

## Experience with a Novel Technique of Stapled side side cervical esophagogastric anastomosis using two linear cutting staplers in Ca Oesophagus

### Authors:

**Tarun Kumar Batra<sup>1</sup>, Manjot Kaur<sup>2</sup>, Mandar Tilak<sup>3</sup>**

1 Associate Professor, Department of Surgical Oncology, Institute of Medical Sciences (IMS), BHU- Banaras Hindu University; Varanasi, Uttar Pradesh, India.

2 Resident Fellowship at GI Surgical Oncology, Institute of Medical Sciences (IMS), BHU- Banaras Hindu University; Varanasi, Uttar Pradesh, India.

3 Resident (MCH) Surgical Oncology, Institute of Medical Sciences (IMS), BHU- Banaras Hindu University; Varanasi, Uttar Pradesh, India.

### Corresponding Author:

Manjot Kaur, MS, First year Resident Fellowship GI Surgical Oncology, Institute of Medical Sciences (IMS), BHU- Banaras Hindu University; Varanasi, Uttar Pradesh, India – 221005.

**Email address:** drmanjotkaurbhinder05@gmail.com

### Abstract

**Background:** Anastomotic leak from cervical esophagogastric anastomoses is a serious problem after esophagectomy. Various modifications of anastomotic techniques have evolved to minimize anastomotic complications. This study presents the technique of cervical esophagogastric anastomosis using linear cutting staplers and experience with the technique compared to the hand-sewn anastomosis.

**Materials and Methods:** 105 patients with oesophagus or gastroesophageal junction carcinoma underwent curative-intent resection either via a right posterolateral thoracotomy (TTE) or transhiatal esophagectomy or video-assisted thoracoscopic surgery. 57 patients were treated with linear stapler technique (Group A) and 48 patients were treated with hand-sewn anastomosis (Group B). The average follow-up was approximately 18 months.

**Results:** Anastomotic leakage was observed in one patient (1.75%) in linear anastomosis technique and thirteen patients (27.7%) in hand-sewn technique. There was no incidence of anastomotic site stricture in group A. In contrast, three patients (6.25%) had post anastomotic stricture in group B. Early postoperative morbidity in the form of respiratory infections was seen in 15 patients in linear stapler group as compared to 8 patients in the hand-sewn group.

**Conclusion:** The linear-stapled esophagogastric anastomosis is a safe and effective anastomotic technique, which can decrease the rate of leak, postoperative dysphagia, and anastomotic stricture. This technique uses only 2 linear staplers whereas other techniques use

three or more staplers which are also cost-effective. The procedure deserves more attention and further application.

**Keywords:** Carcinoma Oesophagus, stapled cervical esophagogastric anastomosis, Hand-sewn anastomosis

### **Introduction**

Carcinoma of the esophagogastric junction and the lower oesophagus is a multifaceted and complex disease with a high social and financial burden on global healthcare systems.<sup>1</sup> It is one of the most challenging malignancies to cure or palliate. Surgery is the primary curative treatment modality for the carcinoma of the mid and lower oesophagus and gastro-esophageal junction. After the excision of tumors either by trans-thoracic (McKeown's) or trans-hiatal route using an open or minimally invasive method, cervical esophagogastric anastomosis is the endpoint.<sup>2</sup> Besides the early postoperative pulmonary complications, the anastomotic leakage is the Achilles' heel point of oesophagus cancer surgery. A leak rate of 15-25% is observed in cases of cervical esophagogastric anastomosis.<sup>3-4</sup> To lower the complication of the leakage incidence, various anastomotic techniques have evolved over some time. These techniques developed from hand-sewn to partially and stapled anastomosis techniques.<sup>5</sup> Although these techniques advanced with time, with fewer complications, there is still no standard proven technique of esophagogastric anastomosis treatment. This study presents a technique and our experience of side-to-side stapling of esophagogastric anastomosis using two linear cutting staplers, a proposed minimal incidence of the leak, and a late anastomotic stricture rate.

### **Materials and Methods**

This is a retrospective analysis of patients with carcinoma of the esophagus treated at Institute of Medical Sciences (IMS), BHU- Banaras Hindu University; Varanasi, Uttar Pradesh, India between January 2017 to Dec 2019. Institutional research and ethics committee approval was secured for the study as per the standard protocols of the institute. Written informed consent of the patients were taken before the commencement of the study. Patients who were suffering from carcinoma of the mid and lower esophagus, and Siewert Class I gastroesophageal junction tumor was included in the present study. Patients were treated either upfront or post neoadjuvant chemotherapy or neoadjuvant chemoradiation, as per standard guidelines.

