GASTROESOPHAGEAL ANASTOMOSIS: SINGLE-LAYER VERSUS DOUBLE-LAYER TECHNIQUE—AN EXPERIENCE ON 50 CASES

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Background: Considerable controversy exists regarding the optimum technique for gastroesophageal anastomosis. Double layer technique has long been considered important for safe healing but there is evidence that single layer technique is also safe and can be performed in much shorter time. The purpose of this study was to compare the outcome of single layer and double layer techniques for gastroesophageal anastomosis. **Method:** A prospective randomized study was conducted in cardiothoracic unit, Lady Reading Hospital from Jan 2006 to Jan 2008. Fifty patients with oesophageal carcinoma undergoing subtotal oesophagectomy were randomized to have the anastomosis by single layer continuous or double layer continuous technique (group A (n=24) and B (n=26) respectively). The demographic data, operative and anastomosis time, postoperative complications and hospital mortality were recorded on a proforma and analyzed on SPSS 10. **Results:** There was no significant difference between group A and B in terms of age, gender, postoperative complications and duration of hospital stay. Anastomotic leak occurred in 4.2% patients in group A and 7.7% in group B (p=NS). Mean anastomosis time was 10.04 minutes in group A and 19.2 minutes in group B (p=0.0001). Mean operative time was 163.83 minutes and 170.96 minutes in group A and B respectively. Overall hospital mortality was 2%; no deaths occurred due to anastomotic leak. **Conclusion:** Single layer continuous technique is equally safe and can be performed in shorter time and at a lower cost than the double layer technique.

Keywords: Oesophagus, oesophageal neoplasms, anastomosis, suture technique

INTRODUCTION

Gastroesophageal (GE) anastomosis is the most frequently performed procedure in the thoracic surgery. Anastomotic dehiscence remains the main cause of morbidity and mortality after GE anastomosis.[1] The problem of the anastomotic leakage leading to fistula formation is disastrous and in developing countries like Pakistan, the management of such patient is an economic burden, both for the patient and the hospital.

The process of gut anastomotic healing mimics that of wound healing.[2] A leading role is played by the submucosa, where collagen synthesis and degradation takes place.[3] Most of the strength of the bowel wall resides in the submucosa and hence this is the only layer which provides mechanical strength to the anastomosis while other layers contribute very little; that is why sutures that don't stitch onto submucosa are unreliable.[4]

The role of the suture technique has long been emphasized. The controversy regarding single layer versus double layer anastomosis goes as far back as 19th century, when Halsted proposed interrupted single layer extramucosal anastomosis;[4] however this technique did not enjoy widespread usage initially. In 1880, Czerny advocated the use of two layers to reduce the risk of leakage and to achieve a precise mucosal approximation.[5] Senn in 1893 also suggested a two layer interrupted technique.[6] Since then, the technique has remained essentially unchanged except for the evolution of suture materials. Single layer continuous technique was first described by Hautefeuille in 1976.[7]

The objections against the traditional double layer anastomosis are that it ignores the principles of accurately apposing the clean cut edges and large amount of ischemic tissue is incorporated in the suture line which may increase the risk of leak. The inner layer increases the chances of strangulation of mucosa due to the damage to submucosal vascular plexus and the outer seromuscular layer may lead to narrowing at the site of anastomosis.[8] Many studies have reported that single layer anastomosis takes less time to create[9], allows more accurate tissue apposition[10], causes less damage to the vascularity of bowel wall[8] and less narrowing of the intestinal lumen.

The purpose of this study was to compare the outcome of single layer and double layer techniques for gastroesophageal anastomosis. Hypothesis of this study was that there is no difference between the two techniques in terms of anastomotic leak and that single layer anastomosis can be performed in less time and at lower cost than the double layer technique.

MATERIAL AND METHOD

This prospective, randomized study was conducted in cardiothoracic unit at Lady Reading Hospital, Peshawar from Jan 2006 to Jan 2008. The Ethical committee approval was obtained for this study.

The study included 50 patients of either gender and any age group with a diagnosis of oesophageal carcinoma undergoing subtotal oesophagectomy. Patients were randomized to have anastomosis constructed by single layer or double layer technique. Simple random sampling technique was used; 50 randomization cards containing the name of one or the other anastomotic technique were prepared, enclosed in opaque envelopes, sealed and mixed before the start of the study.

Randomization was done at surgery after the removal of the tumour and prior to gastroesophageal anastomosis.

Informed consent was taken from all the patients before including them in the study. Patients with serious medical co-morbidity, previous gastrectomy, preoperative chemoradiotherapy, tumours in the cervical and upper thoracic oesophagus, locally advanced tumours and metastatic disease on preoperative assessment were excluded from the study.

A detailed history and thorough physical examination were done. Investigations included blood complete, serum creatinine, urea, electrolytes, glucose, liver function test and serum albumin, electrocardiography, chest radiograph, pulmonary function test, barium swallow and meal, upper gastrointestinal endoscopy with biopsy, thoracic and upper abdominal intravenous and oral contrast enhanced computed tomography.

