Original Article on Gastrointestinal Surgery

Modified technique for cervical esophagogastric anastomosis by circular stapler after priority attachment of the anvil in the narrow neck region

Hiroshi Makino[1], Hiroshi Maruyama[1], Tadashi Yokoyama[1], Atsushi Hirakata[1], Yuta Kikuchi[1], Takuma Iwai[1], Masafumi Yoshioka[1], Jyunji Ueda[1], Hideyuki Takata[1], Hiroshi Yoshida[2]

[1]Department of Surgery, Nippon Medical School, Tama-Nagayama Hospital, Tokyo, Japan; [2]Department of Gastrointestinal and Hepato-Biliary-Pancreatic Surgery, Nippon Medical School, Tokyo, Japan

Contributions: (I) Conception and design: H Makino; (II) Administrative support: H Yoshida; (III) Provision of study materials or patients: H Makino, H Yoshida; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Hiroshi Makino, MD. Department of Surgery, Nippon Medical School, Tama Nagayama Hospital, 1-7-1, Nagayama, Tama-city, Tokyo, Japan. Email: himiyumo@nms.ac.jp.

Background: Surgical resection is a critical element in the treatment of esophageal cancer. Minimally invasive esophagectomy (MIE) has the potential to reduce morbidity and mortality in esophageal cancer surgery. Among postoperative complications after esophagectomy, anastomotic leakage is the greatest concern. Since anastomosis is performed at the end of a long esophageal cancer resection surgery, a simple anastomosis method which can be completed quickly and safely is desired.

Methods: A CDH trocar inserted to the gastric tube is attached to the anvil head and the head is inserted into the esophagus. Anastomosis of the stomach to the cervical esophagus is performed using a circular stapler (CS) after priority attachment of the anvil.

Results: Anastomotic leakage and postoperative stenosis were observed in approx. 5% of cases. Stable circular stapled anastomosis using this method is possible, regardless of the length of the gastric tube.

Conclusions: Consequently, we performed circular stapled anastomosis using a CS. Moreover, we perform cervical anastomosis even for arthroscopy or thoracotomy since direct vision is possible, and this method is safe even in cases where problems in suturing occur.

Keywords: Circular stapler (CS); esophagogastric anastomosis; cervical anastomosis

Received: 25 July 2018; Accepted: 21 August 2018; Published: 23 August 2018.
doi: 10.21037/jovs.2018.08.01
View this article at: http://dx.doi.org/10.21037/jovs.2018.08.01

Introduction

There are many papers regarding anastomotic leakage and stricture rates after esophagectomy. Anastomotic leakage, as a complication of esophageal cancer resection should be highly avoided. Anastomotic leakage rates are high comparing with gastric or colonic surgery, and are reported to be 13% (1). In addition, various suture methods including hand-sewn, circular stapler (CS), and linear stapler (LS) to reduce frequency are reported. No significant difference has been reported in the comparison between hand-sewn and CS, but frequency of stenosis and anastomotic leakage between CS and LS has not been clearly identified. We select a CS for anastomosis in the neck, but the narrow surgical field in the neck during anastomosis operation is a disadvantage. Consequently, we would like to report on our consideration of a technique first reported by Tangoku *et al.*

Table 1 Anastomotic site and method after minimally invasive esophagectomy

Site	Method	Technique	Stapler	Number
Neck	Circular stapler	CDH	Priority attachment of the anvil	87
		CDH	Standard	22
		EEA	Orvil	5
	Hand sewn			6
Chest	Circular stapler	CDH	Standard	7
Total				127

Table 2 Reconstruction route and organ

Route	Number	Organ	Number
SR	23	Colon	1
		Stomach	22
PR	102	Stomach	102
AR	2	Colon	2
Total	127		127

Methods

Patient selection and workup (Tables 1,2)

Patients with esophageal carcinomas underwent video-assisted thoracoscopic surgery of the esophagus (VATS-E). We developed an original anastomotic technique in the cervical field after esophagectomy. The modified anastomotic technique using a CS in the narrow neck field was performed in 78 cases.

Equipment preference

Electrical devices used for gastric tube formation and cervical anastomosis were SonoSurg (Olympus Medical Systems, Tokyo, Japan) or LigaSure Maryland jaw sealer (Covidien, Mansfield, MA, USA). Port devices were three 5 mm ports (Single-port; EZ Trocars: Hakko Medical Device Division, Nagano, Japan) and two 12 mm ports (Single-port; Covidien, Mansfield, MA, USA. Balloon Blunt Tip; Applied Medical, CA, USA). Other: 5 mm flexible laparoscope (Olympus Medical Systems, Tokyo, Japan); Endoscopic forceps (Olympus Medical Systems, Tokyo, Japan). Electric cautery (ERBE Electric Medicine, Tubingen, Germany).