Curative surgery, either McKeown's transthoracic esophagectomy (open or minimally invasive – thoracoscopy assisted method) or trans hiatal esophagectomy, was performed. Post excision of the tumor completely stapled cervical esophagogastric anastomosis was performed side-to-side using two linear cutting staplers. (one 55mm and one 75 mm green cartridge)

## Procedure

After completion of esophagectomy, a 4-5cm wide gastric conduit was constructed and brought via the posterior mediastinum into the cervical incision. A stapled cervical esophago-gastric anastomosis was performed in the following manner:

- 1) At least a minimum of 6cm length of proximal esophageal remnant should be left behind.
- 2) A 1.5cm longitudinal opening was made on the posterior wall of the gastric conduit. Then the posterior wall of the esophageal remnant and gastric conduit was approximated with four sutures, one at each end and two in the middle.
- 3) A linear cutting stapler with a 55mm green cartridge was fired along both posterior walls. A 4cm stapled opening was created between the posterior wall of the esophagus and gastric conduit. The stapled opening retracts to form a V-shaped pathway between the both. (figure 1)
- 4) The anterior wall of the esophagus and gastric conduit opening was approximated using five sutures, three in the middle and one at each end in 10, 12, and 2 o'clock direction.
- 5) Transversely, a linear cutting 75mm green stapler was fired so that anastomosis between the anterior wall of the esophagus and both the walls of the gastric conduit took place. The poorly vascularized distal redundant end of gastric conduit was also transected. (figure 2)
- 6) No cervical drain was placed.



Fig 1: Anastomosis of posterior layer of stomach conduit and cervical esophagus

Fig 2: Anastomosis of anterior later of gastric conduit with cervical esophagus

Post-operatively, patients were followed to assess any anastomotic leakage and various other complications like respiratory compromise, hemorrhage, and wound infection. The signs suspected anastomotic leakage of redness, swelling, or crepitus at the incision site. If anastomotic leakage has been observed, then a cervical incision was made to allow its drainage. In case of no leakage, oral gastrograffin swallow was used to rule out any

radiological findings of leakage. After ruling out anastomotic leakage, oral intake was started for the patients.

Apart from the complication of anastomotic leakage, pulmonary morbidity (chest infections) and hemorrhage at the anastomotic site were also noted. The minor causes of morbidity were not considered. Within 90 days of surgery, the mortality rate in patients was also noted. Post anastomotic strictures were considered only if they were symptomatic and required endoscopic dilatation. The data obtained from 57 stapled technique treated patients were then compared with data collected from 48 previously treated patients in the department using handsewn anastomosis.

### **Statistical analysis:**

The data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) for Windows 26.0. (SPSS, Inc. Chicago, Illinois) Confidence intervals were set at 95%, and a p-value  $\leq$  of 0.05 was considered statistically significant. Independent t-test was applied to compare 2 years retrospective data collected from previously treated cases in the Department of Oncosurgery using handsewn anastomosis.

### **Results**

A total of 57 patients were operated using stapled cervical esophagogastric anastomosis (CEGA) for carcinoma of the esophagus. Out of 57, 35 (61.40%) were males, and 22 (38.59%) were females, respectively. 30 (52.63%) patients were suffering from squamous carcinoma, and 27 (47.37%) had adenocarcinoma. 36.84% had tumors in the mid-thoracic region, 33.33% of the patients had lower thoracic, and 29.82% had gastroesophageal junction tumors. 52% of the patients were suffering from stage III, 38% with stage II, and 10% with stage I carcinoma. Before subjecting patients to surgical intervention, albumin levels were checked. Those having low albumin levels were given nutritional supplementation pre-operatively. Around 8 (14.03%) patients were directly subjected to surgery (upfront cases), whereas 49 (85.96%) patients had undergone surgery after undergoing neoadjuvant therapy (chemotherapy was given to 87.75% patients and concurrent chemoradiation in 12.24% patients). Open trans-thoracic esophagectomy (McKeown) was done in 61.40% of patients; thoracoscopy assisted esophagectomy in 21.05% of patients while open trans-hiatal esophagectomy in 17.5% of patients. The average operative time was recorded to be around 224 min with an average intraoperative blood loss of 340cc. The average follow-up was approximately 18 months.