Preoperative management included deep venous thrombosis prophylaxis and Ceftriaxone Sodium 1 gram intravenously at the time of induction.

All the cases were operated upon by a senior surgeon. All the patients underwent subtotal oesophagectomy via left thoracolaparotomy with cervical GE anastomosis. The patients were placed in right lateral decubitus position with the left arm flexed at 90° to the body and placed in an arm rest. An oblique incision was made extending from a point midway between the umbilicus and the xiphisternum to costal margin. Resectability of the tumour assessed. The incision was then extended to the 7th intercostal space. Oesophageal hiatus was incised, vagi divided and oesophagus mobilized. Stomach tube, based on right gastroepiploic artery and right gastric artery was made with Vicryl 2/0 sutures. 14 G jejunostomy feeding tube was inserted in all the patients using Whitzel's technique.

A left cervicotomy was made along the anterior margin of sternomastoid. Sternomastoid and carotid sheath were retracted laterally; trachea and thyroid were retracted medially using finger only. Recurrent laryngeal nerve was identified and preserved. Dissection of oesophagus was carried out. The prepared gastric tube was gently pushed from below through the mediastinum and delivered to the neck. After adjustment of the length, the oesophagus was divided and the anastomosis made.

All single layer anastomoses were constructed using continuous 3/0 75 mm Vicryl suture. The sutures incorporated all the layers of the bowel wall. All double layer anastomoses were constructed using continuous 3/0 75mm Vicryl suture for inner layer (full thickness). Outer layer was constructed using the same suture in continuous fashion incorporating only seromuscular layer. Each bite of the suture was evenly placed about 4-5mm apart and at 5mm depth. Care was taken to avoid excessive tension on the suture while following it. The time for anastomosis began with the placement of first stitch and ended when excess suture from last stitch was cut. Calculations for the cost were based on the actual cost of the suture. One pack of 3/0 Vicryl suture was used for single layer technique and 2 packs for double layer technique.

Postoperatively patients were kept in ICU and shifted to general ward when stable. Jejunostomy feeding was started after 48 hours; nasogastric tube was removed on 4th postoperative day. Oral fluids were allowed on 5th postoperative day. Gastrograffin swallow study was performed on 7th postoperative day.

Patients were discharged after they remained stable for few days. Skin stitches were removed on 10th post operative day. Patients were referred to the oncologist for chemo-radiotherapy after 2 weeks.

Anastomotic leak was defined as the radiographic demonstration of leakage of contrast and or clinical evidence of leakage of gastrointestinal contents from the wound. Wound infection was defined as discharge of pus with or without systemic features. Postoperative hospital stay was defined as the number of days from the day of operation to discharge.

All the data was entered on a pre designed proforma which included: Demographic detail, operative findings, operating time, anastomotic time, operative and postoperative complications especially anastomotic leak, wound infection, cardiopulmonary complications, hospital mortality and duration of hospital stay.

The data was processed on the SPSS version 10. Student's *t*-test was used to analyse the continuous data. Fischer exact test was used to determine the statistical significance of categorical data. A *p*-value of less than 0.05 was considered significant.

RESULTS

This study was conducted in Cardiothoracic surgery unit at Lady Reading Hospital, Peshawar. The study included 50 patients with oesophageal carcinoma. Twenty-four patients were randomized to single layer anastomosis (group A) and 26 patients to double layer anastomosis (group B).

There were no significant differences in the age, gender distribution and nutritional status between the two groups. Demographic data is presented in Table-1.

Mean anastomosis time was 10.04 minutes in group A and 19.2 minutes in group B (p=0.0001). Mean operative time was 163.83 minutes in group A and 170.96 minutes in group B (p=0.015). Detail of the operative data is given in Table-2.

Postoperative complications were assessed. Main postoperative complications were anastomotic leak, aspiration pneumonia and wound infection. Anastomotic leak developed in one patient in the group A and two patients in group B, (p=NS). Overall anastomotic leak occurred in 6% patients. It settled with conservative management. Overall superficial wound

infection occurred in 10%. Detail of postoperative complications is given in Table-3.

No intraoperative deaths occurred. Postoperatively no patient died of anastomotic leak. One patient (3.8%) died from aspiration pneumonia in group B; overall hospital mortality was 2%.

Table-1: Demographic Data

Features	Group A (n=24)	Group B (n=26)	*p*-value
Age (years):			
Mean±SD	60.9±4.13	62.1±3.13	NS
Range	53–75	50–73	
Gender:			
Male	15 (62.5%)	14 (53.8%)	NS
Female	10 (41.6%)	12 (46.1%)	NS
Pathology:			
Adenocarcinoma	15 (62.5%)	16 (61.5 %)	NS
Squamous cell carcinoma	9 (37.5%)	10 (38.4%)	NS
Level of tumour:			
Middle	10 (41.6 %)	11 (42.3%)	NS
Distal	14 (58.3%)	15 (57.6%)	NS
Haemoglobin (g/dl):			
Mean±SD	10.5±0.80	10.4±0.75	NS
Range	8.7–12	8.7–11.8	
Serum albumin (g/L):			
Mean±SD	34.1±1.19	34.3±1.24	NS
Range	31–35.4	31–36	NS

