# Intrathoracic anastomosis using handsewn purse-string suturing by the double-ligation method in laparo-thoroscopic esophagectomy

Takamasa Takahashi, Yuji Kaneoka, Atsuyuki Maeda, Yuichi Takayama, Hiroki Aoyama, Takahiro Hosoi, Kazuaki Seita

Department of Surgery, Ogaki Municipal Hospital, Ogaki, Japan

**Purpose:** In minimally invasive esophagectomy (MIE), it is important to reduce the rate of anastomotic leakage to ensure its safety. At our institute, the double-ligation method (DLM) has been introduced to insert and fix the anvil of the circular stapler for intracorporeal circular esophagojejunostomy in gastric surgery. We adopted this method for intrathoracic anastomosis (IA) in MIE. The aim of this study was to investigate the safety of IA with DLM in MIE.

**Methods:** In this study, 48 patients diagnosed with primary middle or lower third segment thoracic esophageal carcinoma with clinical stage I, II, III or IV disease were retrospectively evaluated. Postoperative outcomes were assessed.

**Results:** Among the 48 patients, 42 patients underwent laparo-thoroscopic esophagectomy and IA using a circular stapler with the DLM. The average total operation time and thoracoscopic operation time were 433 and 229 minutes, respectively. The average purse-string suturing time was 4.7 minutes. The rates of anastomotic leakage and stenosis were 2.4% and 14.3%, respectively. The overall incidence of postoperative complications (Clavien-Dindo grade of  $\geq$ III) was 16.7%. The average postoperative stay was 16 days.

**Conclusion:** The procedure of IA using a circular stapler with the DLM in MIE was safe and provided a low rate of anastomotic leakage.

**Keywords:** Esophageal cancer, Thoracoscopic surgery, Intrathoracic anastomosis, Circular stapler

**Received** February 1, 2023

**Revised** March 31, 2023

**Accepted** April 25, 2023

## Corresponding author

Takamasa Takahashi

Department of Surgery, Ogaki

Municipal Hospital, 4-86

Minaminokawamachi, Ogaki, Gifu

503-8502, Japan

E-mail: tkms1108@yahoo.co.jp

<https://orcid.org/0000-0003-2430-1839>

© 2023 The Korean Society of Endo-Laparoscopic & Robotic Surgery  
This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## INTRODUCTION

Anastomotic leakage is one of the most common severe complications that occur after minimally invasive esophagectomy (MIE). Anastomotic leakage is associated with a prolonged postoperative hospital stay and can lead to postoperative mor-

bidity. In Japan, cervical anastomosis (CA) has been mainly performed in MIE. The rate of CA in esophagectomy was 88.0% in a comprehensive registry of esophageal cancer in Japan [1]. However, the incidence of anastomotic leakage was reported to be 12.7% in a review of the national clinical database in Japan [2]. On the other hand, the incidence of anastomotic

leakage is lower in intrathoracic anastomosis (IA) than in CA [3–6]. To overcome the risk of anastomotic leakage, IA is considered one of the candidate procedures.

For IA in MIE, stapled circular anastomosis or stapled side-to-side anastomosis using a linear stapler are usually selected. Circular anastomosis is a standard procedure in open Ivor-Lewis esophagectomy. However, circular anastomosis in MIE can be a challenging procedure due to the difficulty of inserting an adequate-sized anvil of circular stapler into the thoracic esophagus and purse-string suturing to hold the anvil in the esophagus. To secure the IA using a circular stapler in MIE, it is important to overcome these difficulties.

In our institute, the double-ligation method (DLM) has been introduced to insert and fix the anvil of the circular stapler for intracorporeal circular esophagojejunostomy in gastric surgery [7]. In this procedure, a handsewn purse-string suture was laparoscopically placed, the anvil was fixed by ligation, and the ligated thread was turned through the remnant of the posterior wall of the esophagus. The turned thread was finally ligated again to confirm reinforcement of the fixation. Then, intracorporeal esophagojejunostomy was performed using a circular stapler. To guarantee the safety of the insertion and the hold of the anvil into the thoracic esophagus in MIE, DLM previously reported was introduced.

In the present study, our novel procedure of the IA in MIE using DLM was introduced, and the surgical outcomes of the procedure were retrospectively evaluated.

