Oncologic outcomes of laparoscopic gastrectomy after endoscopic treatment for gastric Cancer; A comparison with open gastrectomy

Kwon Hye Youn
Department of Medicine

The Graduate School, Yonsei University
Oncologic outcomes of laparoscopic gastrectomy after endoscopic treatment for gastric Cancer; A comparison with open gastrectomy

Kwon Hye Youn
Department of Medicine
The Graduate School, Yonsei University
Oncologic outcomes of laparoscopic gastrectomy after endoscopic treatment for gastric Cancer; A comparison with open gastrectomy

Directed by Professor Woo Jin Hyung

The Master's Thesis submitted to the Department of Medicine
the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree of Master of Medical Science

Hye Youn Kwon

December 2012
This certifies that the Master's Thesis of Hye Youn Kwon is approved.

------------------------------------
Thesis Supervisor: Woo Jin Hyung
------------------------------------
Thesis Committee Member #1: Sang-Kil Lee
------------------------------------
Thesis Committee Member #2: Suk-Hoon Jung
------------------------------------

The Graduate School
Yonsei University

December 2012
ACKNOWLEDGEMENTS

First of all, I really appreciate my thesis supervisor professor Woo-Jin Hyung, for his supervision and encouragement to study this subject. Thanks to professor Hyung, I had this great opportunity to experience this study.

I also appreciated professors Seung-kook Sohn and Kang-young Lee who help me to experience many studies about surgical oncology and gave me experienced advices.
<TABLE OF CONTENTS>

ABSTRACT .............................................................................................................. 1

I. INTRODUCTION ................................................................................................. 3

II. MATERIALS AND METHODS ........................................................................... 4

   1. PATIENTS .............................................................. 4

   2. INDICATION OF SURGERY AFTER ENDOSCOPIC RESECTION 5

   3. FOLLOW-UP AND RECURRENCE........................................... 5

   4. STATISTICAL ANALYSIS ................................................. 6

III. RESULTS .......................................................................................................... 6

   1. COMPARISON OF CLINICOPATHOLOGIC FEATURES .............. 6

   2. INDICATIONS OF RADICAL GASTRECTOMY ....................... 8

   3. SHORT-TERM POSTOPERATIVE OUTCOME ......................... 8

   4. LONG-TERM ONCOLOGIC OUTCOME .......................... 10

IV. DISCUSSION ...................................................................................................... 13

V. CONCLUSION ..................................................................................................... 15

REFERENCES ........................................................................................................ 16

ABSTRACT (IN KOREAN) ..................................................................................... 20
LIST OF FIGURES

Figure 1. Surgical indication and method of operation …………8
Figure 2. Comparison of disease free survival for patients after laparoscopic and conventional open gastrectomy…..11

LIST OF TABLES

Table 1. Comparison of clinicopathologic features …………7
Table 2. Short-term postoperative clinical outcomes …………9
Table 3. Postoperative pathologic outcomes…………………..10
Table 4. Univariate and Multivariate analyses of risk factors for recurrence after gastrectomy…………………………12
Table 5. Univariate and Multivariate analysis of prognostic factors for relapse free survival ……………………………12
ABSTRACT

Outcomes of laparoscopic gastrectomy after endoscopic treatment for gastric Cancer; A comparison with open gastrectomy

Hye Youn, Kwon

Department of Medicine

The Graduate School, Yonsei University

(Directed by Professor Woo Jin, Hyung)

Background: Additional gastrectomy is needed after endoscopic resection (ER) for early gastric cancer when pathology confirmed any possibility of lymph node metastasis or margin involvement. No studies depicted the optimal type of surgery to apply in these patients. We compared the short-term and long-term outcomes of laparoscopic gastrectomy with those of open gastrectomy after ER to identify the optimal type of surgery.

Methods: From 2003 to 2010, 110 consecutive patients who underwent gastrectomy with lymphadenectomy either by laparoscopic (n=74) or by open (n=36) for gastric cancer after ER were retrospectively analyzed. Postoperative and oncological outcomes were compared according to types of surgical approach.

Results: Clinicopathological characteristics were comparable between the two groups. Laparoscopic group showed significantly shorter time to gas passing and soft diet and hospital day than open group while operation time and rate of
postoperative complications were comparable between the two groups. All specimens had negative margins regardless of types of approach. Mean number of retrieved lymph nodes did not differ significantly between the two groups. During the median follow-up of 47 months, there were no statistical difference in recurrence rate (1.4% for laparoscopic and 5.6% for open, P=0.25) and in overall (P=0.22) and disease-free survival (P=0.19) between the two groups. Type of approach was not an independent risk factor for recurrence and survival.

