

## Randomized Clinical Trial of the Effects of Pyloromyotomy on Transposed Gastric Emptying Rate in Patients with Esophageal Cancer, after Esophagectomy and Cervical Esophagogastrostomy

G. Godazandeh, A. Khalilian, I. Maleki, H. Fakheri, F. Mahboob, H. Khani and S. Afzali

Department of Surgery, Division of Thoracic Surgery,  
Mazandaran University of Medical Sciences, Sari, Iran

**Abstract:** Stomach is widely used for esophageal reconstruction in esophageal cancer surgery. The aim of this clinical trial was to study the effects of pyloromyotomy in patients with esophagectomy and gastric transposition for esophageal cancer surgery, in terms of gastric emptying and postoperative complications. In this randomized controlled trial on patients with esophageal cancer admitted for esophagectomy and gastric transposition in two medical centers of Sari, Iran, Gastric radioisotope scanning with labeled radiosolids was performed on patients 6 to 8 weeks after operation to evaluate transposed gastric emptying with or without pyloromyotomy. All the patients were followed up for 6 months postoperatively being assessed clinically. The mean age of the subjects was  $46.6 \pm 7.2$  years and 12 were female pathologic reports of 23 patients were Squamous Cell Carcinoma (SCC) and remaining 7 were adenocarcinoma. In patients with pyloromyotomy, 11 cases had delayed gastric emptying time and 4 patients were normal. In patients without pyloromyotomy, 9 patients had delayed gastric emptying time and 6 were normal. There was no statistical significance in gastric emptying rate and postoperative complications between the two groups. Based on the results it is recommended that esophageal resection and gastric transposition be performed without any additional intervention to improve gastric drainage.

**Key words:** Esophageal cancer, esophagectomy, cervical esophagogastrostomy, pyloromyotomy, gastric emptying

### INTRODUCTION

The worldwide prevalence of esophageal cancer especially adenocarcinoma is growing in recent decades. Esophageal cancer is relatively rare in most of the countries, but has high mortality. The incidence rate of esophageal cancer varies in different areas of the world. This rate is 93 and 110 per 100 000 men and women, respectively in South coast of the Caspian Sea. Prognosis of patients with esophageal cancer is poor and the 5-year survival is not more than 5%.

The main intention of surgery in esophageal cancer management is cure. However, most of the patients with surgical intervention die due to cancer relapse and occurring metastases. Thus, postoperative quality of life in operated patients should be seriously considered in surgical treatments (Graf *et al.*, 1994; Ferri *et al.*, 2006; Chen *et al.*, 2006; Svanes *et al.*, 1995).

Various surgical techniques for esophageal reconstruction after esophagectomy have no difference in

terms of postoperative prognosis of the patients, but they may influence postoperative complications, gastrointestinal function and patients' quality of life (Deron *et al.*, 2001; Branicki *et al.*, 1998; Lanschot *et al.*, 1994; Urschel, 2001; Muller *et al.*, 1990).

Esophageal reconstruction after esophagectomy using another part of gastrointestinal tract is an acceptable therapeutic strategy in patients with esophageal cancer. This method leads to improved oral feeding and thus, no further need to intravenous nutrition or tube enterostomy (Graf *et al.*, 1994; Ferri *et al.*, 2006; Chen *et al.*, 2006; Svanes *et al.*, 1995; Deron *et al.*, 2001; Branicki *et al.*, 1998; Lanschot *et al.*, 1994; Urschel, 2001; Muller *et al.*, 1990).

Stomach is frequently used for esophageal reconstruction after esophagectomy in benign and malignant diseases of esophagus. During esophagectomy and gastrectomy for esophageal reconstruction, vagotomy occurs which decreases gastric receptive relaxation. Therefore, after each meal, intragastric pressure rises and

fluid evacuation velocity is highly increased. It has been always a concern that loss of pyloric zone innervations after vagotomy may cause functional obstruction against gastric emptying. Gastric movement is affected by not only vague nerve but also by gastrointestinal tract regional humoral mechanisms. Surgeons routinely use techniques to improve gastric emptying such as pyloromyotomy or pyloroplasty on transposed stomach (Muller *et al.*, 1990; Bemelman *et al.*, 1995; Olak and Detsky, 1992). Most of them claim that the main reason for implementing techniques to promote gastric emptying is prophylaxis against pyloric obstruction, aspiration pneumonia and improving terminal foregut function.