## METHODS

### Patients

This retrospective study enrolled 48 patients diagnosed with

primary middle or lower third segment thoracic esophageal carcinoma with clinical stage I, II, III or IV (M1 lymph node metastasis in the supraclavicular lymph nodes) who underwent planned curative resection from April 2018 to December 2021 at Ogaki Municipal Hospital in Ogaki, Japan. Three patients underwent laparotomy because two patients had gastric cancer and the other had rectal cancer, and they were excluded from the study. Two patients underwent thoracotomy due to a history of thoracotomy and were also excluded from the study. One patient underwent to CA instead and was also excluded from the study (Fig. 1). The remaining 42 patients underwent laparothoracoscopic esophagectomy. All operations were performed by a single surgeon (TT).

Data on the patients' clinical characteristics as well as laboratory, treatment, and pathological data were collected from their medical records. Tumor staging was determined according to the 8th edition of the TNM classification system [8].

### Operative procedure

Under general anesthesia, patients were placed in a modified lithotomy position, and the abdominal part of the surgical procedure was started. In the case of three-field lymph node dissection, the cervical part was performed after the laparoscopic part. 4K imaging technology (IMAGE1 S 4U Rubina; Karl Storz Endoscopy-America, Inc.) was used for the laparo-thoracoscopic procedure and fluorescence imaging for displaying indocyanine green (ICG). By the open method, a 30° endoscope (HOPKINS Forward-Oblique Telescope 30°; KARL STORZ Endoscopy-America, Inc.) was inserted below an umbilical incision. An additional four ports were created, and a Nathanson liver retractor for liver lift was inserted under laparoscopic vision (Fig. 2A). Gastric mobilization and dissection of the lower mediasti-

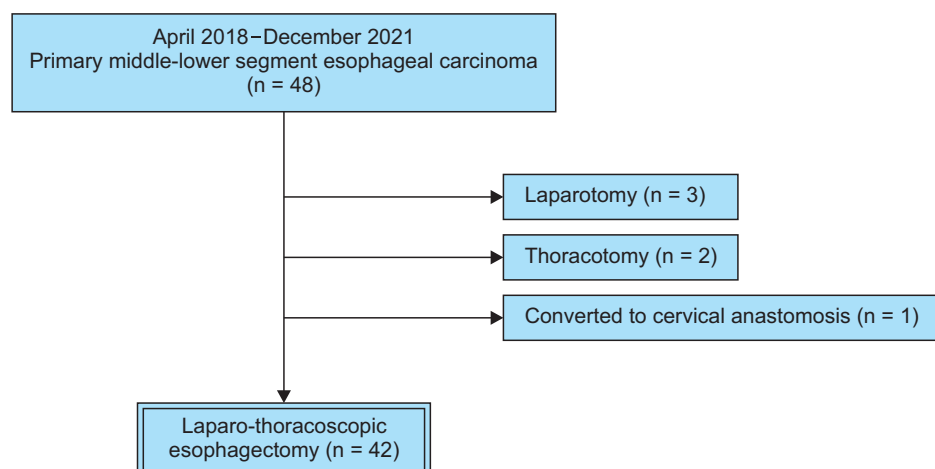
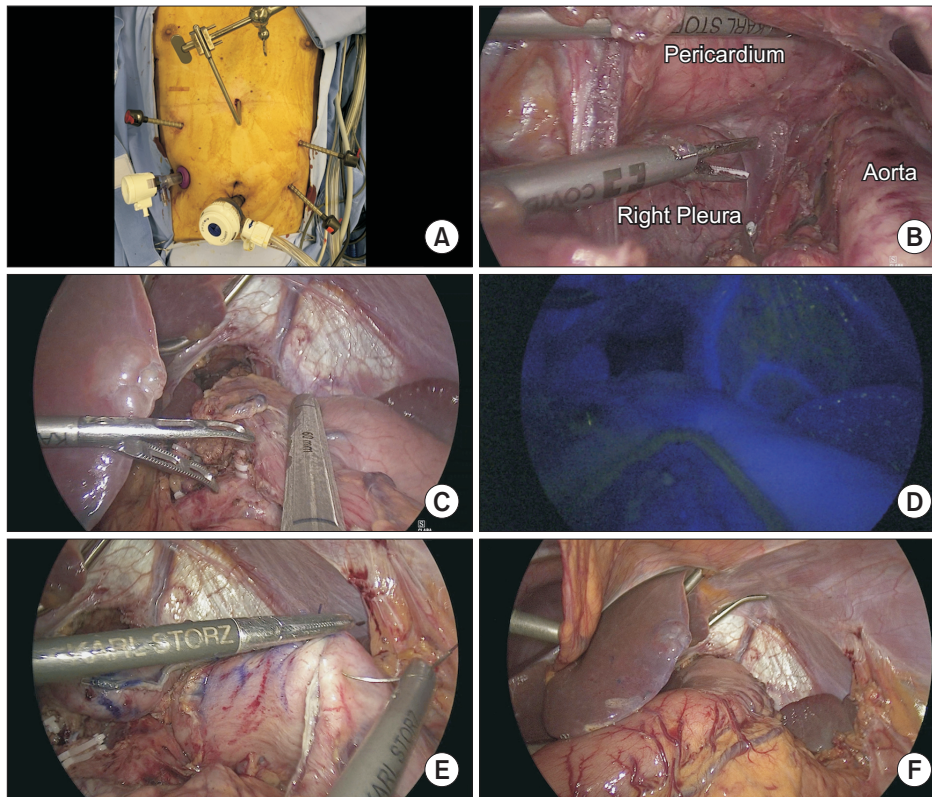


