



# The Role of Esophagogastric Anastomotic Technique in Decreasing Benign Stricture Formation in the Surgery of Esophageal Carcinoma

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## ABSTRACT

**Introduction:** Postoperative stenosis and dysphagia after esophageal carcinoma resection is the major problem. The aim of this study is to compare two types cervical esophagogastric anastomosis in reduction of stricture formation in esophageal cancer surgery. **Methods:** The subjects of this study were 223 patients undergoing esophageal carcinoma resection during 1998 to 2007. Twenty two patients were excluded from the study because of recurrent malignancy of anastomosis, mortality and losing in follow up period. Two hundred and one patients remained by the end of study were classified into two groups: 98 patients were treated by routinely transverse hand-sewn cervical esophagogastric anastomosis (group 1); and 103 patients were treated by the proposed oblique hand-sewn esophagogastric anastomotic technique (group 2). All the operations were with high abdominal and left cervical incisions (Transhiatal esophagectomy). All patients of both groups were followed up at least 6-month for detection of anastomotic strictures. **Results:** Postoperative dysphagia occurred in 20 patients of group 1 versus 5 patients of group 2. In working up by rigid esophagoscopy, two patients of group 2 and four patients of group 1 had not true strictures. Anastomotic strictures occurred in 16 cases of group 1, versus 3 cases of group 2. Statistical comparative analysis results of two groups about stricture formation were significant (3% versus 16%  $P=0.003$ ). **Conclusion:** The oblique hand-sewn esophagogastric anastomotic techniques reduce markedly the rate of stricture formation after esophagectomy.

## Introduction

Patient safety and acquiring skilled practice has always been of great importance for the physician of all eras.<sup>1-27</sup> Churchill and Sweet reported a series of esophageal resections with successful anastomosis with hand-sewn technique in 1942. Apart from the four common forms of esophageal resection transhiatal approach with gastric pull up (THE, Orringer) has been popular in our center. Dysphagia after transhiatal esophagectomy and cervical esophagogastric anastomosis is common and often related to anastomotic strictures. Recurrence of dysphagia after successful esophagectomy is a major problem affecting normal swallowing.<sup>28</sup>

Although the esophagogastric anastomosis can be hand-sewn or stapled, the former technique is an easier and cheaper technique compared to the later one. Transverse hand-sewn cervical esophagogastric anastomotic technique is common in some centers as ours.

The oblique hand-sewn cervical esophagogastric anastomosis has been being used in our center since

2002. In the present retrospective comparative study, the advantages of two above mentioned surgical methods in the surgery of esophageal carcinoma have been evaluated and discussed.

## Materials and Methods

### Study design

This study is a retrospective analysis of the medical records of patients with surgery of esophageal cancer admitted in our referral center, Thoracic surgery ward of Imam Reza Hospital affiliated to Tabriz University of Medical Science. This study compares two types of cervical hand-sewn esophagogastric anastomotic technique in formation of stricture after esophageal cancer surgery.

The study was carried out from 1998 to 2007 after being approved by ethical review board of Tabriz Medical Sciences University.

### Patients

From 1998 to 2007, two hundred and twenty three patients with proven esophageal carcinoma were enrolled in this

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study.

Inclusion criteria in the present study were (201 patients):

1. All types of esophageal cancers (Squamous cell carcinoma with 198 patients and 3 patients of adenocarcinoma) without preoperative radiotherapy treatment history, and absence of distant metastasis being confirmed by preoperative sonography or CT scan studding.
2. 98 patients with transverse hand sewn esophagogastric anastomosis.
3. 103 patients with oblique hand sewn esophagogastric anastomosis.

Twenty two patients were excluded from the study based on the following criteria:

- 6 patients with malignant stricture formation after both cervical hand- sewn esophagogastric anastomoses for esophageal cancer surgery.
- 13 patients with perioperative mortality (7 cases of transverse and 6 patients of oblique techniques),
- 3 patients were lost in follow up period.

201 patients were classified into two groups:

Group 1 patients were treated by using routine transverse hand-sewn cervical esophagogastric anastomotic technique for esophageal cancer surgery, and Group 2 patients were treated by oblique hand-sewn cervical anastomotic technique.