Pre-operative preparation

General anesthesia with one lung ventilation was performed using a double lumen endotracheal tube for VATS-E and bilateral lung ventilation was performed for the cervical and abdominal procedure. An epidural anesthesia tube was inserted to relieve pain in the upper abdomen. The patient was placed in a semi-prone position with a "magic bed" (or vacuum fixing bed) and a shoulder roll that was placed under the axillary. The cervical and abdominal procedure was performed in a spine position.

Cases in our department involving the stomach as the organ targeted for reconstruction were selected. Cases involving of postgastrectomy state, double stomach cancer requiring stomach resection, and patients with a history of epigastric laparotomy and adhesion, were excluded.

Procedure

VATS-E

Our thoracoscopic minimally invasive surgery and lymph node dissection are described on previous paper (2).

Gastric tube formation

Under laparoscopy, the stomach and right gastroepiploic

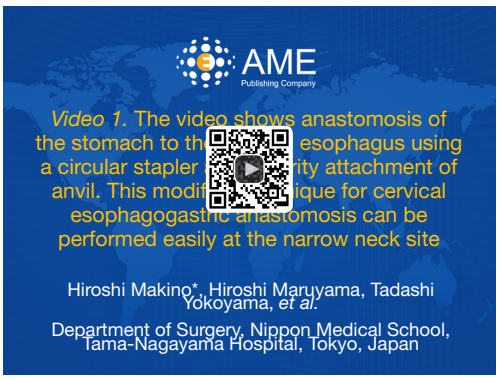

Figure 1 The video shows anastomosis of the stomach to the cervical esophagus using a circular stapler after priority attachment of anvil. This modified technique for cervical esophagogastric anastomosis can be performed easily at the narrow neck site (3).
Available online: http://www.asvide.com/article/view/26518

artery and vein were separated. The three branches of the right gastric artery were preserved to ensure sufficient blood supply of gastric tube during gastric tube formation. The vessels between the third branch and fourth branch were ligated and cut. Specifically, the lymph nodes along the left gastric artery and around lesser omentum were removed, allowing the stomach to come out of the wound from the small abdominal incision, and form an approx. 4 cm wide diameter gastric tube. The stomach was cut from this point to the gastric fundus using LSs. The proximal end of the gastric tube was resected as much as possible to ensure the good vascularity.

Moreover, a posterior mediastinal (PM) route, which is the shortest route, is usually chosen. However, in cases where multiple lymph node metastasis is observed, and recurrence in mediastinum is predicted, the posterior sternal route is selected.

Skin incision

As shown in the figure, a U-shape incision is performed only on the left side of the cervical region, and is opened from the left rim of the sternocleidomastoid muscle sternal branch and anterior muscles of the neck.

Isolating the esophagus

The esophagus is detached between the common carotid artery and trachea, and the cervical esophagus is identified. If a stomach tube is inserted, it is easier to see. The left recurrent laryngeal nerve in tracheoesophageal sulcus is preserved, and the cervical esophagus is bluntly peeled off from the trachea and prevertebral fascia in order to isolate the cervical esophagus.

Esophageal resection and a purse-string suture of the margin

A Purstring TM45 or purse string instrument (PSI) is applied to the cervical esophagus and the straight Prolene thread is passed through to separate the esophagus. This method is possible up to 5 cm from the esophageal entrance.

Gastric tube traction

The gastric tube is pulled up from abdominal cavity through substernal reconstruction (SR) via PM routes. For a PM route, the cotton tape which is connected to the pleural space is attached, for a SR route, the stomach tube connected by insertion from the neck is attached, to the small diameter gastric tube in a plastic bag, and the wound is drawn to the neck region. The plastic bag is easier to pull and remove after puncturing to release the vacuum state between the small diameter gastric tube and the bag.

Cases of esophagus cancer on the Lt to the middle Ut

Insertion of a CS from the margin of the gastric tube margin

The edge of the gastric tube is cut open and held with Allis forceps, then opened using an intestinal clamp, and a CS (Proximate ILS CDH 25; Ethicon, Cincinnati, OH, USA) is inserted.