Fig. 1. Treatment summary.

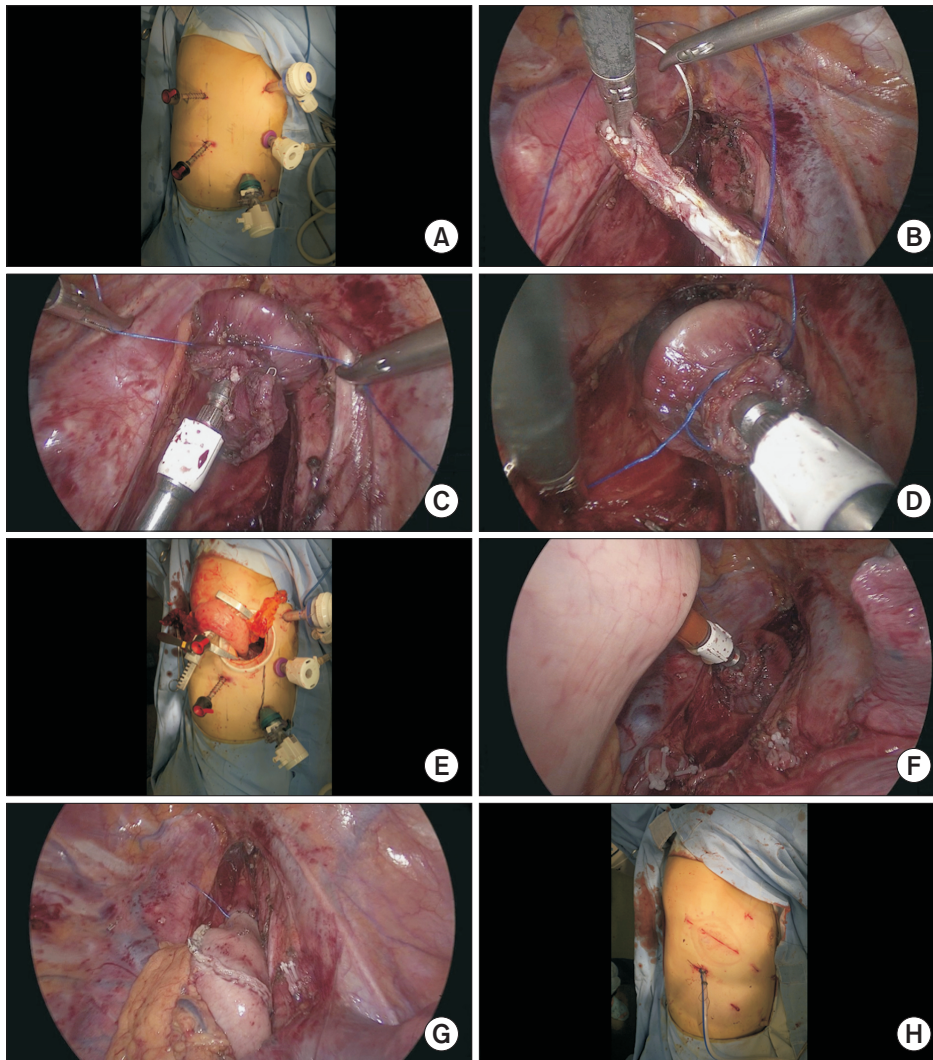


**Fig. 2.** (A) Distribution of five ports during the abdominal procedure. (B) Dissection of lower mediastinal lymph nodes. (C) Laparoscopic creation of gastric tube. (D) Indocyanine green-stained imaging. (E) Suturing of the staple line of the gastric tube. (F) Pulling up of the gastric tube.

nal lymph nodes (Fig. 2B), perigastric lymph nodes, and lymph nodes along the left gastric and the common hepatic artery were performed. A 4-cm-wide gastric tube was created laparoscopically using two to three firings of a linear stapler (Endo GIA Purple Reload with Tri-Staple Technology, Medtronic) (Fig. 2C). A bolus of 10 mg of the ICG dye (Diagnogreen for injection; Dai-ichi Pharm) was injected from a peripheral vein, and the site of anastomosis was decided (Fig. 2D). The staple line was sutured using 3-0 Vicryl (Ethicon) (Fig. 2E). Pyloroplasty or feeding jejunostomy were not performed in all patients. Finally, the gastric tube was filled to the lower mediastinal cavity (Fig. 2F). Feeding jejunostomy was not performed in all patients.

Patients were then changed to a left lateral position using blocker intubation (COOPDECH Endobronchial Blocker Tube; Daiken Medical Co.) to establish single-lung ventilation. The thoracic procedure was performed using five ports under 8-mmHg pneumothorax. (Fig. 3A). After mediastinal lymph node dissection, including dissection of the lymph nodes beside the right and left recurrent laryngeal nerves, and esophageal mobilization, the esophagus was cut above the aortic arch using a linear stapler (Endo GIA Purple Reload with Tri-Staple Technology). Then, the esophagus was cut again just above the staple line using an ultrasonically activated scalpel (Harmonic Ace