Huang *et al.* (1985) believes that the main cause for obstruction after esophagectomy and gastric transposition is intrathoracic transposed stomach twitching or pressure on prepyloric zone by diaphragmatic hiatus and pylorus has no role in obstruction. Moreover, the rate of dumping syndrome and bile reflux is increased after pyloromyotomy or pyloroplasty and the risk of leakage from site of pyloroplasty suture lines is considerable too. The aim of this randomized clinical trial was to study the effects of pyloromyotomy in terms of gastric emptying rate in patients with esophageal cancer undergone esophagectomy and cervical esophagogastrostomy.

## **MATERIALS AND METHODS**

All patients scheduled for esophageal cancer surgery at emam and shafa hospital were considered for inclusion in the trial, which was approved by ethic committee of university. The reasons for exclusion were unresectable ( $n = 2$ ), bulky middle thoracic tumor refer for neoadjuvant chemotherapy ( $n = 2$ ) and previous gastric operation ( $n = 1$ ). Randomization was conducted by non-surgical staff using computer-generated random number tables, without any communication with the treating surgical team. Patients were randomly allocated into two groups: I, those treated with pyloromyotomy in esophagectomy and cervical esophagogastrostomy; II, patients operated for esophagectomy and cervical esophagogastrostomy with no gastric emptying assisting technique.

Thirty patients with documented esophageal cancer were treated with esophagectomy and cervical esophagogastrostomy. In all patients esophagus was reconstructed by gastric transposition followed by pyloromyotomy in only 15 cases. To choose the best surgical plan, barium swallows imaging, thoracic and

abdominal CT-Scan with contrast and bronchoscopy (if needed) were performed.

The two groups were matched in terms of age, gender and tumor characteristics such as tumor type, site and staging. Patients were followed up monthly for 6-months and all the complications such as chest and abdomen fullness sensation, dumping syndrome, anastomosis site stricture and gastric outlet obstruction were recorded.

**Surgical techniques:** In 30 included patients, 24 (80%) underwent transhiatal esophagectomy. In remaining 6 (20%), esophagectomy by right thoracotomy was carried out. Thoracotomy was inevitable due to site of tumor in 5 of 30 patient and in one case because of an inadvertent rupture of trachea during esophageal dissection while performing transhiatal esophagectomy.

In all patients, anastomosis was located in the neck, hence, the stomach was totally placed in thorax. To avoid pressure effect of esophageal hiatus on transposed stomach, it was incised between clocks 1-3 and then dilated completely. In group I, the pylorous muscle layer was incised entirely to mucosa. All patients were operated by the same surgical team.

**Gastric radioisotope scanning:** To determine the postoperative gastric emptying rate, gastric radioisotope scanning with labeled radiosolids was performed 6-8 weeks postoperation. In order to take the images, the patients were fed with 2 scrambled eggs labeled with 500-700 mCi Tc99m after fasting for 12 h. Thirty one-minute dynamic images with two min intervals (all together 90 min) were taken using a gamma camera (Prism Gantry, USA, 1997). In patients whose T1/2 (duration of depleting radioactive substance in stomach to half) were less than 90 min, gastric emptying scanning reported normal and in patients with T1/2 more than 90 min, the result were considered delayed. In patients with delayed gastric emptying rate, one min dynamic images with regular and definite intervals for determining the T1/2 would have accomplished.

**Statistics:** Statistical analysis were preformed using SPSS version 12.0 software. Quantitative data were analyzed using T-test and qualitative data using Chi-squar Test.  $p < 0.05$  was considered statistically significant. Analysis indicated that a sample size of fifteen cases in each group would be required to detected a statistically significant difference with power of 80 p% ( $[\alpha] = 0.05$ ) (Fig. 1).

