Novel reconstruction method after laparoscopic total gastrectomy : Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE)

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-ASTRACT-

Novel reconstruction method afterlaparoscopic total gastrectomy : Intra-Corporeal Esophagojejunostomywith Endoloop(ICEE)

Background. *Although laparoscopic distal gastrectomy has been used widely for treatment for gastric cancer, laparoscopic total gastrectomy(LTG) is still uncommon. One of the reasons is the technical difficulty of performing the esophagojejunal anastomosis, especially anvil-insertion. Various reconstruction methods have been reported, but optimal method has not been established. Based upon our experience of laparoscopic total gastrectomy, we developed very simple and safe esophagojejunal anastomosis method and we named it as Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE). In this study , we compared the short outcomes of LTG reconstructed by conventional purse-string suture and by ICEE.*

Methods. *From January 2009 to December 2012 , LTG with intracorporeal esophagojejunostomy was performed in 62 patients at Ajou university hospital, Suwon, Korea. Among them, 35 consecutive cases with gastric cancer underwent totally laparoscopic total gastrectomy with intracorporeal anvil wrapping with loop tie without purse-string suture. After transection of the abdominal esophagus, anvil head was inserted into the distal esophagus and a laparoscopic loop tie was applied and tied to wrap the edge of the esophagus. After the creation of a Roux-en-Y jejunal limb, laparoscopic esophagojejunal anastomosis was performed by docking the body of the stapler to the anvil head. The jejunal stump was closed with a linear stapler.*

Results. *Laparoscopic esophagojejunostomy was performed successfully for all the patients. No postoperative complications related to anastomosis occurred. The mean operation time was 227.2 min, and the estimated blood loss was 155.9 ml. Complication was developed only in 3 patients with wound seroma, postoperative ileus ,intraabdominal fluid collection . And all of them were successfully treated conservatively. Mean hospital stay was 8.4 (6-12) days.*

Conclusion. *This technique is feasible can lower the operation time and complications after totally laparoscopic total gastrectomy. We believe this method is most easy and safe.*

Keywords :laparoscopic total gastrectomy(LTG), esophagojejunostomy, Anvil insertion and wrapping, Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE)

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I. INTRODUCTION

Since Kitano et al[1] introduced laparoscopic distal gastrectomy(LDG) in early gastric cancer in 1994 , LDG in early gastric cancer has become widely used and has been well studied for its feasibility and benefits[2,3]. LDG in early gastric cancer has lots of advantages, including reduced surgical invasiveness, less postoperative pain andearlier postoperative recovery[2,4-6]

In contrast, laparoscopic total gastrectomy(LTG) has not gained such widespread acceptance as LDG because of a lower incidence of early cancer requiring LTG[7] and its technical difficulties, especially the esophagojejunostomy. In conventional total gastrectomy, esophagojejunal reconstruction with circular stapler is the most common performed and extracorporeal circular-stapled esophagojejunostomy through minilaparotomyhas been commonly performed after LTG[8-10]. However, it is difficult to complete anastomosis through minilaparotomy due to the narrow and deep operation field for insertion and fixation of anvil head in obese patients. Several authors have described various techniques of esophagojejunostomy. However, these procedure still appeared to be complicated and have not been accepted widely.

In this study , we describe the new novel reconstruction method after laparoscopic total gastrectomy-Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE)and compare the short-term outcomes of that with LTG reconstructed by hand sewn purse-string suture[11].

II. Materials and Methods

A. Patients

Between January 2009 and December 2012, 62 patients withgastric cancer underwent laparoscopic total gastrectomy with intracorporeal esophagojejunostomy in the Department of surgery,Ajou University School of Medicine. Of these, 27 received LTG reconstructed by hand sewn purse-string suture from January 2009 to September 2011, and the remaining 35received LTG reconstructed by ICEE from October 2011 to December 2012.

B. Surgeon

All 62 operations were performed by anexperienced laparoscopic surgeon, who hadexperienced 1055 LDG cases, 82 LTG cases with mini-laparotomy for esophagojejunostomy before this study, andmore than 600 open gastrectomies.