+7, Ethicon; or Sonicision Curved Jaw, Medtronic). By the DLM as described previously, the anvil head with 25-mm diameter of the circular stapler (Premium Plus CEEA, Medtronic) was placed into the upper esophagus. First, a handsewn purse-string suture was placed using a 20-cm, 2-0 Prolene (Ethicon) along the cut end of the esophagus with a full-thickness stitch from the outside-in and inside-out (Fig. 3B). Second, the anvil rim was introduced into the esophageal lumen. Third, the suture was ligated, and the anvil was fixed (Fig. 3C). Fourth, the ligated thread was turned through the remnant posterior wall of the esophagus, and the turned thread was ligated again (Fig. 3D). Finally, the remnant esophageal wall was incised. The 5-mm trocar port on the posterior axillary line was extended to 7 cm, and the gastric tube was lifted to the thoracic cavity (Fig. 3E). Gastroesophageal anastomosis was performed using the circular stapler (Premium Plus CEEA) (Fig. 3F). The gastric tube was cut at 2 cm proximal side from the anastomosis using a linear stapler (Endo GIA Purple Reload with Tri-Staple Technology) (Fig. 3G). The incision protector was again placed, and the stump was sutured using 3-0 Vicryl using five ports under 8-mmHg pneumothorax. The anastomosis was surrounded by the greater omentum. Finally, a chest drainage tube was placed (Fig. 3H).



**Fig. 3.** (A) Distribution of five ports during the thoracic procedure. (B) Handsewn purse-string suturing. (C) Insertion of the anvil and ligation of the purse-string suture. (D) Ligation of the turned thread (double-ligation method). (E) A 7-cm mini-thoracotomy and pulling up of the gastric tube. (F) Gastroesophageal anastomosis. (G) Cut of the gastric tube using a linear stapler. (H) Detention of the chest tube.