### Operative techniques

Surgical approaches used in both techniques were transhiatal esophagectomy with gastric pull up interposition used as an esophageal substitute and jejunostomy feeding tube. High midabdominal and left cervical incisions were performed gastric releasing and after esophageal resection the stomach was delivered through thoracic inlet into the left cervical area. Cervical esophagus was cut obliquely in group 2 with two centimeter distance from left recurrent nerve insertion while in group 1 it was cut transversely with the same distance from the left recurrent nerve. The surface diameter of oblique hand- sewn anastomosis of esophogastrectomy in the neck reached to 4.5-5.5 cm whereas transverse anastomosis had a diameter of nearly 3 cm. Cut surfaces were measured by sterilized steel ruler. Details of techniques of cervical esophagogastric anastomosis in both groups are illustrated in [Figure 1](#) and [Figure 2](#). Both hand- sewn anastomosis groups were accomplished using an interrupted two layer suturing with 3-0 vicryl in inner layers and 3-0 silk sutures in outer layers.

Since September 2002 the new "Oblique hand-sewn" technique started and results were compared with transverse technique regarding formation of anastomotic strictures. Diagnosis of benign anastomotic stricture was mad through complaint of dysphasia while solid, semisolid or fluid materials intake. The gold standard to assess and diagnose stricture formation was endoscopy

in our study. The true strictures were dilated using rigid esophagoscopy and gum tipped (Jackson woven) or Eder-Puestow dilators under sedation or general anesthesia, until a maximum diameter of 16-25 mm were achieved. In all of strictures, biopsies were also taken. Data were obtained from medical records and office records. Reflux symptoms, dysphagia, cervical anastomotic leak, strictures, second hospitalization for rigid esophagoscopy, anastomotic dilation and prognosis were studied. Discharged patients were followed up in outpatient clinic one, two, four, six and twelve months after the surgery. Usually surgeons assessed outcome of the surgeries and they were not blinded regarding the operative technique. Barium swallow was not given routinely in patients with dysphagia and endoscopy was also not routinely performed on asymptomatic patients for determining the degree of reflux. Only patients suffering from recurrent dysphagia were investigated and hospitalized for performing rigid esophagoscopy. Dilation was performed only if true strictures were present. Sometimes dilations were repeated if symptoms persisted.

### Statistical analysis

The primary endpoint was comparison of postoperative dysphagia in two groups and benign stricture rates were the main end points of study. Data were expressed as Mean $\pm$  SD & N (%). The Kolmogrov – Smirnov statistic was used for testing normality for continuous variables. Independent samples T test was used for continuous variables and Chi – square or Fisher exact test for nominal or ordinal variables. *P*-value less than 0.05 were considered statistically significant. The statistical package for social science (SPSS 15) was used for statistical analysis.

### Results

The demographic data of 201 patients who underwent hand-sewn anastomosis are listed in [Table 1](#). There were 57 (58.2%) males and 41 (41.8%) females in group 1, and 62 (60.2%) males, 41 (39.8%) females in group 2. Age distribution in group 1 were from 28 -81 years with a mean age of (60.84 $\pm$  10.64), and in group 2, from 35 -80 years with a mean age of (60.10 $\pm$  11.94) years.

Results of two esophagogastric anastomosis groups of this study were compared as follows: There were no significant differences in the age, sex distribution, site of lesions, associated illness, pathologic types of tumor and staging between two groups ([Table 1](#)).

Both groups of our patients have low percent of serum albumin (64% in group 1 versus 69% in group 2), anemia (38% in group 1 versus 41% in group 2), and hypoproteinemia with weak nutritional status (47% in group 1 versus 52% in group 2). Mean percent of serum albumin changes in group 1 and 2 were 19.02 $\pm$  5.35 and 21.85 $\pm$  5.11. Hb level changes in group 1 and 2 were 11.45 $\pm$  2.08 and 12.07  $\pm$  2.12. Nutritional status of both groups was below normal. The mean operative