A postoperative cervical esophagogastric anastomotic leak was seen in only one patient (1.75%). There was no incidence of post anastomotic stricture. The Median follow-up was 18 months. The present study results using the stapler technique were compared with records collected retrospectively from patients before 2017; who were operated on with hand-sewn technique. (Table no 1). The patient characteristics were similar, and there was no selection bias. There was no statistically significant difference in early 90 days post-operative mortality (8.77 vs. 8.33%). Early postoperative morbidity was seen in 38.59% of patients in stapled group and 44.9% in the hand-sewn group, with no statistically significant difference (p-value > 0.05). The leading causes of morbidity were respiratory infection and

pneumonia. Cervical esophagogastric anastomosis leak was noticed only in 1 patient (1.75%) with stapled technique and in 13 (27.08%) patients treated with hand-sewn technique; with a significance level of  $p=0.045$ .

There was no incidence of symptomatic anastomotic stricture found in patients operated with stapled CEGA, which was statistically significantly ( $p$ -value  $< 0.00$ ) lower than cases of the stricture with hand-sewn CEAG. (6.25%) The results showed that stapled technique is a better Cervical esophagogastric anastomosis technique, with lesser complications and decreased rate of both anastomosis leak and stricture formation.

## Discussion

Management of oesophageal cancer has evolved since the last two decades with the advent of multi-modality treatment and minimally invasive and robotic approaches. Esophagectomy remains the primary treatment for early-stage oesophageal cancer.<sup>3</sup> The main postoperative complications of esophagectomy respiratory infections, lung collapse and consolidation, anastomotic leakage, stricture formation.<sup>6</sup>

The high leak rate (13-25 %) <sup>3,4</sup> in CEGA has been attributed to the poor blood supply of the distal end of the gastric conduit and due to tension on the anastomotic line.<sup>7</sup> CEGA leaks result in an anastomotic stricture due to fibrosis at the time of secondary healing. The late anastomotic stricture requires the need for repeated oesophageal dilatations to restore comfortable swallowing in patients.<sup>8</sup> This leads to increased late post-operative morbidity, poor quality of life, and an additional financial burden on the patient for further treatment. Hence, the technique of gastroesophageal anastomosis remains crucial.

The incidence of CEGA leakage with hand-sewn technique has varied between 15 % to 25%.<sup>3-4</sup> Over the years, there has been a continuous search for better anastomotic techniques. Techniques evolved from partial stapling to the stapled anastomosis. The use of stapling devices itself evolved from circular staplers to linear cutting staplers. Partially stapled cervical esophagogastric anastomosis using Linear Stapler was described by Collard et al.<sup>9</sup> and modified by Orringer et al.<sup>8</sup> While the stapled anastomoses are considered to be more expedient and less traumatic to the tissues, they also have lower leak and stricture rates with less morbidity.<sup>10</sup>

But still, insufficient evidence existed in the literature to definitively recommend linearly stapled (LS) anastomosis over handsewn cervical esophagogastric anastomosis. Thus, the primary objective of our paper was to explain the procedure of side to side linearly stapled (LS) anastomosis; and assess the success of the procedure by determining the leak rate, stricture formation, morbidity, and mortality rates. The data obtained from the LS technique was then compared with our previous study data<sup>5</sup> obtained from patients operated using handsewn anastomosis (HS).

The handsewn anastomosis is a skilled and time-consuming task taxing at the end of a lengthy, complex surgical procedure. The high anastomotic leak rate of hand-sewn anastomosis is decreased to about 2.7% using staplers in various studies.<sup>7,10-12</sup> Our study

showed a statistically significantly lower rate in the anastomotic leak in patients treated with stapled technique than handsewn, with a decrease rate of 93.54%. Similar results have been found in studies conducted by Wang et al.<sup>7</sup>, Saluja et al.<sup>10</sup>, Price et al.<sup>11</sup>, and Purkayastha et al.<sup>12</sup>, who also compared hand-sewn and linear stapler techniques of CEGA (Table 2). Thus, compared with the hand-sewn technique, totally stapled side to side CEGA using linear cutting staplers has a lower rate of anastomosis leakage. This could be because the stapled anastomosis is considered to be more expedient and less traumatic to tissues, LS sutures allow for reduced tension on the anastomosis without compromising gastric conduit microcirculation, and LS provides triple-layered staple construction that is less traumatic and more watertight than HS.<sup>12-15</sup> The surgical technique used in our study is stapled side to side anastomosis, in which the perpendicular staple lines enabled a wide conical anastomosis.<sup>16</sup> The triple-layered final anterior staple line was more secure and allowed excision of the poorly vascularized redundant distal end of the gastric conduit. The side-by-side stapled CEGA is quicker, easier, and less taxing at the end of a lengthy and complex surgery.<sup>17</sup> As compared to circular stapler or endo GIA stapler technique for CEGA, open linear cutting stapler which is relatively cost-effective and also does not require additional gastrotomy as in circular stapler technique.<sup>18</sup>