### Definition of postoperative morbidity

Postoperative anastomotic leakage was diagnosed by computed tomography scanning, which would demonstrate the presence of any extraluminal air or fluid collection. Postoperative anastomotic stricture was defined in patients who had difficulty swallowing and underwent upper gastrointestinal endoscopy after esophagectomy if the diameter of the anastomosis was smaller than the diameter of the endoscope (9.9 mm). The grade of other complications was defined according to the Clavien-Dindo (CD) classification [9].

### Literature review

To review the literature about intrathoracic esophagogastric anastomosis using circular stapler for thoracoscopic esophagectomy, “intrathoracic anastomosis,” “thoracoscopic,” and “circular stapler” were used as keywords for PubMed.

## RESULTS

### Patient characteristics

Table 1 shows the patient characteristics. There were 31 male (73.8%) and 11 female patients (26.2%) with a mean age of 68 years (range, 50–83 years). The location of the tumors was the middle thorax in 25 patients (59.5%) and the lower thorax in 17 patients (40.5%). The disease rates in clinical stage I, II, III, and IVB were 33%, 17%, 40%, and 10%, respectively. All clinical stage IVB patients had supraclavicular lymph node metastases and no distant organ metastasis.

### Surgical outcomes

The surgical outcomes are shown in Table 2. The median operative time was 433 minutes (range, 327–641 minutes). The median laparoscopic time and thoracoscopic time were

**Table 1.** Patients' characteristics

Characteristic	Data
No. of patients	42
Age (yr)	68 (50–83)
Sex	
Male	31 (73.8)
Female	11 (26.2)
ASA PS classification	
I	13 (31.0)
II	29 (69.0)
Pathological differentiation	
SCC	42 (100)
Location of tumor	
Middle	25 (59.5)
Left	17 (40.5)
cT status	
T1	15 (35.7)
T2	1 (2.4)
T3	26 (61.9)
cN status	
N0	21 (50.0)
N1	12 (28.6)
N2	9 (21.4)
cM status	
M0	36 (85.7)
M1	6 (14.3)
Clinical stage	
I	14 (33.3)
II	7 (16.7)
III	17 (40.5)
IVB <sup>a)</sup>	4 (9.5)

Values are presented as number only, median (range), or number (%), ASA PS; American Society of Anesthesiologists Physical Status; SCC, squamous cell carcinoma.

<sup>a)</sup>All patients were diagnosed as clinical stage IVB because of supraclavicular lymph nodes metastases.

135 minutes (range, 90–237 minutes) and 229 minutes (range, 131–321 minutes), respectively. The total blood loss and blood loss of the thoracic part were 200 mL (range, 5–1,235 mL) and 150 mL (range, 0–1,230 mL), respectively. Three-field lymph node dissection was performed in 19 patients (45.2%). R0 resection was performed in 35 patients (83.3%). The number of harvested lymph nodes was 44 (range, 17–115). The purse-string suture time (from the insertion of 2-0 Prolene into the esophageal wall to completion) was 4.7 minutes (range, 1.4–12.1

**Table 2.** Surgical outcomes

Characteristic	Data
Operative time (min)	
Total	433 (327–641)
Laparoscopic time	135 (90–237)
Thoracoscopic time	229 (131–321)
Cervical time <sup>a)</sup>	111 (37–157)
Blood loss (mL)	
Total	200 (5–1,235)
Thoracic part	150 (0–1,230)
Lymph node dissection	
Two field	23 (54.8)
Three field	19 (45.2)
Curability	
R0	35 (83.3)
R1	4 (9.5)
R2	3 (7.1)
No. of harvested lymph nodes	44 (17–115)
Purse-string suturing time (min)	4.7 (1.4–12.1)
Conversion to open surgery	0 (0)

Values are presented as median (range) or number (%).

<sup>a)</sup>Patients with cervical lymphadenectomy (n = 20).

minutes). No conversions to open surgery were observed.