C. Surgical technique

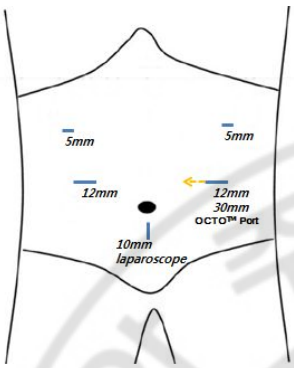

Figure 1. position of port and extension of ski incision

Patients were placed in a supine position under general anesthetic; the operator stood on the right side of the patient, the first assistant on the left, and the assistant holding the camera stood between the surgeon's right and scrub nurse. After a CO2 pneumoperitoneum of 12-14cm H_2O was established throw infraumbilical camera port, additional four working ports were introduced into the right upper quadrant (5 mm), right middle quadrant (12 mm), left middle quadrant (12 mm), and left upper quadrant (5 mm) regions of the abdomen. A 30-degree rigid videolaparoscope was used to maintain the optimal surgical field. To secure the laparoscopic operating field, V-shape liver retraction was done as we already reported.After the stomach had been mobilized with lymphadenectomy, the exposed esophaguswas mobilized and transected with a 60-mm endoscopic linear stapler(Ethicon Endo Surgery, Inc.,USA). The resected specimen were placed in a plastic bag and retrieved through left middle port incision(12mm) extended mediallyupto 30-35mm by enlarging the left rectus muscle split and skin incision.(Fig. 1). Through that,Octoport™ (Dalim, Seoul, Korea) was applied and the anvil of a 25-mm circular stapler(ECS; Ethicon Endosurgery, Cin-cinnati, OH, USA) was introduced into the abdominal cavity. On the outside the operation table, the retrieved was inspected and proximal resection margin was sent to the pathologist. After theOctoport™ was attached, pneumoperitoneum was re-established.

Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE):

The operator located the inserted anvil near to esophagus. From the right side of the transected esophagus edges , the operator made a partial transection upto 3/4 width of transected esophagus with harmony scalpel(Ethicon Endosurgery, Cin-cinnati, OH, USA) along the stapler line during the first assisted pull down the transected esophagus with forcepping both edge of stapled line.With the coordination of three grasping forceps(one-operator Lt hand , the others- 1st assistant) the partial transected esophagus was opened with the shape of the triangle. Endo-loop was applied upto the transected esophagus by step by step opening and closing of the forceps. The anvil head was inserted into the opening of esophagusand anvil head was wrapped with esophageal wall by the gathering the three forceps andtheendo-loop was tightened. And another Endo-loopwas applied and tightened(Fig. 2).

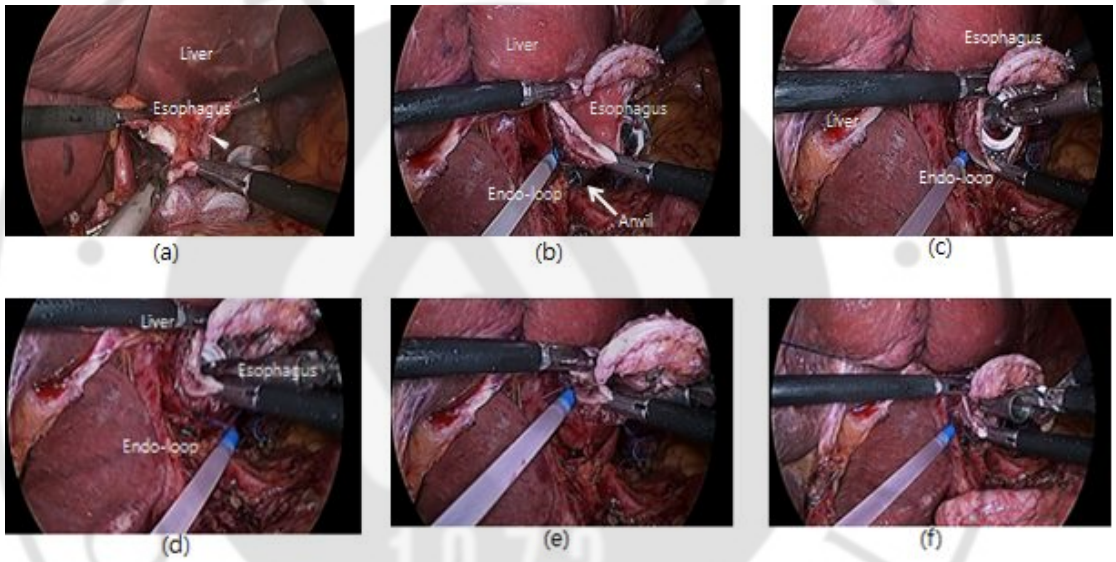

Figure 2. Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE)

(a). Transection of the distal esophagus(to the ¾ length , white arrow) with the Harmonic scalpel

(b). Positioning of the endo-loop to the distal esophagus

(c). Insertion of the Anvil into the distal esophagus

(d). Wraping of the esophagus with grasp forceps and pulling the drawstring of the endo-loop slowly

(e). Pulling the drawstring of the endo-loop firmly

(f). Reinforcement of the anvil with another endo-loop

LTG reconstructed by hand sewn purse-string suture:

Anvil head insertion and fixation was done by purse-string sutures as reported by Kinoshita et al[11].