Anastomosis of the stomach to the cervical esophagus using a CS after priority attachment of anvil (*Figure 1*)

The CDH trocar is inserted up to the posterior wall on the greater curvature side of the gastric tube which is 2–3 cm away from the insertion hole of CDH. When the insertion hole is larger, a purse-string suture around the trocar is performed. Priority attachment of the anvil head to the CDH trocar, and closure up to a distance of 2 cm are performed. The cervical esophagus margin is held in place by Allis forceps and opened by an intestinal clamp in order to perform anastomosis. The CDH trocar is attached to the anvil head and the head is inserted into the esophagus. The Allis forceps are removed and a purse-string suture is performed. Furthermore, suture ligation on the same section is repeated to form double ligation. The axis in the cervical esophagus direction continuing to the hypopharynx is adjusted, the CDH trocar attached to the anvil head is

closed, and a circular stapled anastomosis is performed.

Cases of esophagus cancer on the upper Ut to the lower Ce

High anterior anastomosis using Orvil™ devices

In cases which require resection from the esophageal entrance up to 3 cm, the cervical esophagus is peeled back as much as possible and a resection a little longer on the left side is made using a LS. DST Series™ EEA™ OrVil™ 25 is orally inserted, and a small opening on the left side is made the length of the esophagus resection margin using an electric scalpel. The OrVil™ 25 (Covidien, Mansfield, MA, USA) tube is drawn until the anvil is pulled out, the securing thread is cut, and the anvil is held with an anvil holder. Similar to CDH, the main EEA™ unit is inserted from the insertion hole of gastric tube stump, and then the center shaft is inserted up to the posterior wall on the greater curvature side. The center rod of the anvil is connected to the center shaft of EEA™ and semi-double stapling is performed. At this time, thoroughly peeling up to the esophagus orifice from the trachea is important. If this is insufficient, the anvil head will not lay smoothly and will shift without achieving anastomosis. The axis in the cervical esophagus direction continuing to the hypopharynx is adjusted, the EEA™ trocar attached to the anvil head is closed, and a circular stapled anastomosis is performed.

Confirmation and reinforcement on the anastomosis region

After suturing, the resected ring is removed from the anvil and confirmation that both are complete circumferential rings is carried out. A cotton ball is inserted from the inside to confirm whether there is any bleeding. In cases of anastomotic leakage, all suture layers are added on the trachea side of the posterior wall where it is easier to overlay on the thoracic cavity side. The anesthesiologist inserts the stomach tube and guides it inside the gastric tube.

Closure of the insertion hole

If there is more than 3 cm between the anastomosis section and the gastric tube stump, the insertion hole is closed using a liner stapler. However, in cases where the length of the gastric tube is insufficient, the length of the margin will be short. Consequently, PSI forceps are applied to perform a purse-string suture using straight Prolene thread. A transfixing-encircling ligature is performed using silk thread to form a double ligation, followed by a seromuscular suture.

Protection of the anastomotic part, subcutaneous drain, and wound closure

The gastric greater omentum is wrapped to the anastomotic part. In particular, tucking it down the side of the membranous portion is attempted. After rinsing with 1 L of warm saline, the gastric tube is drawn from the abdominal side. Low pressure suction drain indwelling near the anastomotic part is placed, and the platysma muscle is sutured under the skin with 4-0 absorbable thread.

Results

Postoperative achievement

Anastomotic leakage in cases using this method was 3/60 cases (5%). Postoperative stenosis was observed in approx. 5% cases. However, improvement could be achieved by multiple endoscopic balloon dilatation.

After priority anvil attachment, stable circular stapled anastomosis by inserting the remaining esophagus is possible regardless of the length of the elevated gastric tube.

Discussion

There are many papers regarding anastomotic leakage and stricture rates after esophagectomy, which compare location (chest *vs.* neck), route (SR *vs.* PM), organ for reconstruction (stomach *vs.* colon) and method (hand sewn *vs.* CS *vs.* LS) (1,4-15) (*Table 3*). A recent Japanese nationwide web-based database study targeting 5,354 esophageal cancer patients indicated that the frequency of leakage remains high (1). Gooszen *et al.* mentioned that intrathoracic anastomosis was associated with lower rates of anastomotic leakage and recurrent nerve paresis (4) (*Table 1*). Niwa *et al.* repoted that no patients who underwent thoracic anastomosis (87 patients) by CS developed anastomotic leakage in (5). This may explain the shorter hospital stay observed among patients with an intrathoracic anastomosis than that for patients with a cervical anastomosis.