### Operative morbidities and mortality

Details of the postoperative morbidities and mortality are shown in Table 3. Postoperative complications of CD grade II or more occurred in 19 patients (45.2%). Anastomotic leakage occurred in only one patient (2.4%). The complications, excluding anastomotic leakage, were pneumonia (23.8%), vocal cord palsy (9.5%), pancreatic fistula (4.8%), chylothorax (2.4%), empyema (2.4%), and wound infection (2.4%). Unplanned intubations occurred in five patients (11.9%). Complications of CD grade III or more occurred in seven patients (16.7%). Reoperations were required in one patient due to postoperative hemorrhage. One patient (2.4%) died due to gastrobronchial fistula with pulmonary infection.

Anastomotic stricture occurred in six patients (14.3%). All patients were relieved by endoscopic balloon dilatation. Three patients underwent it once, one patient underwent twice, one patient underwent four times, and one patient underwent six times.

Reflux esophagitis of Los Angeles classification grade A or more occurred in four patients.

## DISCUSSION

In the present study, we introduced our novel procedure of IA with DLM in MIE. The incidence of anastomotic leakage was only 2.4%. To overcome the difficulty of the insertion and fixation of the anvil of the circular stapler in the thoracoscopic procedure, we adopted the DLM. In this procedure, by using only 2-0 Prolene, the anvil was safely inserted and fixed without another device, such as OrVil (Covedien Medtronic), Endo-Stitch (Medtronic), or ENDOLOOP Ligature (Ethicon).

The Ivor-Lewis procedure has been considered the standard

treatment for middle or lower esophageal cancer in Western countries and has been reported to be preferable to the McKeeown operation [4,6,10]. This approach allows a lower incidence of postoperative anastomotic leakage, recurrent laryngeal nerve injury, and a shorter hospital stay. In contrast, CA is a commonly performed procedure in Japan, where three-field lymph node dissection is a standard esophagectomy. After mediastinal lymph node dissection by the thoracoscopic approach, the gastric tube was pulled up through the mediastinal or retrosternal route, and CA was performed. However, the incidence of anastomotic leakage was reported to be 12.7% in a review of the national clinical database in Japan [2], and it was higher than for IA in Western countries [5,10]. To decrease the rate of anastomotic leakage, we adopted the thoracoscopic IA technique for middle and lower thoracic esophageal carcinoma, even for three-field lymph node dissection. Nineteen patients among the 42 patients in this study underwent three-field lymph node dissection.

For IA using circular anastomosis, insertion of the anvil of the circular stapler in the upper esophagus is a crucial procedure. We summarize the surgical outcomes of various methods for anvil fixation for circular esophagojejunostomy, including more than 30 cases in Table 4 [11–14]. In three studies using a hand-sewn procedure, ligation was performed just once [11–13]. In the DLM, after the purse-string suture was ligated and the anvil was fixed, the ligated thread was turned through the remnant posterior wall of the esophagus, and the turned thread was ligated again. The DLM was the useful method for the ligation and fixation of the anvil using the only one thread in intracorporeal circular esophagojejunostomy in gastric surgery [7]. We borrowed this method for intrathoracic esophagogastric anastomosis. To reinforce the fixation of the anvil, ENDOLOOP Liga-

**Table 3.** Operative morbidity and mortality

Complication	Data
Anastomotic leak	1 (2.4)
Pneumonia	10 (23.8)
Vocal cord palsy <sup>a)</sup>	4 (9.5)
Pancreatic fistula	2 (4.8)
Chylothorax	1 (2.4)
Postoperative bleeding	1 (2.4)
Empyema	1 (2.4)
Wound infection	1 (2.4)
Unplanned intubation	5 (11.9)
Any complications with CD grade $\geq$ III	7 (16.7)
Reoperation	1 (2.4)
Anastomotic stricture	6 (14.3)
Reflux esophagitis <sup>b)</sup>	4 (9.5)
Postoperative hospital stay (day)	16 (13–59)
Postoperative mortality	1 (2.4)

Values are presented as number (%) or median (range).

<sup>a)</sup>Clavien-Dindo (CD) grade  $>$ I. <sup>b)</sup>Los Angeles grade  $\geq$ A.