Jejunalloop was extracted through the left middle extended port site and transected , and extracorporeal end-to side jejunojejunostomy was performed to create 55-cmRoux-en-Y limb. The body of circular stapler was introduced through Octoport™ and inserted into the

distal limb of the jejunum, which was half-tied by a 2-0 silk to prevent slippage of the jejunum from the circular stapler during the intracorporeal procedure. The circular stapler was then introduced to the abdominal cavity and pneumoperitoneum was re-established. The circular stapler was combined with the anvil tail and esophagojejunal anastomosis was performed under laparoscopic vision .Finally , the jejunal stump was closed using endoscopic linear stapler. 2 stiches were made with antimesenteric side of jejunal limb and mesocolon to prevent the limb falling and kicking. The anastomosis site and abdominal cavity was checked and two drain tube were placed through a 5mm port site around the esophagojejunal anastomosis.

D. Statistical analysis

Statistical analysis were performed using Statistical Package for Social Science ver. 18.0 (IBM Corp. NY, USA). Chi-square tests were adopted to analyze the difference of distribution among the categorized data.A *P* value was of 0.05 or less was considered statistically significant.

III. RESULTS

A. Demographics of patients

Patient characteristics are listed in Table 1. There was no significant difference in age, gender, degree of obesity(body mass index (BMI), presence of comorbid disease, past history of laparotomy, clinical tumor staging, or the extent of lymph node dissection between the two groups.

Table1. Demographics of patients

Characteristics	ICEE(n=35)	Purse-string suture(n=27)	*p value*
Age(years)	58.3±10.8	57.3±12.1	*0.739*
Gender(male/female)	25/10	22/5	*0.39*
Body mass index(kg/m2)	23.4±2.5	24.2±3.3	*0.306*
Comorbid disease			
Presence	23	15	*0.401*
Cardiovascular	14	10	
Respiratory	0	2	
Renal disease	0	0	
Diabetes mellitus	5	3	
Liver disease	3	3	
Other disease	2	3	
Past history of laparotomy(%)	4(11.4%)	6(22.2%)	*0.327*
Clinical staging(cTNM)			
Ia	17	15	*0.639*
Ib	11	10	
IIa	5	2	
IIb	2	0	
Lymph node dissection			
D1	3	0	*0.059*
D1+α	1	2	
D1+β	16	6	
D2	15	19	

B. Short-term outcomes of surgical procedure

All procedure was performed without conversion to open methods. Total operation time(177 vs214) and anvil insertion time(6.9 vs 16.7) were significantly shorter in ICEE group($p<0.001$). No significant difference was observed in total blood loss, number of retrieved lymph node and proximal margin. In the purse-string suture group. Incidence of postoperative complications was similar($p = 0.742$). In ICEE group , there was no anastomosis related complication but in purse-string suture group , there was two(1-stenosis, 1-leakeage). There was no significant difference in the time to liquid diet and postoperative hospital stay.

Table2. Surgical outcomes

Characteristics	ICEE(n=35)	Purse-string suture(n=27)	*p value*
Total operation time(min)	177.5±39..1	214.2±44.4	*<0.001*
Anvil insertion time(min)	6.9±2.2	16.7±4.6	*<0.001*
Estimated blood loss(g)	162.2±114.4	209.2±80.9	*0.063*
Proximal margin(cm)	3.2±1.4	3.7±1.3	*0.195*
No. of dissected lymph nodes	39.3±15.3	36.9±14.9	*0.541*
Postoperative complications			
Wound	2	2	*0.742*
Fluid collection	1	1	
Pancreatic fistula	1	1	
Intra-abdominal abscess	1	1	
Anastomotic leakage	0	1†	
Anastomotic stenosis	0	0	
Anastomotic bleeding	0	1‡	
Postoperative mortality	0	0	
Time to liquid diet(days)	3.8±3.0	5.1±4.3	*0.185*
Postoperative hospital stay(days)	7.7±4.5	12.5±14.0	*0.098*

IV. DISCUSSION

Although many studies have shown laparoscopic distal subtotal gastrectomy is an alternativeto open gastrectomy for the treatment of gastric cancer, the acceptance of laparoscopictotal gastrectomy for upper gastric cancer has been rather slow in clinical practice[10,12,13]. Oneof the reasons for the low penetration of this procedure is the difficulty in esophagojejunal anastomosis[14,15].