Table 1: Patient demographic and tumor characteristics

Characteristics	Group 1 with pylorotomy (n = 15)	Group 1 without pylorotomy (n = 15)	Total patients (n = 30)	p value
Age (years)				NS = 0.8
D.S±mean	7.2±62.46	7.6±59.6	7.6±61.03	
Range	71-47	78-41	78-41	
Gender				NS = 0.71
Male	(% 66.7) 10	(% 53.3) 8	(% 60) 18	
Female	(% 33.3) 5	(% 46.7) 7	(% 40) 12	
Type of tumor				NS = 1
Squamous cell carcinoma	(% 80) 12	(% 73.3) 11	(% 76.7) 28	
Adenocarcinoma	(% 20) 3	(% 26.7) 4	(% 23.3) 7	
Site of tumor				NS = 0.27
Cervical	-	-	-	
Upper thoracic	-	-	-	
Middle thoracic	(% 66.7) 10	(% 40) 6	(% 53.3) 16	
Inferior thoracic	(% 53.3) 5	(% 60) 9	(% 46.7) 14	

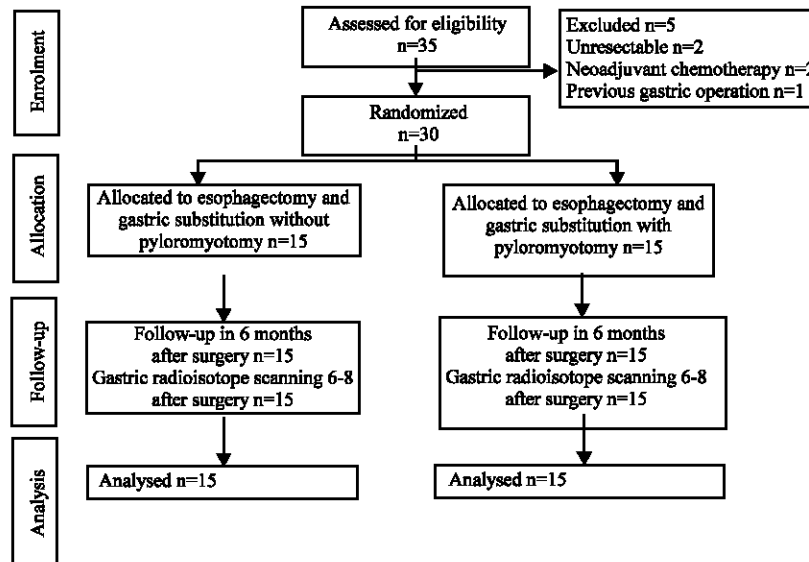


Fig. 1: Flow diagram for esophageal cancer surgery

## RESULTS AND DISCUSSION

Mean age of the patients (40% female) was  $46.62 \pm 7.21$  years (41-73 years). Seventy six percent (23 of 30) had squamous cell carcinoma and 23.3% (7 of 30) were diagnosed with adenocarcinoma. In 53% (16 of 30) of the patients, the tumor was situated in middle thorax and in others it was in inferior thoracic area and cardia. There was no significant correlation in demographic characteristics; age, gender, tumor type and location between the two groups of patients (Table 1).

Under normal condition, the curve of stomach evacuation based on labeled radiolids is S-shaped (sigmoid curve) in healthy population. It means that there is a lag phase in initial part of the curve, which shows no labeled radiolids evacuation. The lag phase is due to gastric receptive relaxation caused by vagus nerve. In patients with esophagectomy and cervical

esophagogastrostomy with or without pyloromyotomy, no lag phase was seen, which maybe caused by vagotomy and omission of receptive relaxation.

Anterior and posterior images of the stomach in 0, 30, 60 and 90 min after labeling solid ingestion and gastric emptying curve are shown in two patients without pyloromyotomy with normal and delayed gastric emptying time (Fig. 2 and 3).

In group I, 73.3% (11 of 15) had delayed gastric emptying and 26.7% (4 of 15) had normal values. In group II, 60% (9 of 15) had delayed gastric emptying and 40% (6 of 15) had normal gastric emptying. Totally in two groups of patients, 66.7% (20 of 30) had delayed and the remaining 33.3% (10 of 30) had normal gastric emptying time. However, there was no statistical significance in gastric emptying time ( $p = 0.784$ ) and in the number of patients with delayed and normal gastric emptying time between the 2 groups ( $p = 0.7$ ).