Besides leakage, the most important late complication of CEGA is posted anastomotic stricture. As stated earlier, anastomotic leakage causes inflammation and secondary healing, and fibrosis. This leads to subsequent narrowing and stricture. In the present study, it has been noticed that the anastomotic stricture formation rate is significantly reduced in stapled technique when compared with the hand-sewn method. No patient was reported to have anastomotic stricture when operated with side-to-side stapled technique, whereas the handsewn technique showed 6.25% stricture formation in our study. Similar results have been observed in studies conducted by Wang et al.<sup>7</sup>, Saluja et al.<sup>10</sup>, Price et al.<sup>11</sup>, and Purkayastha et al.<sup>12</sup> This could be due to the reason that with the use of side to side linear staples, the wide anastomosis is created with minimal tissue trauma and lesser incidence of the leak. LS anastomosis provides a larger cross-sectional area of esophagogastrostomy, reducing strictures and the subsequent need for later dilatation.<sup>8,12,19</sup>

In a Circular stapled anastomosis, the anastomosis cannot be dilated beyond the stapled line, and the staples can damage the endoscopic balloon dilator.<sup>20</sup> Whereas, Linear cutting stapler side to side anastomosis is wide, conical, and less prone to leak. It is also a quick and easy technique to learn. The application of the LS technique is usually easy and standardized such that the incidence of technical errors is minimized. This technique can be replicated at different surgical centers.

Thus, the present study, together with a previously published study<sup>5</sup>, reported a lower risk of post anastomotic stricture and leaked with LS technique. However, it is commonly accepted that avoidance of anastomotic complications is essential for minimizing early morbidity and maximizing long-term functional results and quality of life. The LS anastomosis has some drawbacks. This technique needs a longer oesophageal remnant. In the procedure of linear side-to-side stapled CEGA, the relative required length of proximal

esophageal remnant precludes its use in upper esophageal cancers. In high esophageal tumors with adequate resection margins, the proximal esophageal remnant is short and unsuitable for the benefit of side to side anastomosis. A randomized clinical controlled trial with large sample size is required to compare hand-sewn and different stapled anastomotic techniques.

### Conclusion

Fully stapled side to side cervical esophago-gastric anastomosis with two linear cutting staplers is a feasible, quicker, standardized, and cost-effective method with minimum leak rate and subsequent very low incidence post anastomotic stricture.

**Conflict of Interest:** None

**Funding:** None

### References

1. Finley RJ, Grace M, Duff JH. Esophagogastrectomy without thoracotomy for carcinoma of the cardia and lower part of the esophagus. *Surg Gynecol Obstet* 1985;160(1):49-56.
2. Dewar L, Gelfand G, Finley RJ, Evans K, Incelet R, Nelems B. Factors affecting cervical anastomotic leak and stricture formation following esophagogastrectomy and gastric tube interposition. *Am J Surg* 1992;163(5):484-9.
3. D'Journo XB, Thomas PA. Current management of esophageal cancer. *J Thoracic Dis* 2014;6(Suppl 2):S253–S264.
4. Deng XF, Liu QX, Zhou D, Min JX, Dai JG. Hand-sewn vs linearly stapled esophagogastric anastomosis for esophageal cancer: a meta-analysis. *World J Gastroenterol* 2015;21(15):4757-64.
5. Kumar T, Krishanappa R, Pai E, Sringeri R, Singh TB, Swain J, et al. Completely Linear Stapled Versus Handsewn Cervical Esophagogastric Anastomosis After Esophagectomy. *Indian J Surg* 2018;80(2):134-139.
6. Patel PK, Shah M, Patni S, Saini S. Cervical esophago-gastric anastomosis using linear cutter stapler in esophageal cancer. *Indian J Cancer* 2017;54(4):669-672.
7. Wang WP, Gao Q, Wang KN, Shi H, Chen LQ. A prospective randomized controlled trial of semi-mechanical versus hand-sewn or circular stapled esophagogastrectomy for prevention of anastomotic stricture. *World J Surg* 2013;37(5):1043–1050.
8. Orringer MB, Marshall B, Iannettoni MD. Eliminating the cervical esophagogastric anastomotic leak with a side-to-side stapled anastomosis. *J Thorac Cardiovasc Surg* 2000;119(2):277-88.
9. Collard JM, Romagnoli R, Goncette L, Otte JB, Kestens PJ. Terminalized semimechanical side-to-side suture technique for cervical esophagogastrectomy. *Ann Thorac Surg* 1998;65(3):814-7.
10. Saluja SS, Ray S, Pal S, Sanyal S, Agrawal N, Dash NR, et al. Randomized trial comparing side-to-side stapled and hand-sewn esophagogastric anastomosis in neck. *J Gastrointest Surg* 2012;16(7):1287-95.
11. Price TN, Nichols FC, Harmsen WS, Allen MS, Cassivi SD, Wigle DA, et al. A comprehensive review of anastomotic technique in 432 esophagectomies. *Ann Thorac Surg* 2013;95(4):1154-60; discussion 1160-1.