In open conventional total gastrectomy ,esophagojejunostomy is performed by using a circular stapler with the insertion and fixation of the anvil head into distal esophagus.Extracorporeal esophagojejunostomy using a circular stapler through minilaparotomy has been performed in a manner similar to that of conventional open surgery in anvil insertion and fixation. It looked familiar to most surgeon and several authors reported that methods[8,16]. However, such a procedure is often difficult or impossible to perform because of the narrow and deep operating field, especially in obese patients.

To overcome these difficulty of anvil insertion and fixation, various technical modifications of intracorporeal esophagojejunostomy have been reported. Jeong et al[17]have reported the transorally inserted anvil(Orvil, Covidien)procedure, which looks very simple and time-saving. But this method has the potential risk of esophageal injury during the passage of anvil and abdominal infection, because of the contaminated Orvil tube enters the abdominal cavity during the procedure.Nunobe et al[18] have reported the three-step esophagojejunal anastomosis with atraumatic anvil insertion technique.This lift-up technique seems to facilitate circular stapled esophagojejunostomy, but it also have potential risk of abdominal infection and it showed relatively high anastomosis related complication rates(12.2%). Inabe et al[19]have reported laparoscopic side-to side anastomosis using a linear stapler for esophagojejunostomy. This method seems favorable for LTGbecause of the reduced complexity related with anvil insertion and circular stapler. However, it requires taking down the esophagus longer toward the mediastinum than usual to secure the distance for anastomosis. This result in the potential risk of mediastinitis if the anastomosis leakeage occurs. Some of very experienced laparoscopic surgeon tried intracorporeal hand-swen purse-string suture for anvil insertion and fixation. Kinoshita et al[11] have reported about this technique with good surgical outcomes. Although it looks fancy, it takes a longer operation time and it is demanding technically.

In this article, we described the novel reconstruction method after laparoscopic total gastrectomy : Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE). Our technique presented in this report is very simple and can be performed with only endoloop without additional difficult suture. In the beginning of LTG with intracorporeal

esophagojejunostomy, we performed esophagojejunostomy using hand-swen purse-string suture and we always placed additional endoloop for reinforcement of purse-string suture. With the accumulation of experience of intracorporeal LTG , we designed Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE). We have successfully performed this procedure in 35 patients without any intraoperative complications or conversion to open surgery. ICEE methods showed reduced operation time and anvil insertion time compared with hand-swen purse-string suture. Although study size was small in number and the follow-up duration was relatively short, there were no perioperative complications (e.g., leakage or stenosis) associated with the anastomosis.

V. Conclusions

This novel technique of Intra-Corporeal Esophagojejunostomy with Endoloop(ICEE) is technically feasible and safe. We believe that this procedure We believe that this procedure is especially useful in obese patients, in whom conventional extracorporeal anastomosis often is difficult.

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– 국문요약 –

복강경 위 전 절제술 이후 복강내 식도-공장 문합법: 쌈지 봉합(Purse-string suture)없이 복강경 루프(endoloop) 을 이용한 anvil 삽입 및 고정술

Kitano 등에 의해 복강경 수술이 위암에 도입된 이래 복강경을 이용한 위아전절제술은 급속도로 증가하고 있다.복강경 위 아전 절제술의 수가 증대됨에 따라 많은 연구들을 통하여 복강경 위 아전절제술의 안정성과 수술의 효용성에 대한연구가 진행되고 있다.이에 반하여 복강경을 이용한 위 전절제술은 복강경 위아전절제술에 비해 보급 및 확대가 느리며 이를 막고 있는 가장 큰 요인이 복강경하 문합방법의 어려움이다.개복 수술과 유사하게 작은 절개창을 통하여 복강외문합을 시도하였으며 비만의 환자에서 매우 어려우며 이를 극복하기 위한 다양한 문합 방법들이 보고되고 있으나 아직 적립되지 않은 상태이다.
식도 공장 문합에 있어 선형 문합기를 이용한 문합은 가장 이상적이며 개복 수술에서 시행을 한다.이를 복강경 수술에 적용하였을 때 어려운 부분이 anvil 을 식도 말단에 삽입하고 고정하는 것이다. Anvil 을 식도 말단에 고정하는 많은 방법들이 도출되었지만 아직까지 연구중이며,개복수술과 유사하게 쌈지 봉합술을 이용한 방법이 이상적으로 보이나 기술적으로 매우 어려우며 시간이 많이 소요된다.
본 연구자는 쌈지 봉합술을 시행하지 않고 anvil 을 식도 말단에 넣어 고정하는 방법을 고안하였으며(ICEE), 본연구를 통해 본 방법에 대한 소개와 함께 안전성과 효용성에 대한 연구를 진행하였다.

핵심어 :복강경 위 전 절제술, anvil, 선형문합기,쌈지 봉합술,Intra-Corporeal Esophagojejunostomy with Endoloop (ICEE)