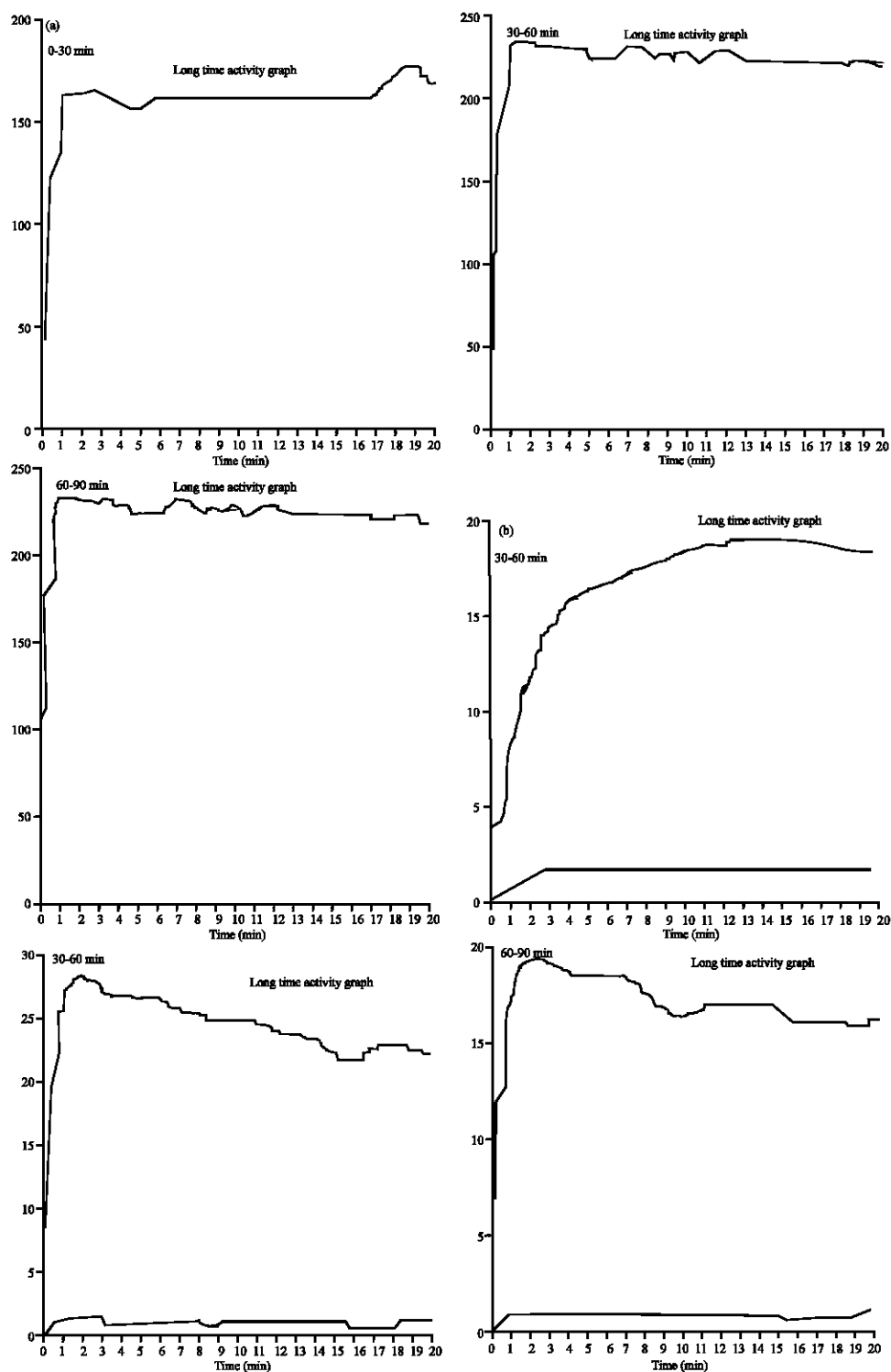


Fig. 2: Stomach emptying rate in a patient without pyloromyotomy (a) delayed emptying, (b) normal

Early postoperative complications including anastomotic leakage in 10% (3 of 30) of the cases, hemothorax in 20% (6 of 30), pneumonia in 3.3% (1 of 30)

and late postoperative complications including thoracic and abdominal fullness sensation in 30% (9 of 30), dumping syndrome in 13.3% (4 of 30) and anastomosis

