Comparison of Hand-Sewn and Stapled in Esophagogastric Anastomosis after Esophageal Cancer Resection: A Prospective Randomized Study

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Objective: *Compare the postoperative outcome of the hand-sewn method and the staple method of primary esophagogastric anastomosis after esophagectomy in patients with esophageal carcinoma. The study focused on leakage, stricture rates, operative time, blood loss, and complication.*

Material and Method: *A prospective randomized trial was undertaken in 117 patients with squamous cell carcinoma of the thoracic esophagus who underwent Ivor-Lewis esophagectomy. Patients were classified according to esophageal size, based on the diameter of the divided esophagus (< or > 30 mm) and then were randomized to have primary anastomosis using either hand-sewn or stapled method.*

Results: *The mean total operating time of esophagectomy when using hand-sewn technique and staple technique were 218.1 ± 47.8 minutes and 203.7 ± 23.4 minutes, respectively (p = < 0.001). The mean blood loss in the handsewn group and in the staple group was 864 ± 346.6 mls and 803 ± 301.2 mls, respectively (p = 0.02). Anastomotic leakage was 6.7% in the hand-sewn group and 3.4% in the staple group (p = 0.69). Pulmonary and cardiac complications were 13.5% and 16.9% in the hand-sewn group compared with 17.2% and 18.9% in the staple group (p = 0.77, p = 0.96). Anastomotic stricture was found in 10 of 52 patients (19.2%) in the handsewn group and 19 of 52 patients (36.5%) in the staple group (p = 0.08). In the patients with a small esophagus, the stricture rate was significantly lower in the hand-sewn group compared with the staple group (15.2% vs. 38.8%) (p = 0.03). Mortality rate in both groups were not significantly different (11.8% vs. 10.3%) (p = 0.97).*

Conclusion: *From the present study, it can be concluded that both hand-sewn method and the staple method in primary esophagogastric anastomosis after esophagectomy in the patients with esophageal carcinoma were safe. The stapled method had a higher incidence of anastomotic stricture especially small esophagus, whereas it consumed less operative time and less blood loss.*

Keywords: *Hand-sewn technique, Staple technique, Esophagogastric anastomosis*

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In conventional esophagectomy, using the stomach for restoring gastrointestinal continuity, the postoperative complication can be categorized in two phases. In the early phase, the important complications consist of anastomotic, pulmonary, and cardiac complication. In the late phase, anatomotic stricture was a crucial complication. Anastomotic dehiscence is associated with high mortality[1-3] in early postoperative period. The esophagogastric anastomosis can be performed with the hand-sewn method or the stapled method. Several retrospective[17-19] studies showed that both techniques were safe, but the stapled method was associated with higher stricture rate. The present study was a prospective randomized study designed to compare the result of the hand-sewn method and the staple method for primary esophageal anastomosis in esophagectomy at Suratthani Hospital.

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Material and Method

Between October 2000 and September 2005, 117 patients with carcinoma of the thoracic esophagus underwent Ivor-Lewis esophagectomy. Tumor removal was performed via right thoracotomy. The whole stomach was used as the substitute for esophagogastric reconstruction in all cases. Esophagogastric reconstruction was performed with the hand-sewn technique or using a circular stapler. After esophageal division, the outer diameter of the divided esophagus was measured. Based on the diameter of the esophagus, the patients were categorized into the large esophagus and the small esophagus. For each size of the esophagus, patients were randomized to have the anastomosis constructed by hand-sewn technique or by staple technique. By hand-sewn selected the patients in odd counter number and by stapler selected the patients in even counter number of running number. The hand-sewn anastomosis was accomplished with a single layer of continuous suture using absorbable multifilament (4:0 Vicryl). For stapled anastomosis intraluminal staple (ILS Ethicon), circular stapler was used. The size of the stapler was selected depending on the diameter of esophagus. ILS No 25 was used for esophagus-diameter less than 30 mm, whereas ILS No 31 was used for esophagus-diameter more than 30 mm. Patients were assessed for anastomotic leakage by gastrografin contrast study performed on day 7th after surgery. Diagnosis of benign anastomotic stricture was made by flexible endoscope if it was unable to pass the anastomosis and the malignant stricture was diagnosed on histological evidence. Patients were asked to follow up with the protocol of every month for three months and then at a 3-month interval. Perioperative morbidity and mortality, anastomotic leakage, benign anastomotic stricture rate, cardiopulmonary complication, septic complication, the operating time, blood loss, were the main endpoints of the present study. The statistical analysis was used Chi-square (x^2) or Fishes' exact test and Student-T test. Statistical analysis was significant when p was less than 0.05.