**Table 1.** Patients characters in two groups

	Group 1	Group 2	P-value
Age (years)	60.84± 10.64	60.10± 11.94	0.64
Gender M/F	58/42	60/40	0.88
Site of lesion			
Upper third	6(6)	7(7)	0.89
Middle third	44(44)	46(46)	
Lower third	50(50)	47(47)	
Associated illness			
Diabetes	9(9)	12(12)	0.58
Hypertension	19(19)	26(26)	
Pathologic diagnosis			
SCC	83(83)	91(91)	0.14
ADC	17(17)	9(9)	
Pathologic stage			
Stage 0	0(0)	0(0)	0.13
Stage I	5(5)	2(2)	
Stage II	37(37)	28(28)	
Stage III	58(58)	70(70)	

**Table 2.** Postoperative complications and treatment in relation to anastomosis in two groups

	Group 1 (n)	Group 2 (n)	P-value
Postoperative leakage	33	24	0.21
Reflux	15	17	0.84
Dysphagea	20	5	0.002
True stricture	16	3	0.003
Successful dilation	13	3	0.016
Strictureplasty	1	0	0.50

time of group 1 patients were  $164.14 \pm 34.95$  (ranging 120-240 minutes) and of group 2 patients were  $156.02 \pm 39.32$  (ranging 128 to 250 minutes) ( $P=0.124$ ). Also there was no significant difference in the estimated blood loss between two groups (group 1,  $640.12 \pm 210.57$  ml vs.  $610.42 \pm 180.14$  ml of group 2,  $P=0.28$ ). Analysis of the duration of hospital stay revealed no significant difference of anastomotic techniques of two groups (oblique hand sewn techniques versus transverse were:  $12.25 \pm 4.86$  days versus  $13.49 \pm 4.20$  days;  $P=0.055$ ).

Analysis of the postoperative esophagogastric anastomotic leak rate was shown 24 (23.3%) patients in group 1 versus 13 (13.26%) patients in group 2 ( $P=0.03$ ). In general, anastomotic leak required hospitalization as following: a mean  $17.08 \pm 2.79$  days in group 1 compared to a mean of  $16.46 \pm 3.86$  days in group 2 ( $P=0.19$ ). All leaks of both groups were managed successfully by cervical drainage, followed by jejunostomy feeding tube alimentations and antibiotics. In rare cases of empyema, closed chest tube drainage was added to treatment.

There were 32 patients (16%) who had symptomatic reflux after transhiatal esophagectomy (15 patients in group 1 and 17 patients in group 2) with ( $P=0.84$ ).

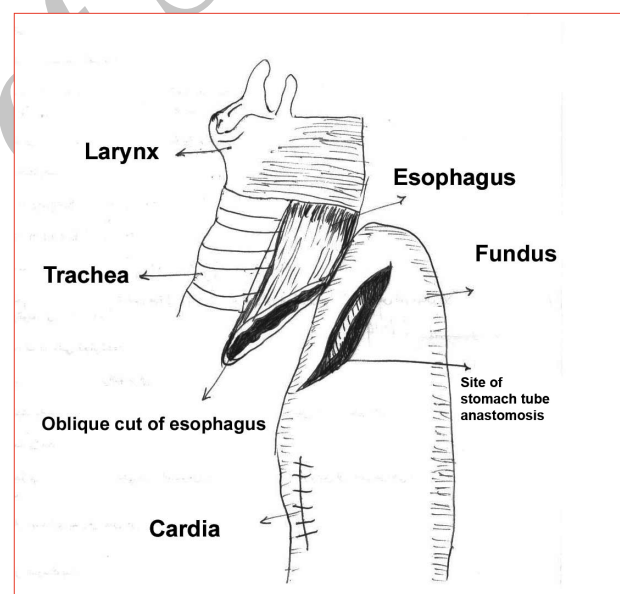
Dysphagia was found in 25 patients (12.5%), 20 patients in group 1 (20%), and 5 patients of group 2 (5%) during follow up period ( $P=0.002$ ). After workup and during rigid esophagoscopy, 16 patients of group 1 and three patients of group 2 had true anastomotic strictures ( $P=0.003$ ). Mean time of anastomotic strictures presentation was  $4.30 \pm 0.24$  month. After a minimum of two month follow up, the frequency of postoperative dilation between two groups were started (mean 3.5, ranging 1-6 month).

Comparison of anastomotic strictures, symptomatic reflux, dysphagia, true stricture during rigid esophagoscopy and response to dilations were shown in Table 2.

There was statistically significant difference between the incidence of anastomotic leak versus stricture formation in both groups ( $P=0.001$ ).