Table 2: Early and late postoperative complication

Characteristics	Group 1 (n = 15) (.No)	Group 2 (n = 15) (.No)	Total patients (n = 30) (.No)	p value
Early complications				
Leakage anastomosis	(% 13.3) 2	(% 6.7) 1	(% 10) 3	NS = 1
Chylothorax	-	-	-	-
Hemothorax	(% 26.7) 4	(% 13.3) 2	(% 20) 6	NS = 0.65
Pneumonia	-	(% 6.7) 1	(% 3.3) 1	NS = 1
Intraabdominal abscesses	-	-	-	-
Wound infection	(% 13.3) 2	(% 6.7) 1	(% 10) 3	NS = 1
Thromboembolism	-	-	-	-
Tracheal laceration	-	(% 6.7) 1	(% 3.3) 1	NS = 1
Recurrent liver injury	-	(% 13.3) 2	(% 6.7) 2	NS = 1
Empyema	-	(% 6.7) 1	(% 3.3) 1	NS = 1
Late complications				
Fulness sensation	(% 46.7) 7	(% 13.3) 2	(% 30) 9	NS = 1
Dumping syndrome	(% 13.2) 2	(% 13.2) 2	(% 13.3) 4	NS = 1
Stenosis of anastomosis	-	(% 13.2) 2	(% 6.7) 2	NS = 0.48

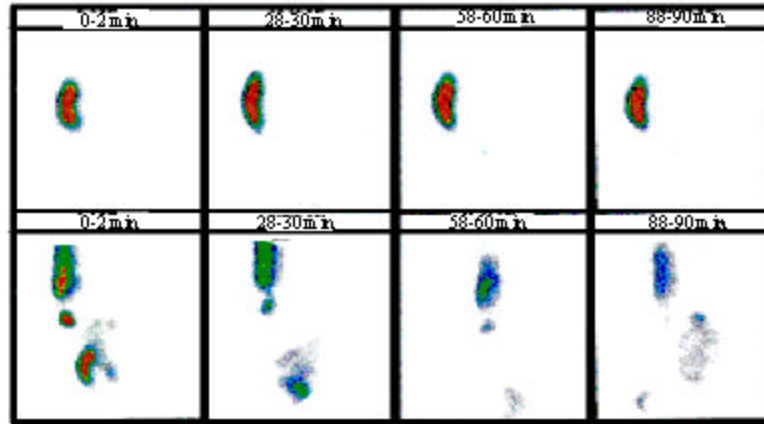


Fig. 3: Gastric radioisotope scanning in a patient without pyloromyotomy (a) delayed emptying, (b) normal

stricture in 6.7% (2 of 30) were observed. There was no chylothorax, intraabdominal abscess and thromboembolism among our patients, also no mortality occurred during follow up period (Table 2).

The aim of this study, was to obtain information about the effects of pyloromyotomy on transposed gastric emptying rate in patients with esophageal cancer, after esophagectomy and cervical esophagogastrostomy. The results of this study suggest that esophagectomy with pyloromyotomy does not foster gastric emptying compared with esophagectomy alone. Gastric motility depends on gastrointestinal tract hormonal and neural mechanisms. Esophagectomy and accompanied branch vagotomy raises surgeons' concerns about gastric function because of denervation of transposed stomach. After vagotomy, gastric muscles motility is preserved and intragastric pressure and liquid drainage are increased

because after vagotomy receptive relaxation against swallowing wave is absent. However, because of pyloric valve denervation, pylorus may cause functional obstruction against gastric emptying. To prevent gastric emptying dysfunction after esophagectomy and cervical esophagogastrostomy, most surgeons routinely perform techniques to promote gastric drainage on transposed stomach, such as pyloroplasty or pyloromyotomy (Law *et al.*, 1997; Manjari *et al.*, 1996; Manson *et al.*, 1991; Akiyama *et al.*, 1981; Belsey, 1980; Ong and Kwong, 1969). On the other hand, some surgeons believe that these interventions can be followed by various complications such as dumping syndrome, bile reflux and pyloroplasty suture line leakage which affect postoperative patients quality of life (Christain *et al.*, 2001; Huang and Wu, 1984; Angorn, 1975; Shapiro and Hamlin, 1972; Golematis *et al.*, 1982; Hinder, 1979).

Several investigations were accomplished studying the effects of gastric drainage techniques on gastric emptying. Law *et al.* (1997) studying 92 patients claimed that either pyloromyotomy or pyloroplasty was safe and employing them was depended upon surgeons' skill and expertise. Menjari *et al.* (1996) studied different gastric drainage techniques and demonstrated that all of them were efficient and safe with no statistical significance between the type of techniques in terms of clinical complications and gastric emptying rate. Olak *et al.* (1992) showed that gastric drainage techniques were effective for 95% of cases. Similarly Urschel *et al.* (2003) demonstrated that gastric drainage techniques decline the risk of gastric outlet obstruction after esophagectomy and esophagogastrostomy, but rarely influential on patients prognosis.