Results

There was no significant difference in age, gender, tumor location, and tumor staging between the two groups listed in Table 1. Forty patients in the staple group had a small esophagus-diameter and the remaining 18 patients had a large size esophagus as listed in Table 2. In the hand-sewn group, there were 51 patients with small size esophagus and eight patients with large esophagus as listed in Table 3.

The average duration of operation in the staple group was 203.7 $\pm$ 23.4 min shorter than the hand-sewn group (218.1 $\pm$ 47.8 min). Similarly, blood loss in the staple group was a significantly less amount than the hand-sewn group (803.4 $\pm$ 301.2 mls vs. 864.4 $\pm$ 346.6 mls). Anastomotic leakage, pulmonary complication, cardiac complication, and 30-day mortality are listed in Table 4. Anastomotic leakage developed in 4/59 patients (6.7%) the hand-sewn group and 2/58 patients (3.4%) in the staple group. Seven (11.8%) patients in the hand-sewn group died from anastomotic leakage with septic complication. In the staple group, six patients (10.3%) died with the same cause. Regarding pulmonary and cardiac complication, there was no statistical difference between both groups (13.5% vs. 17.2% and 16.9% vs. 18.9%) as shown in Table 4. There

Table 1. Demographic data of 117 patients who underwent a hand-sewn or a stapled esophagogastric anastomosis

	Hand-sewn (n = 59)	Stapler (n = 58)	p
Age (yrs) (mean)	63.6 (47-76)	62.0 (45-74)	0.21
Sex (M:F)	50:9	48:10	0.97
Location of tumor			0.52
Middle thoracic	31	26	
Lower thoracic	28	32	
Stage of tumor			0.72
I	1	2	
II	12	14	
III	46	42	

Table 2. Types of staple used in stapled esophagogastric reconstruction and hand-sewn group

Size	Esophageal diameter	
	< 30 mm	$\geq$ 30 mm
ILS 25	40	0
ILS 31	0	18

Table 3. Esophageal size in hand-sewn group

	Esophageal diameter	
	< 30 mm	$\geq$ 30 mm
Hand-sewn	51	8

Table 4. Perioperative data in both hand-sewn group and the staple group

	Hand-sewn (n = 59)	Stapler (n = 58)	p
Operating time (min)	218.1 (182-278)	203.7 (182-228)	<0.001**
Blood loss (ml)	864.4 (600-1300)	803.4 (500-1100)	0.02**
Anastomotic leakage (%)	4 (6.7%)	2 (3.4%)	0.69
Pulmonary complication (%)	8 (13.5%)	10 (17.2%)	0.77
Cardiac complication (%)	10 (16.9%)	11 (18.9%)	0.96
30-day mortality (%)	7 (11.8%)	6 (10.3%)	0.97

Table 5. Incidence of anastomotic stricture with anastomotic technique relate to esophageal size

	Hand-sewn	Stapler	p
< 30 mm	7/46 (15.2%)	14/36 (38.8%)	0.03**
≥ 30 mm	3/6 (50.0%)	5/16 (31.2%)	0.75
Total	10/52 (19.2%)	19/52 (36.5%)	0.08

Table 6. Incidence of mortality in each anastomotic technique relate to esophageal size