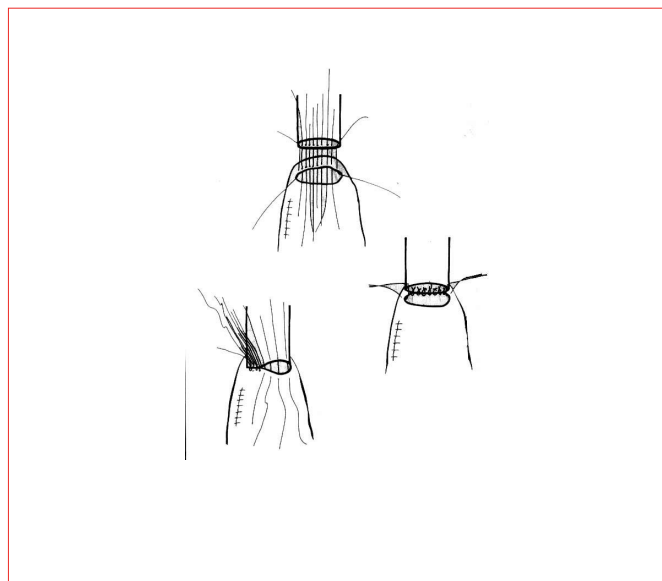
Postoperative caring between two groups is not different. Treatment of anastomotic strictures is performed by dilation (2-5 times in both groups) and preserves satisfactory in group 2, but three patients of group 1, were not responding satisfactorily to dilation.

One patient of group 1 was treated by surgical strictureplasty. After one year follow up period the results were not changed.

**Figure 1.** Oblique esophagogastric anastomosis after delivery of gastric graft through posterior mediastinum and thoracic outlet to cervical area.

## Discussion

The incidence of anastomotic complications after cervical esophagogastric anastomosis is high.<sup>29</sup> Using staplers helped to decrease intrathoracic esophagogastric anastomotic leak to below 5%, but similar results were not obtained with cervical anastomosis surgical technique is likely to play a major role in stricture formation.<sup>30-32</sup> Even today, most of the surgeons consider hand sewing techniques to be superior to the mechanical technique for esophagogastric anastomosis.<sup>31,33-34</sup> In one prospective



**Figure 2.** Transverse esophagogastric anastomosis technique after delivery of gastric graft through posterior mediastinum and thoracic outlet to cervical area.

randomized controlled clinical trial of Zhang's study in 516 patients showed markedly decreased stricture formation in hand sewn patients.<sup>35</sup> Conflicting reports exist regarding the superiority of hand sewn versus stapler sutures, but our purpose is not the comparison of hand sewn and mechanical stapled techniques.<sup>33</sup>

Stricture formation is one of the known complications of esophageal cancer surgery. Numerous factors have been proposed in the etiology of anastomotic leak of benign anastomotic strictures.<sup>32,36</sup> Therefore all the factors related to the incidence of anastomotic leaks may play a role in developing anastomotic strictures. Hypoalbuminemia, increased intraoperative blood loss, hypotension, hypoxemia are the known causes.

Both groups of our patients have low percent of serum albumin, anemia, and hypoproteinemia with low nutritional status because of advanced stages of esophageal carcinoma. Cardiovascular disease, gastric tube compared with colonic interposition and anastomotic leakage were also known causes for the development of benign cervical strictures.<sup>37</sup> Type of anastomosis is known to be the most important factors in occurring leak and postoperative strictures.<sup>38</sup> Dysphagia following esophagectomy with cervical esophagogastric anastomosis is common and often can be attributed to anastomotic strictures. Comparing one layer anastomosis with two layer anastomosis revealed a slightly higher rate of leak in one layer anastomosis, but incidence of stricture formation was found to be lower. Two layer hand- sewn esophagogastric anastomosis have shown a slightly higher rate of strictures than one layer anastomotic technique. Circular end to end anastomosis has shown a higher rate of associated strictures.<sup>32</sup> By selecting end to side semi mechanical anastomosis and creation of large cross-sectional area, Orringer and colleagues

reported a marked decrease in the need for postoperative dilations and treatment of strictures (48% to 35%).<sup>39</sup> By using oblique interrupted hand sewn anastomosis, we made large cross-sectional area in the anastomotic surface and obvious drop in occurring postoperative strictures happened. The interrupted two layer hand-sewn anastomotic technique method was used in both groups of our series. The operating time was not different between two groups.