On the other hand, Deron *et al.* (2001) in a prospective evaluation of dietary status and symptoms after near total esophagectomy without gastric emptying procedure on 48 patients showed that the surgery is well tolerated and allows a return to subjectively acceptable and nutritionally appropriate dietary eating pattern without significant associated side effects.

Huang *et al.* (1985) reported that pyloroplasty makes no changes in clinical evaluations, gastric emptying and postoperative complications after esophagectomy and gastric substitution. Su *et al.* (1978) demonstrated that gastric peristalsis and barium passage through transposed pylorus valve is increased in patients without pyloroplasty by examining gastric and intestinal function in various intervals.

Thus, there is a great deal of controversy about performing gastric drainage techniques after esophagectomy and cervical esophagogastrostomy operations. In line with the current controversy on the issue, the results of this study were not conclusive in favor or against gastric emptying techniques.

Delayed gastric emptying reported by radioisotope scan is consistent with postprandial intrathoracic fullness sensation. Postmeal fullness sensation is improved gradually over time. Regarding the impact of food osmolality, particle size and the amount of diet fat and calorie on gastric motility, taking small meals in shorter intervals, chewing well and avoiding excessive high caloric and greasy meals lead to significant clinical improvement.

## CONCLUSION

In summary, absence of statistical significance between the two groups of patients in terms of gastric emptying after surgery and also presence of

postoperative complications such as dumping syndrome in the treated group, suggest that gastric drainage promoting techniques in esophageal resection and gastric transposition should not be recommended.

## ACKNOWLEDGEMENT

The authors of this study, would like to thank Mazandaran University of Medical Sciences for financial support and all the staff of operating room, Intensive Care Unit and general surgery ward of Imam Khomeini and Shafa hospitals of Sari, staff of imaging center of Dr Mahboob, patients and their families and Ameneh Ghorbani MSc for her valuable help in data collection and analysis. We also would like to extend our gratitude to Dr Enayati for his editorial assistance.

## REFERENCES

- Akiyama, H., M. Tsurumara, T. Kawamura and Y. Ono, 1981. Principles of surgical treatment for carcinoma of the esophagus. *Ann. Surg.*, 194: 438-446.
- Angorn, I.B., 1975. Esophagogastrostomy without a drainage procedure in esophageal carcinoma. *Br. J. Surg.*, 62: 601-604.
- Belsey, R.H.R., 1980. Palliative management of esophageal carcinoma. *Am. J. Surg.*, 139: 789-794.
- Bemelman, W.A., C.W. Taat, J.F.M. Slors, J.J.B. Van Lanschot and H. Obertop, 1995. Delayed postoperative emptying after esophageal resection is dependent on the size of the gastric substitute. *J. Am. Coll. Surg.*, 180: 461-464.
- Branicki, F.J., S.Y. Law, M. Fok, R.T. Poon, K.M. Chu and J. Wong, 1998. Quality of life in patients with cancer of the esophagus and gastric cardia: A case for palliative resection. *Arch. Surg.*, 133: 316-322.
- Chen, G., Z. Wang, X.Y. Liu and F.Y. Liu, 2006. Recurrence patterns of esophageal cancer after ivor-lewis esophagectomy, a report of 196 cases. *Ai Zheng*, 25: 96-99.
- Cheung, H.C., K.F. Siu and J. Wong, 1987. Is pyloroplasty necessary in esophageal replacement by stomach? A prospective, randomized controlled trial. *Surgery*, 102: 19-24.
- Christain A. Gutschow, Jean Marie Collard, Renato Romagnoli, Jean Marie. Michel, Mauro Salizzoni and Arnulf H. Hischer, 2001. Bile exposure of the denervated stomach as an esophageal substitute. *Ann. Thorac. Surg.*, 71: 1786-1791.
- Deron J. Ludwig, Richard C.Thirlby and Donald E. Low, 2001. A prospective evaluation of dietary status and symptoms after near-total esophagectomy without gastric emptying procedure. *Am. J. Surg.*, 181: 454-458.