	Hand-sewn	Stapler	p
< 30 mm	5	4	0.56
≥ 30 mm	2	2	0.76
Total	7	6	0.29

were 7/59 patients in the hand-sewn group and 6/58 patients in the staple group who died in the perioperative phase as shown in Table 6. Therefore, there were 52 patients in each group alive for evaluation of the stricture complication. Anastomotic stricture in the hand-sewn group occurred less frequently than in the stapled group (19.2% vs. 36.5%) but there was no statistically difference (p = 0.08). However, in the subgroup of patients with a small esophagus, there was a statistical lower incidence of stricture in the hand-sewn group than in the staple group (15.2% vs. 38.8%) (p= 0.03) as shown in Table 5. There was no statistical difference in mortality related to the esophagus-size and anastomotic technique (Table 6).

Discussion

Controversies in the surgical treatment of esophageal cancer include operative approach, radicality of resection, multimodality therapy, and methods of reconstruction. Reconstructive options after esophagectomy can be categorized according to choice of conduit, location of anastomosis (thoracic or cervical), anastomotic method (hand-sewn or stapler), route of reconstruction (posterior or anterior mediastinum), and necessity of gastric drainage procedures (pyloroplasty, pyloromyotomy, or no drainage)[17].

For carcinoma of the thoracic esophagus, intrathoracic esophagogastric reconstruction is one method of choice performed after tumor removal. Anastomotic complication such as leakage after esophagectomy is a very serious complication that may result in high morbidity and mortality[7]. Anastomotic method has been thought to be one of the variables that may affect operative morbidity and postoperative bowel function[17]. However, several trials did not demonstrate any difference in incidence of anastomotic leakage between the hand-sewn technique and the staple technique. Mueller et al reviewed[21] 1201 papers on esophagectomy, they found that anastomotic leakage occurred 11% in the hand-sewn group (n = 8726) and 13% in the staple group (n = 1964) (p < 0.02). In other areas of upper gastrointestinal surgery, Seufert et al[16] demonstrated that staple technique and hand-sewn technique for esophageal anastomoses had equal results. With the present study complication of anastomotic leakage in the hand-sewn group and the staple group were not statistically different (6.7% vs. 3.4%, p = 0.69). Valverde et al,Law S et al,West Scotand et al[9-11] also reported that anastomotic leakage in hand-sewn technique and staple technique were not different.

The etiology of anastomotic leakage in esophagogastric reconstruction is multifactorial. Technical errors and occult ischemia of the mobilized gastric fundus are the two major causes[1-3]. Stapling device has been introduced for performing esophagogastric reconstruction at the difficult location such as the apex of the chest[4-7]. For these reasons, stapled technique of esophagogastric reconstruction has been favored by many experienced surgeons. However, the surgeon's skill and experience[1-3] are usually more important than

the choice of technique. Good blood supply of the gastric fundus is required for successful anastomotic healing.

Several randomized trials[8,9,11-15] reported a higher stricture rate after esophagogastric reconstruction in the patients using the staple technique. The reason for this is not clear. Nonrandomized studies[18,19] also found similar results. The use of the stapling device showed a lower incidence of leakage anastomosis. In this prospective study, the staple method had more stricture rate than the hand-sewn group in esophagogastric reconstruction. The incidence of anastomotic stricture was higher in the staple group compared with the hand-sewn group (36.5% vs. 19.2%) but there was no statistical significance ($p = 0.08$). Size of the esophagus might be an important factor that caused anastomotic stricture. The stricture rate occurred with a statistically higher incidence in the staple group than the hand-sewn group (38.8% vs. 15.2%; $p = 0.03$) that had statistical significance only in the patients with a small esophagus (Table 5). Recently, Law et al[20] found a very much higher stricture rate after esophagogastric reconstruction using the stapler (44%) in the patients with a small esophagus. The explanation for this may be from lacking of mucosa to mucosa apposition. The secondary healing by granulation tissue formation at the staple line may delay the epithelialization and may predispose to have excessive fibrosis resulting in more stricture formation. In contrast, the hand-sewn method allows mucosa to mucosa apposition and minimizes its tension. Therefore, there is less stricture rate in the hand-sewn group. Although there was a higher stricture rate in the staple group it took less operative time and less blood loss in the present study with statistical significance ($p = 0.001$ and $p = 0.02$ respectively) as shown in Table 4. Pulmonary complication, cardiac complication and 30-days mortality rate in both groups were not different but pulmonary and cardiac complication were the leading cause of postoperative death (Table 4).