Table-2: Operative data

Operative data	Group A (n=24)	Group B (n=26)	*p*-value
Operative time (minutes):			
Mean±SD	163.83±9.03	170.96±9.17	0.015
Range	150–185	155–195	
Anastomosis time (minutes):			
Mean±SD	10.04±1.37	19.2±1.93	0.0001
Range	7–12	15–22	
ICU stay (days):			
Mean±SD	3.25±1.36	3.73±1.37	NS
Range	2–7	2–6	
Postoperative hospital stay:			
Mean (days)±SD	12.6±2.87	13.1±3.44	NS
Range	10–20	10–23	

Table-3: Postoperative complications

Complications	Group A (n=24)	Group B (n=26)	*p*- value
Anastomotic leak	1 (4.2%)	2 (7.7%)	NS
Wound infection	2 (8.3%)	3 (11.5%)	NS
Aspiration pneumonia	1 (4.2%)	2 (7.7%)	NS
Transient hoarseness	2 (8.3%)	1 (3.8%)	NS
Hospital mortality	0	1 (3.8%)	NS

DISCUSSION

Esophagectomy is a major operation. Despite significant advances in the surgical technique and peri-operative management, complications are still frequent and are often lifethreatening.[11, 12] The most feared complication of oesophagectomy is anastomotic dehiscence.[13,14] It complicates up to 30% of esophagectomies[13] and is associated with considerable morbidity in terms of prolonged ICU and hospital stay, medical expenses and psychological trauma to the patient.[14,15] It also accounts for one third of postoperative deaths.[13–16]

Healing of the anastomosis depends upon many factors.[10,11] The anastomosis between the esophagus and its replacement conduit is particularly prone to leak than most other GI anastomosis.[12] This may be related to the intrinsic property of the esophagus i.e., absence of serosa and longitudinal orientation of the muscle fibers which hold the sutures poorly.[10,12]

Role of systemic factors is slightly controversial. Most of these factors have not been clearly predictive of anastomotic failure.[17,18] A prospective study on risk factors related to GE anastomosis leak has reported that age, hemoglobin, hypoproteinemia, diabetes, cardiopulmonary disease, cirrhosis and previous radiotherapy are statistically insignificant factors.[17] Technical factors such as tension on the anastomosis[13], vascularity of the gastric conduit,[13,14] surgeon's experience and hospital volume[19,20] seem to be more important.

Many authors agree that anastomotic technique is an important determinant of the outcome.[9,14,17,18] There is considerable debate about the technical details of hand sewn technique.[9] The conventional 2 layer technique was once very popular among surgeons and is still in common use because of the sense of security associated with it. However many studies have reported that single layer technique is equally safe.[9,11,13,21,22] There is no evidence to suggest that single layer technique leads to more anastomotic complications than the double layer technique.[9,11,13,21] In this study anastomotic leak occurred in 4.2% patients in group A and 7.7% in group B (*p*=NS). This is similar to that reported by Zieren *et al*.[21]

Anastomosis leak varies in its severity. The spectrum ranges from an occult leak (radiologic finding) with little or no impact on the management to clinically major leak and even conduit necrosis with life threatening septicaemia and MOF.[11,12] Management depends upon the severity of the leak. In majority of patients it is managed conservatively.[9,15,23,24] Surgical intervention is rarely required.[9,23] In this study all the patients with anastomotic leak were managed conservatively with opening the wound, daily irrigation and packing. No patient died of anastomotic leak. This is in agreement with other studies.[13,25]

Another important anastomotic complication is stricture formation.[26] Zieren *et al* has reported that single layer anastomosis is superior to double layer technique in terms of non malignant stricture formation.[21]

A drawback of double layer technique is that it is time consuming and tedious. Single layer anastomosis can be constructed in a much shorter time compared to double layer anastomosis.[9,10,27,28] Bardini *et al* in a prospective randomized study suggested that single layer continuous technique was associated with significantly less operative time.[29] In this study mean anastomosis time in group A was 10.04 minutes and

19.2 minutes in group B (p=0.0001) moreover, operative time was also less for single layer technique.

In this study single layer technique was found to be more cost effective (in terms of suture cost) than the double layer technique. Cost benefit of single layer technique has also been reported in other studies.[9-11, 27-29] Single layer anastomosis is more cost effective than stapled anastomosis. One pack of Vicryl suture used for single layer technique costs Rs. 200, whereas a circular stapler costs about Rs. 23,000 and is not even widely available here. The financial benefit of single layer anastomosis is thus especially important in our setup where most patients are very poor.

An important limitation of this study was the sample size; number of patients included in the study was too small to draw statistically sound conclusion; much larger series is required to assess the two techniques. Longer follow up is also needed to assess the long term outcome of the two techniques.

CONCLUSION

Single layer continuous technique is a safe technique. It can be performed in much shorter time and at a lower cost than the double layer technique. It should be used in preference to double layer method for gastroesophageal anastomosis.

This study was conducted as pilot study; further data collection is under process.

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