However, anastomotic leakage in patients with an intrathoracic anastomosis received a longer intensive care and hospital stay. Intrathoracic anastomotic leak used to be associated with a high postoperative mortality of 60% (16). This suggests that the clinical course in patients with an intrathoracic anastomotic leak is indeed more severe. Recently, anastomotic leak is accurately eliminated by computed tomography (CT) (6) and endoscopic, radiologic and surgical possibilities for treatment of

Table 3 The reported rate of leakage and stricture by anastomotic methods

Author	Region	Method 1	Method 2	Method 3	Leakage, %	Stricture, %
Feng F	Neck	HS	End to end	Albert-lembert	3.36	5.04
Feng F			End to end	Hybrid layered	12.61	13.51
Nederlof N			End to end		22	40
Nederlof N			End to side		41	18
Niwa Y		Circular (CS)	End to side		1.47	
Makino H					5.00	10
Tanaka T						13.60
Huang C					19.00	23.50
Gooszen JA		CS or HS			21.90	
Zhou D		Not described		Omentoplasty (+)	4.60	
Zhou D				Omentoplasty (–)	15.10	
Ben-David K		Linear (LS)	Side to side		8.50	
Huang C			Delta		7.70	2.60
Harustiak T	Chest	Hand sewn (HS)	End to end		20.90	20.30
Kang N			End to side		2.79	
Niwa Y		Circular (CS)	End to side		0	
Jeon HW					3	
Gooszen JAH		CS or HS			17	
Ben-David K		Linear (LS)	Side to side		4.4	
Harustiak T		Linear	Side to side		10	6.30

HS, hand sewn; CS, circular stapler; LS, linear stapler.

intrathoracic anastomotic leakage have become available, and it is now considered a manageable complication. Endoscopic vacuum therapy, clipping by endoclip or Over-the-Scope Clip (OTSC) and stent implantation with self-expandable covered metal stent are reported (16-21). Benefits of intrathoracic anastomosis include a lower incidence of anastomotic leakage and possibly a lower incidence of benign strictures requiring dilatation.

Benefits of cervical anastomosis are said to be the possibility of a wider resection margin and less severe complications in cases of anastomotic leakage. Moreover, cervical anastomosis carries a higher risk for anastomotic leakage than intrathoracic anastomosis. van Workum *et al.* described that both anastomotic locations have possible benefits (21). Historically, the cervical anastomosis was introduced in order to minimize the disastrous effects of intrathoracic anastomotic leakage. While cervical anastomotic leakage can be managed by bedside opening in some cases, severe intrathoracic complications have been reported. During an esophagectomy, cervical esophagogastric anastomosis is commonly preferred since it eliminates the risk of postoperative mediastinitis due to intrathoracic anastomotic leaks, which are often associated with fatal consequences. Recently, development of a double-layer esophago-gastric anastomosis method using 3-0 absorbable barbed sutures have been also reported (7).

Reconstruction in most patients undergoing esophagectomy is performed using a gastric conduit with a preserved right gastroepiploic artery route via the PM. As previously reported, the PM route has the advantages of a shorter distance to the cervical esophagus, improved blood supply at anastomosis, lower rates of perioperative complications, fewer anastomotic leaks and strictures, and improved mortality compared to SR or anterior mediastinal routes (AR). Conversely, the SR route avoids potential issues related to tumor recurrence, including obstruction

and increased morbidity of salvage radiation. The SR route also lends itself well to staged operations and improved access to strictures. The surgical effect of SR and PM routes in the recession of esophageal carcinoma is currently subject in a clinical study. Currently, both SR and PM routes are commonly used for gastric tube upward lifting. Some scholars believe that the use of the PR route has advantages of a shorter anastomosis distance and greater operating convenience. However, other scholars believe that isolation of the retrosternal gap is safe, fast, and very convenient for stomach lifting (8,9).

Almost all investigators used stomach as reconstructive organ after esophagectomy. Mine *et al.* reported that the rate of leakage is 5.4% and no mortality was recorded during the period from 1998 to 2008, when ileocolon grafts evolved as the primary choice for interposition. Based on these results, they consider the application of colon interposition after esophagectomy with extended lymphadenectomy feasible (10).