**Table 4.** Literature review of surgical technique of intrathoracic anastomosis using circular stapler

Study	Year	Sample size (n)	Method	Total operation time (min)	Operation time of thorax part (min)	Anastomotic leakage rate (%)	Anastomotic stricture rate (%)
Campos et al. [14]	2010	37	OrVil (Covedien Medtronic)	275	-	2.7	13.5
Ai et al. [13]	2014	62	Handsewn (purse-string suture)	260	155	1.6	-
Jeon et al. [11]	2016	54	Handsewn (purse-string suture)	372	255	5.2	8.6
Kang et al. [12]	2018	215	Handsewn (purse-string suture)	297	-	2.8	-
Present study	2022	42	Handsewn (double-ligation method)	433	229	2.4	14.3

ture may be useful. OrVil is also reported to be another useful method for the intrathoracic esophagogastric anastomosis [14]. However, the cost of ENDOLOOP Ligature is \$3.14 and that of OrVil is \$226. In contrast, only one thread (2-0 Prolene) was used in DLM. Therefore, DLM is more economical and simple method to ensure the definite fixation of the anvil.

Anastomotic stricture is one of disadvantages of the circular anastomosis. The rate of postoperative anastomotic stricture was 14.3% in this study although all patients could be relieved by endoscopic balloon dilatation. Also in other studies, the rate was 8.6% [11] or 13.6% [14] (Table 4). In contrast, using linear stapled intrathoracic esophagogastric anastomosis, that was reported to be 1.9% [3] or 2.8% [15], and those were lower compared with the circular anastomosis. Shiraishi et al. [16] reported the anastomotic stricture was only 3.8% when the stapler was fired through the natural thickness of the stomach wall in cervical esophagogastric anastomosis. In our IA, the stapler tended to be fired while pulling because the anastomosis was performed through 7-cm mini-thoracotomy, and that can be one of causes of the anastomotic stricture. To reduce the rate of the anastomotic stricture in our method, we should pay attention to not pulling the gastric tube when the stapler is fired.

In IA using a circular stapler, mini-thoracotomy is necessary to pull up the gastric tube and insert an end-to-end anastomosis (EEA) body into the gastric tube. In our surgical procedure, the posterior 7-cm length of incision was made to insert the EEA body. Through thoracotomy, the latissimus dorsi muscle was dissected, which can impair respiratory function. In our cases, the incidence of postoperative pneumonia was 23.8%, which was higher than that in past reports performing IA [5,10]. Additionally, in a review of the national clinical database in Japan, the incidence of pneumonia was only 13.9% in MIE [2]. To decrease the incidence of pneumonia, muscle-sparing mini-thoracotomy might be useful [17]. If the mini-thoracotomy is made in the anterior incision, the latissimus dorsi muscle can be preserved, and respiratory function may also be preserved in our operative procedure.

The limitations of this study were the very small sample size, the clinical data at only a single institution and the retrospective self-analysis results. Therefore, this study should be considered a preliminary study. To verify the usefulness of IA with the DLM, further phase III multicenter randomized controlled trials are necessary.

In conclusion, the novel procedure of IA with DLM in MIE was safe and provided a lower rate of anastomotic leakage for middle to lower esophageal carcinoma.

## NOTES

### Ethical statements

This study protocol was approved by the Institutional Review Board of the Ogaki Municipal Hospital (No. 20220728-3) and written informed consent was obtained from all patients.

### Authors' contributions

Conceptualization, Formal analysis: TT

Data curation: TT, HA, TH, KS

Investigation: TT, TH

Supervision: YK, AM, YT

Writing—original draft: TT

Writing—review & editing: YK, AM, YT, HA, TH, KS

All authors read and approved the final manuscript.

### Conflict of interest

All authors have no conflicts of interest to declare.

### Funding/support

None.