Conclusion

As the incidence of perioperative morbidity and mortality for hand-sewn group and staple group were not different, the present study confirmed that both methods are safe for esophagogastric reconstruction. The hand-sewn technique was superior to the staple technique in the aspect of longterm stricture especially in the patients with a small esophagus. The benefit of the staple technique was less operating time and less blood loss.

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เปรียบเทียบการตัดต่อด้วยมือ และการใช้เครื่องมือตัดต่ออัตโนมัติในการเย็บหลอดอาหารหลังการผ่าตัดมะเร็งหลอดอาหาร

ประกอบ ลือชาเกียรติศักดิ์, ศุภพงศ์ เกษตรสุนทร

วัตถุประสงค์*: การศึกษานี้เพื่อเปรียบเทียบผลการผ่าตัดมะเร็งหลอดอาหารที่เย็บหลอดอาหารและกระเพาะอาหารโดยใช้มือและเครื่องมือตัดต่อ อัตโนมัติเปรียบเทียบในเรื่องอัตราการรั่ว, การตีบของหลอดอาหาร, เวลาการผ่าตัด, การเสียเลือดและภาวะแทรกซ้อนต่าง ๆ*

วัสดุและวิธีการ*: เป็นการศึกษาเปรียบเทียบแบบสุ่มมีตัวควบคุมในผู้ป่วยจำนวน 117 ราย ที่เป็นมะเร็งหลอดอาหารในช่องอก และได้รับการผ่าตัดและตัดต่อมะเร็งหลอดอาหารในช่องอกผู้ป่วยถูกจำแนกโดยใช้ขนาดของหลอดอาหารที่ขนาด 30 มิลลิเมตร หลังจากนั้นสุ่มเลือกต่อโดยใช้มือต่อและใช้เครื่องมือตัดต่ออัตโนมัติ*

ผลการศึกษา*: ระยะเวลาเฉลี่ยในการผ่าตัดและการสูญเสียเลือดในการผ่าตัด ระหว่างการใช้มือต่อมากกว่า การใช้เครื่องมือตัดต่ออัตโนมัติมีนัยสำคัญทางสถิติ อัตราการรั่ว, ภาวะแทรกซ้อนทางการหายใจ, ภาวะแทรกซ้อนด้านหัวใจ และอัตราการตายไม่มีความแตกต่างกันของกลุ่มที่ตัดต่อด้วยมือและกลุ่มที่ตัดต่อด้วยเครื่องมือตัดต่ออัตโนมัติ การตีบของหลอดอาหารโดยรวมพบว่าไม่แตกต่างกัน แต่ถ้าในกลุ่มที่หลอดอาหารมีขนาดเล็ก อัตราการาตีบของหลอดอาหารจะพบมากกว่าในกลุ่มที่ใช้เครื่องมือตัดต่ออัตโนมัติเมื่อเทียบกับการต่อด้วยมือต่ออย่างมีนัยสำคัญทางสถิติ*

สรุป*: จากการศึกษาพบว่าการผ่าตัดมะเร็งหลอดอาหารโดยใช้วิธีการผ่าตัดโดยใช้การตัดต่อด้วยมือ และใช้เครื่องมือตัดต่ออัตโนมัติมีความปลอดภัย ทั้ง 2 แบบ แต่การตัดต่อโดยใช้เครื่องมือตัดต่ออัตโนมัติมีแนวโน้มว่าจะมีอัตราการตีบของหลอดอาหารสูงกว่า โดยเฉพาะในกลุ่มที่มีหลอดอาหารขนาดเล็ก ขณะที่ระยะเวลาในการผ่าตัดและอัตราการสูญเสียเลือดจะน้อยกว่า*