Prospective randomized trials conducted by Saluja *et al.* reported that the incidence of anastomotic leak and stricture are comparable between hand sewn and stapled anastomosis (11). Their results indicated that both hand sewn and stapled anastomotic techniques are equally effective when performing a cervical esophagogastric anastomosis although the stapled technique is more expensive than hand sewn technique. Harustiak *et al.* reported that LS anastomosis had an overall leakage rate of approximately half that of HS anastomosis (12). However, major leaks were not significantly reduced using LS. This may be explained by the fact that the LS technique reduced the incidence of minor leaks but not major ones. Minor leaks are often caused by a small defect in anastomosis, which is sealed off by the surrounding tissue. Feng also mentioned that HS anastomosis including end-to-end (ETE) and end-to-side (ETS) anastomosis has become the procedure of choice for some surgeons (7). A recent prospective randomized trial by Nederlof *et al.* reported that ETS HS anastomosis was associated with a higher anastomotic leakage rate, while ETE hand sewn anastomosis was associated with a higher anastomotic stricture rate (13).

Ben David showed minimally invasive esophagectomy (MIE) utilizing a linear stapled side-to-side anastomosis and the rates of anastomotic leak were 4.4% for Ivor-Lewis and 8.5% for McKeown resection (14).

Huang *et al.* observed a decrease in anastomotic leakage in delta-shaped anastomosis (DSA) by the LS group compared to the CS group, although the difference was not statistically significant. Application of LS for cervical esophagogastric anastomosis can effectively reduce anastomotic complications compared to conventional HS anastomosis (15).

Patients with anastomotic leakage often develop an anastomotic stricture. Several studies have shown that the LS technique has a lower frequency of anastomotic stenosis than the CS technique (12,14,15).

Zhou *et al.* described that omentoplasty decreased anastomotic leakage rates for cervical anastomosis and a significant difference in anastomotic stricture occurrence between patients who underwent omentoplasty and those who didn't was not demonstrated, proving that anastomotic leakage and leakage associated mortality can be markedly reduced with the help of a pedicled omental graft technique (22).

In a study demonstrated by Feng *et al.*, anastomotic stricture developed in 6 out of 119 patients (5.04%) in the hybrid-layered suture group, which was significantly lower than that for the Albert-Lembert suture group (13.51%) (7). Anastomotic strictures are mainly associated with the following factors, including anastomotic technique, surgeon specialty and anastomotic leakage (23).

The CS anastomosis technique is considered to be useful for shortening operation time and reducing anastomotic leakage compared to hand-sewn anastomosis (24,25).

Our data also showed the lower rate (5%) of anastomotic leakage (*Table 2*). Niwa *et al.* showed the rate of leakage is only 3.9% in the cervical site and 0% in the thoracic site using circular stapler.

This appears to be a safe, effective, and straightforward surgical technique with improved short-term outcome, such as lower anastomotic leak and stenosis rate.

Conclusions

Anastomosis by circular stapler after priority attached anvil can be performed easily and quickly, with lower risk of anastomotic leakage. Moreover, from the insurance standpoint, a stapler is targeted for addition, so this technique is not considered to pose a problem with regards to medical costs.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jovs.2018.08.01). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Ethics Board of Nippon Medical School, Tama Nagayama Hospital (approval ID number is 499), and written informed consent was obtained from all patients.