12. Purukayastha J, Kania HH, Talukdar A, Das G, Pegu N, Kalita D, Hand-sewn versus stapled cervical esophagogastric anastomosis for esophageal : A study of post operative clinical outcomes from a high-incidence center of northeast India. *J Cur Oncol* 2019;2(2):61-6.
13. Iannettoni MD, Whyte RI, Orringer MB. Catastrophic complications of the cervical esophagogastric anastomosis. *J Thorac Cardiovasc Surg* 1995;110(5):1493-500; discussion 1500-1.
14. Orringer MB, Marshall B, Iannettoni MD. Transhiatal esophagectomy: clinical experience and refinements. *Ann Surg* 1999;230(3):392-400; discussion 400-3.
15. Pines G, Buyeviz V, Machlenkin S, Klein Y, Laor A, Kashtan H. The use of circular stapler for cervical esophagogastric anastomosis after esophagectomy: surgical technique and early postoperative outcome. *Dis Esophagus* 2009;22(3):274-8
16. Okushiba S, Kawarada Y, Shichinohe T, Manase H, Kitashiro S, Katoh H. Esophageal delta-shaped anastomosis: a new method of stapled anastomosis for the cervical esophagus and digestive tract. *Surg Today* 2005;35(4):341-4.
17. Jo WM, Shin JS, Lee IS. Mid-term outcomes of side-to-side stapled anastomosis in cervical esophagogastric anastomosis. *J Korean Med Sci* 2006;21(6):1033-6.
18. Casson AG, Porter GA, Veugelers PJ. Evolution and critical appraisal of anastomotic technique following resection of esophageal adenocarcinoma. *Dis Esophagus* 2002;15(4):296-302.
19. Santos RS, Raftopoulos Y, Singh D, DeHoyos A, Fernando HC, Keenan RJ, Luketich JD, Landreneau RJ. Utility of total mechanical stapled cervical esophagogastric anastomosis after esophagectomy: a comparison to conventional anastomotic techniques. *Surgery* 2004;136(4):917-25.
20. Fok M, Ah-Chong AK, Cheng SW, Wong J. Comparison of a single layer continuous hand-sewn method and circular stapling in 580 oesophageal anastomoses. *Br J Surg* 1991;78(3):342-5.

**Table 1: Comparison of stapler anastomosis with hand sewn technique**

Type of anastomosis	Avg stage	Up Front Cases	Post Nact/ Naccrt cases	Mid thoracic tumor	Lower thoracic tumor	GE junction	Median Pre-Op Albumin	Median Intra-operative blood loss	Anastomotic Leak	Anastomotic stricture
Stapled anastomosis	III	8	49	20	18	19	4.3	340	1(1.75%)	0
Hand-sewn anastomosis	III	3	45	27	15	6	4.2	320	13(27.08%)	3(6.25%)

**Table 2: Comparison of Present Study with Previous Studies**

<b>Sr No</b>	<b>Study</b>	<b>Stapled</b>	<b>Hand Sewn</b>	<b>Anastomotic leak stapled</b>	<b>Anastomotic leak handsewn</b>	<b>Stricture stapled</b>	<b>Stricture hand sewn</b>
1	Singh et al <sup>3</sup>	34	43	1(3)	10(23)	6(18)	25(58)
2	Price et al <sup>4</sup>	57	260	21 (8%)	11(19%)	33	13
3	Saluja <sup>5</sup>	87	87	16	14	17/87	7/87
4	Sugimura <sup>6</sup>	127	127	3%	8%	15%	59%
5	Santos <sup>7</sup>	125	41	7(6%)	10(24%)	18%	45%
6	Mishra <sup>8</sup>	74	66	12	12	4.3%	16%
7	Present Study	57	48	1(1.75%)	13(27.77%)	0	3(6.25%)