**Conclusion:** Laparoscopic gastrectomy after ER showed comparable oncologic outcomes to open approach while maintaining benefits of minimally invasive surgery. Thus, laparoscopic gastrectomy can be a treatment of choice for patients previously treated by ER.

Key word: laparoscopic surgery, gastrectomy, endoscopic treatment, gastric cancer
Outcomes of laparoscopic gastrectomy after endoscopic treatment for gastric Cancer; A comparison with open gastrectomy

Hye Youn, Kwon

Department of Medicine

The Graduate School, Yonsei University

(Directed by Professor Woo Jin, Hyung)

I. INTRODUCTION

With the help of widespread health screening and development of endoscopic technology, early detection of gastric cancer has been raised where gastric cancer is prevalent such as Korea and Japan. (1-2) Endoscopic resection, endoscopic submucosal resection or endoscopic submucosal dissection has been gaining acceptance as a useful method to treat early gastric cancer due to its minimal invasiveness and favorable results in maintaining good quality of life. (3-6) However, additional gastrectomy is needed after endoscopic resection for early gastric cancer when pathology confirms any possibility of lymph node metastasis or margin involvement. (7-8)

While there have been several reports regarding the necessity of additional surgery after endoscopic resection, no studies depicted the optimal type of surgery to apply in these patients. Some studies showed successful outcomes of laparoscopic
gastrectomy after endoscopic resection. However, most of these studies only focused on short-term outcomes and not the long-term outcomes. Whether the benefits of minimally invasive surgery can be maintained and oncological safety of laparoscopic approach in these specific patients is not investigated. To the best of our knowledge, there has been no study evaluating oncologic feasibility as well as early postoperative outcomes of laparoscopic gastrectomy after endoscopic resection compared with open surgery. In this context, to identify the optimal type of gastrectomy we compared the long-term outcomes of surgery laparoscopic gastrectomy with those of open gastrectomy for patients previously treated by endoscopic resection. In addition we also assessed the short-term outcomes whether the benefits of laparoscopic approach are existed in these specific patients group.

II. MATERIALS AND METHODS

1. Patients

From January 2003 to December 2010, 139 consecutive patients who underwent gastrectomy with lymph node dissection either by laparoscopic or by open for gastric cancer after endoscopic treatment, either by endoscopic mucosal resection or by endoscopic submucosal dissection, at Severance Hospital, Yonsei University Health System, Seoul, Korea were included in this study. Of these 139 patients, 29 patients underwent gastrectomy because of local tumor recurrences in the same stomach area during follow up after complete resection by endoscopically without
any probability of lymph node metastasis. After excluding 29 recurred patients after complete endoscopic resection, 110 patients were included for the analyses.

Patient demographics, pathologic feature after endoscopic treatment, pathologic outcome after surgery, clinical outcomes including operation time, time to gas passing, time to soft diet, hospital day, complications and long term oncologic outcomes were compared between open and laparoscopic group. The written informed consent was received from all of the patients at the time of surgery.

2. Indications of surgery after endoscopic resection and surgical procedures
The indications of surgery after endoscopic resection are when pathology reports confirms any of following conditions lateral margin involvement of cancer, submucosal invasion with or without basal margin involvement, lymph vascular invasion, and local tumor recurrence after endoscopic resection.
According to the tumor location, we performed distal subtotal or total gastrectomy. The lymph node dissection was performed according to the rules of the Japanese Research Society for Gastric Cancer as follows; D1+α (dissection of group 1 and number 7 lymph node), D1+β (dissection of group 1 and number 7, 8a, and 9 lymph nodes), or D2 lymphadenectomy (dissection of all group 1 and group 2 lymph nodes).(12,13)

3. Follow-up, categorization of recurrence pattern, and survival
We followed up the patients every 3months for 1 year after operation and every
6months for the next 4 years with physical examination, laboratory tests including tumor markers. (CEA, CA 19-9). The chest radiography, abdominal pelvic CT and endoscopy were performed at least once a year. We classified the recurrence pattern as loco-regional, lymphatic, distant metastasis and we confirm the recurrence by the tissue biopsy as possible.