References

1. Takeuchi H, Miyata H, Gotoh M, et al. A risk model for esophagectomy using data of 5354 patients included in a Japanese nationwide web-based database. Ann Surg 2014;260:259-66.
2. Makino H, Yoshida H, Maruyama H, et al. An original technique for lymph node dissection along the left recurrent laryngeal nerve after stripping the residual esophagus during video-assisted thorocoscopic surgery of esophagus. J Vis Surg 2016;2:166.
3. Makino H, Maruyama H, Yokoyama T, et al. The video shows anastomosis of the stomach to the cervical esophagus using a circular stapler after priority attachment of anvil. This modified technique for cervical esophagogastric anastomosis can be performed easily at the narrow neck site. Asvide 2018;5:699. Available online: http://www.asvide.com/article/view/26518
4. Gooszen JA, Goense L, Gisbertz SS, et al. Intrathoracic versus cervical anastomosis and predictors of anastomotic leakage after oesophagectomy for cancer. Br J Surg 2018;105:552-60.
5. Niwa Y, Koike M, Hattori M, et al. Short-term outcomes after conventional transthoracic esophagectomy. Nagoya J Med Sci 2016;78:69-78.
6. Goense L, Stassen PM, Wessels FJ, et al. Diagnostic performance of a CT-based scoring system for diagnosis of anastomotic leakage after esophagectomy: comparison with subjective CT assessment. Eur Radiol 2017;27:4426-34.
7. Feng F, Sun L, Xu G, et al. Albert-Lembert versus hybrid-layered suture in hand sewn end to-end cervical esophagogastric anastomosis after esophageal squamous cell carcinoma resection. J Thorac Dis 2015;7:1917-26.
8. Lv B, Tao YZ, Zhu Y, et al. Comparison of the outcomes between thoracoscopic and laparoscopic esophagectomy via retrosternal and prevertebral lifting paths by the same surgeon. World J Surg Oncol 2017;15:166.
9. Moremen JR, Ceppa DP, Rieger KM, et al. Substernal reconstruction following esophagectomy: operation of last resort? J Thorac Dis 2017;9:5040-45.
10. Mine S, Udagawa H, Tsutsumi K, et al. Colon Interposition After Esophagectomy With Extended Lymphadenectomy for Esophageal Cancer. Ann Thorac Surg 2009;88:1647-53.
11. Saluja SS, Ray S, Pal S, et al. Randomized trial comparing side-to-side stapled and hand-sewn esophagogastric anastomosis in neck. J Gastrointest Surg 2012;16:1287-95.
12. Harustiak T, Pazdro A, Snajdauf M, et al. Anastomotic leak and stricture after hand-sewn versus linear-stapled intrathoracic oesophagogastric anastomosis: single-centre analysis of 415 oesophagectomies. Eur J Cardiothorac Surg 2016;49:1650-9.
13. Nederlof N, Tilanus HW, Tran TC, et al. End-to-end versus end-to-side esophagogastrostomy after esophageal cancer resection: a prospective randomized study. Ann Surg 2011;254:226-33.
14. Ben-David K, Tuttle R, Kukar M, et al. Minimally Invasive Esophagectomy Utilizing a Stapled Side-to-Side Anastomosis is Safe in the Western Patient Population. Ann Surg Oncol 2016;23:3056-62.
15. Huang C, Xu X, Zhuang B, et al. A comparison of cervical delta-shaped anastomosis and circular stapled anastomosis after esophagectomy. World J Surg Oncol 2017;15:31.
16. Persson S., Rouvelas I, Irino T, et al. Outcomes following the main treatment options in patients with a leaking esophagus: a systematic literature review. Dis Esophagus 2017;30:1-10.
17. Hwang JJ, Jeong YS, Park YS, et al. Comparison of

Endoscopic Vacuum Therapy and Endoscopic Stent Implantation With Self-Expandable Metal Stent in Treating Postsurgical Gastroesophageal Leakage. Medicine (Baltimore) 2016;95:e3416.
18. Sisman G, Baran B. Placement of a Self-Expanding Metal Stent to Treat Esophagogastric Benign Anastomotic Stricture via Retroflexed Ultrathin Endoscopy: A Case Report with a Video. Clin Endosc 2015;48:428-30.
19. Heits N, Bernsmeier A, Reichert B, et al. Long-term quality of life after endovac-therapy in anastomotic leakages after esophagectomy. J Thorac Dis 2018;10:228-40.
20. Makino H, Miyashita M, Nomura T, et al. Successful endoscopic clipping and application of fibrin glue for an esophago-mediastinal fistula after an esophagectomy. Esophagus 2011;8:113-7.
21. van Workum F, Bouwense SA, Luyer MD, et al. Intrathoracic versus Cervical Anastomosis after minimally invasive esophagectomy for esophageal cancer: study protocol of the ICAN randomized controlled trial. Trials 2016;17:505.
22. Zhou D, Liu QX, Deng XF, et al. Anastomotic reinforcement with omentoplasty reduces anastomotic leakage for minimally invasive esophagectomy with cervical anastomosis. Cancer Manag Res 2018;10:257-63.
23. Tanaka K, Makino T, Yamasaki M, et al. An analysis of the risk factors of anastomotic stricture after esophagectomy. Surg Today 2018;48:449-54.
24. 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. [Epub ahead of print].
25. Jeon HW, Park JK, Song KY, et al. High Intrathoracic Anastomosis with Thoracoscopy Is Safe and Feasible for Treatment of Esophageal Squamous Cell Carcinoma. PLoS One 2016;11:e0152151.

doi: 10.21037/jovs.2018.08.01
Cite this article as: Makino H, Maruyama H, Yokoyama T, Hirakata A, Kikuchi Y, Iwai T, Yoshioka M, Ueda J, Takata H, Yoshida H. Modified technique for cervical esophagogastric anastomosis by circular stapler after priority attachment of the anvil in the narrow neck region. J Vis Surg 2018;4:177.