### ORCID

Takamasa Takahashi, <https://orcid.org/0000-0003-2430-1839>

Yuji Kaneoka, <https://orcid.org/0000-0001-6212-463X>

Atsuyuki Maeda, <https://orcid.org/0000-0003-2731-7836>

Yuichi Takayama, <https://orcid.org/0000-0002-7484-8480>

Hiroki Aoyama, <https://orcid.org/0000-0003-1044-0686>

Takahiro Hosoi, <https://orcid.org/0000-0001-7878-005X>

Kazuaki Seita, <https://orcid.org/0000-0003-1977-3436>

## REFERENCES

1. Watanabe M, Toh Y, Ishihara R, et al. Comprehensive registry of esophageal cancer in Japan, 2014. *Esophagus* 2022;19:1-26.
2. Takeuchi H, Miyata H, Ozawa S, et al. Comparison of short-term outcomes between open and minimally invasive esophagectomy for esophageal cancer using a nationwide database in Japan. *Ann Surg Oncol* 2017;24:1821-1827.
3. Huang HT, Wang F, Shen L, Xia CQ, Lu CX, Zhong CJ. Clinical outcome of middle thoracic esophageal cancer with intrathoracic or cervical anastomosis. *Thorac Cardiovasc Surg* 2015;63:328-334.
4. Gooszen JA, Goense L, Gisbertz SS, Ruurda JP, van Hillegersberg R, van Berge Henegouwen MI. Intrathoracic

- versus cervical anastomosis and predictors of anastomotic leakage after oesophagectomy for cancer. *Br J Surg* 2018;105:552-560.
5. van Workum F, Verstegen MH, Klarenbeek BR, et al. Intrathoracic vs cervical anastomosis after totally or hybrid minimally invasive esophagectomy for esophageal cancer: a randomized clinical trial. *JAMA Surg* 2021;156:601-610.
  6. Shi Y, Wang A, Yu S, Fei X, Liu S, Liao J. Thoracoscopic-laparoscopic Ivor-Lewis surgery vs. McKeown surgery in the treatment of thoracic middle-lower segment esophageal cancer. *J BUON* 2021;26:1062-1069.
  7. Takayama Y, Kaneoka Y, Maeda A, Fukami Y, Takahashi T, Uji M. A novel technique of hand-sewn purse-string suturing by double ligation method (DLM) for intracorporeal circular esophagojejunostomy. *J Gastric Cancer* 2019;19:290-300.
  8. Brierley J, Gospodarowicz MK, Wittekind C. TNM classification of malignant tumours. 8th ed. John Wiley & Sons, Inc; 2017.
  9. Clavien PA, Strasberg SM. Severity grading of surgical complications. *Ann Surg* 2009;250:197-198.
  10. Bolca C, Dumitrescu M, Fotache G, Stoica R, Cadar G, Cordos I. Comparative study of early postoperative complications: thoracic anastomosis vs cervical anastomosis. In esophageal replacement with gastric graft. *Chirurgia (Bucur)* 2018;113:95-100.
  11. Jeon HW, Park JK, Song KY, Sung SW. High intrathoracic anastomosis with thoracoscopy is safe and feasible for treatment of esophageal squamous cell carcinoma. *PLoS One* 2016;11:e0152151.
  12. Kang N, Zhang R, Ge W, et al. Major complications of minimally invasive Ivor Lewis oesophagectomy using the purse string-stapled anastomotic technique in 215 patients with oesophageal carcinoma. *Interact Cardiovasc Thorac Surg* 2018;27:708-713.
  13. Ai B, Zhang Z, Liao Y. Laparoscopic and thoracoscopic esophagectomy with intrathoracic anastomosis for middle or lower esophageal carcinoma. *J Thorac Dis* 2014;6:1354-1357.
  14. Campos GM, Jablons D, Brown LM, Ramirez RM, Rabl C, Theodore P. A safe and reproducible anastomotic technique for minimally invasive Ivor Lewis oesophagectomy: the circular-stapled anastomosis with the trans-oral anvil. *Eur J Cardiothorac Surg* 2010;37:1421-1426.
  15. Fabbi M, van Berge Henegouwen MI, Fumagalli Romario U, et al. End-to-side circular stapled versus side-to-side linear stapled intrathoracic esophagogastric anastomosis following minimally invasive Ivor-Lewis esophagectomy: comparison of short-term outcomes. *Langenbecks Arch Surg* 2022;407:2681-2692.
  16. Shiraishi O, Yasuda T, Kato H, et al. Circular stapler method for avoiding stricture of cervical esophagogastric anastomosis. *J Gastrointest Surg* 2022;26:725-732.
  17. Niwa Y, Koike M, Hattori M, et al. Short-term outcomes after conventional transthoracic esophagectomy. *Nagoya J Med Sci* 2016;78:69-78.