Recurrent dysphagia after postoperative strictures usually responded to dilations.<sup>40</sup> We did not perform early endoscopic dilation in cases of leakage and all of dilations performed after happening of dysphagia. Some surgeons add a proton pump inhibitor to the patient's regimens to prevent recurrence dysphagia produced by exposure of acid and bile reflux.<sup>41</sup>

The cervical esophagogastric anastomosis has higher leak rates than intrathoracic anastomosis; the incidence is about 10-25%.<sup>42</sup> Our results may have mild high leakage rates especially in group 1. This can be explained by:

- o Using gastric tube interposition in all cases. Gastric tube interposition has higher rate incidence in comparison with colonic interposition.<sup>37</sup>
- o The impact of malnutrition and hypoproteinemia that was common in our patients because of high grade stages of esophageal carcinomas at admissions.
- o The impact of skill in performing esophagogastric anastomosis. Our center is a teaching hospital and near half of anastomosis was performed by residents.

The anastomotic technique has also the most significant bearing effect on stricture formation. In both groups tissue necrosis, inflammation and delayed epithelialization may predispose to excessive fibrosis and stricture formation. Dewar reported 31% strictures in his series.<sup>43</sup> Anastomotic leak after transhiatal esophagectomy had an obvious impact on morbidity, mortality and subsequently for dilation. In Schuchert study on esophagectomy for esophageal cancer surgery, he showed 30(13%) anastomotic leak and greater morbidity and stricture formation (57% vs. 19%). Increasing leak was associated with an increased need for postoperative anastomotic dilations.<sup>44</sup>

The incidence of anastomotic leakages and relation with true stricture formation in two groups of our study were shown in Table 2 ( $P=0.001$ ).

Most patients with symptomatic anastomotic strictures following esophagectomy and cervical esophagogastric anastomosis present within few month after surgery. Dilation is safe and most symptomatic patients relieve with a few dilation.

Most patients of both groups in our series who developed strictures responded to 2 to 5 dilations. They usually needed at less than 6-month during follow up period.

Gupta had studied in one hundred patients with



resectable esophageal carcinoma that were randomly distributed into two groups of 50 each and treated by one stage transhiatal esophagectomy. In one group (3×2 cm) gastric crescent was excised from the anterior wall of the gastric tube before constructing cervical esophagogastric anastomosis and wide cross sectional area achieved in anastomotic site. His study showed less anastomotic complications and stricture formation in this group).<sup>45</sup> Our study also gives a useful result that by creation of large cross-sectional area at the anastomotic site with oblique esophagogastric anastomosis an obvious decrease of strictures was obtained (3% in comparison with 16.3% of transverse esophagogastric anastomosis). In our study with acceptable resection margin rates, the recurrence rates were low for both techniques and also there was not any technical problem in doing oblique hand sewn anastomotic technique. We think by changing anastomotic techniques and creation of large cross-sectional anastomosis, the constant rate leaks could create fibrous formation but could not produce symptomatic strictures because of large diameter of anastomosis in oblique method.

This study has some limitations as following:

- Single center, retrospective nature and the possibility of biases present in the selection criteria that might have influenced the results.
- Surgeon preference of method with retrospective nonrandomized clinical study.
- The oblique esophagogastric anastomotic technique has been discussed to have advantage in decreasing stricture formation in this study. However, further experimental validation is necessary.
- Our results, however may gain wider acceptability if verified through more exclusive studies with larger sample series to confirm our results.
- Median survival rate were not assessed in our study. Determination of formal survival rate analysis may be needed.

## Conclusion

To reduce the benign stricture formation of esophagogastric anastomosis after esophageal cancer surgery, not only omitting anastomotic strictures leak causes are important, but also creation of wide cross-sectional area at anastomotic sites is also important. Hand sewn cervical esophagogastric anastomosis had priority in Kim's meta-analysis study.<sup>33</sup> This new hand sewn surgical technique is simple and may impact on decreasing the debilitating morbidity (dysphagia) in esophageal cancer patients.

**Competing interests:** The authors had no competing interests to declare in relation to this article.

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