- Ferri, L.E., S. Law, K.H. Wong, K.F. Kwok and J. Wong, 2006. The influence of technical complications on postoperative outcome and survival after esophagectomy. *Ann. Surg. Oncol.*, 16: 20-25.
- Golematis, B.C., P.G. Delikaris, G.N. Bonatsos, M.C. Douzinas and S. Kambysis, 1982. Is a gastric drainage procedure necessary after proximal gastrectomy or esophagogastrectomy and esophagogastrectomy? *Mt. Sinai. J. Med.*, 49: 418-420.
- Graf, M., M. Von Flue, U. Herzog, C. Ackermann and P. Tondelli, 1994. Results of surgical therapy in esophagus and cardia carcinoma. *Schweiz Med. Wochenschr.*, 124: 1900-1904.
- Hinder, R.A., 1979. The effect of posture on the emptying of the intrathoracic vagotomized stomach. *Br. J. Surg.*, 63: 581-584.
- Huang, G.J. and Y.K. Wu, 1984. Operative Technique for Carcinoma of the Esophagus. In: Huang G.J., Y.K. Wu. Eds. *Carcinoma of the esophagus and gastric cardia*. Berlin: Springer-Verlag, pp: 313-348.
- Huang, G.J., D.C. Zhang and D.W. Zhang, 1985. A Comparative Study of Resection of Carcinoma of the Esophagus with and Without Pyloroplasty. In Demeester, T.R., D.B. Skinner. Eds. *Esophageal Disorders: Pathophysiology and Therapy*. New York: Raven Press, pp: 383.
- John, D. Urschel, Chris J. Blewett, J. Edward, M. Young, John D. Miller and W. Frederick Bennett, 2002. Pyloric drainage (pyloroplasty) or no drainage in gastric reconstruction after esophagectomy: A meta-analysis of randomized controlled trials. *Dia. Surg.*, 19: 160-164.
- Law, S., M.C. Cheung, M. Fok, K.M. Chu and J. Wong, 1997. Pyloroplasty and pyloromyotomy in gastric replacement of the esophagus after esophagectomy: Randomized controlled trial. *J. Am. Coll. Surg.*, 184: 630-636.
- Manson Fok, Stephen W.K. Cheng and John Wong, 1991. Pyloroplasty versus no drainage in gastric replacement of the esophagus. *Am. J. Surg.*, 162: 477-452.
- Manjari, R., A.K. Padhy and T.K. Chattopadhyay, 1996. Emptying of the intrathoracic stomach using three different pylorus drainage procedures: Results of a comparative study. *Surg. Today*, 26: 581-585.
- Muller, J.M., H. Erasmi, M. Stelzner, U. Zieren and H. Pichlmaier, 1990. Surgical therapy of esophageal carcinoma. *Br. J. Surg.*, 77: 854-857.
- Olak, J. and A. Detsky, 1992. Surgical decision analysis: esophagectomy/esophagogastrectomy with or without drainage? *Ann. Thorac. Surg.*, 53: 493-497.
- Ong, G.B. and K.H. Kwong, 1969. The Lewis-Tanner operation for cancer of the esophagus. *J. R. Coll. Surg. Edmb.*, 14: 3-19.
- Shapiro, S. and Hamlin D. Morganstern, 1972. The fate of the pylorus in esophagoantrostomy. *Surg. Gynecol. Obster.*, 135: 216-218.
- Su, J.H., 1978. Roentgenological study of gastrointestinal function following resection of carcinoma of the esophagus and gastric cardia [Chinese]. *Cancer Res. Prev. Treat.*, 1: 9-15.
- Svanes, K., L. Stangeland, A. Viste, J.E. Varhaug, J.E. Gronbech and O. Soreide Morbidity, 1995. Ability to swallow and survival after esophagectomy for cancer of the esophagus and cardia. *Eur. J. Surg.*, 161: 669-675.
- Urschel, J.D., 2001. Does the interponat affect outcome after esophagectomy for cancer. *Dis. Esophagus.*, 14: 124-130.
- Van Lanschot, J.J.B., W.C. Hop, M.H.J. Voormolen, R.A.J. Van Deelen, J.G.A.M. Blomjous and H.W. Tilanus, 1994. Quality of palliation and possible benefit of extra-anatomic reconstruction in recurrent dysphagia after resection of carcinoma of the esophagus. *J. Am. Coll. Surg.*, 179: 705-713.