The last follow up date was September 11\textsuperscript{th}, 2012.

4. Statistical analysis

Statistical analysis was performed using SPSS\textsuperscript{®} version 18.0 for Windows\textsuperscript{®} (SPSS, Inc., Illinois, USA). Categorical variables were compared using Chi-square or Fisher’s exact test, and continuous variables were compared with Mann-Whitney test. The risk factors associated with tumor recurrence and death were analyzed with univariate and multivariate logistic regression test. The Cox proportional hazard model was used for risk factors affecting disease free survival and overall survival.

III. RESULTS

1. Comparison of clinicopathologic features

Table 1 shows the clinical characteristics and pathologic results of endoscopic resection of the 110 patients who received radical gastrectomy after endoscopic resection. Demographic features in terms of in age and gender between open and laparoscopic gastrectomy group. There were no significant differences between the two groups in pathologic findings of endoscopic resection, except location of the
tumor. In laparoscopic gastrectomy group, tumor located more commonly in the lower third. \((P=0.02)\).

**Table 1** Comparison of clinicopathologic features of 110 patients after endoscopic treatment

|                     | Open (N=36)   | Lap (N=74) | p-value |
|---------------------|---------------|------------|---------|
| **Age(Years)***     | 60.3±9.8(43-76) | 60.4±10.2(40-78) | 0.99† |
| **Gender**          |               |            |         |
| Male                | 22(61.1)      | 49(66.2)   | 0.38¥  |
| Female              | 14(38.9)      | 25(33.8)   |         |
| **Tumor location**  |               |            |         |
| Upper               | 9(25.0)       | 9(12.0)    | 0.02*   |
| Middle              | 9(25.0)       | 8(10.8)    |         |
| Lower               | 18(50.0)      | 57(77.0)   |         |
| **Tumor size (mm)** | 1.28±0.5(4-30) | 1.68±0.5(2-52) | 0.53† |
| **Depth of invasion** |             |            |         |
| Confined to Mucosa  | 13(36.1)      | 25(33.8)   | 0.83¥  |
| Submucosal invasion | 23(63.9)      | 49(66.2)   |         |
| **Differentiation** |               |            |         |
| Adenoca. Well diff. | 11(30.6)      | 29(39.2)   | 0.42*   |
| Adenoca. Mod diff.  | 5(13.9)       | 16(21.6)   |         |
| Adenoca. Poor diff. | 10(27.8)      | 12(16.2)   |         |
| Signet ring cell    | 1(2.8)        | 0(0)       |         |
| Mucinous            | 8(22.2)       | 15(20.3)   |         |
| Undiff.             | 1(2.8)        | 2(2.7)     |         |
| **Lauren**          |               |            |         |
| Intestinal          | 24(53.3)      | 54(56.8)   | 0.96*   |
| Diffuse             | 9(20.0)       | 17(17.9)   |         |
| Mixed               | 1(2.2)        | 3(3.2)     |         |
| Unknown             | 11(24.4)      | 21(22.1)   |         |
| **Margin**          |               |            |         |
| All free            | 17(47.2)      | 32(43.2)   | 0.98*   |
| LM positive         | 9(25.0)       | 19(25.7)   |         |
| BM positive         | 7(19.4)       | 16(21.6)   |         |
| LM +BM positive     | 3(8.3)        | 7(9.5)     |         |
| **LVI**             |               |            |         |
| Negative            | 30(83.3)      | 60(81.1)   | 1.0*    |
| Positive            | 6(16.7)       | 14(18.9)   |         |
2. Comparison of indications of radical gastrectomy

The indications of radical gastrectomy are demonstrated in figure 1. Incomplete resection is defined to presence of carcinoma at lateral resection margin. Presence of LN metastasis is defined to submucosal invasion, histologically undifferentiation or had lymphovascular invasion. There were no differences in indications of additional gastrectomy after endoscopic resection between open and laparoscopic resection group.

![Figure 1: Surgical indication and method of operation](image)

3. Short-term postoperative outcomes

Postoperative outcomes are summarized in Table 2,3. Type of operation (subtotal gastrectomy vs. total gastrectomy) and extent of systemic lymph node dissection were similar between open and laparoscopic gastrectomy group. Mean operation time also showed no significant difference between the open and laparoscopic group.
(161.8min vs. 155.1, p-value 0.80). Laparoscopic group showed significantly shorter time to gas passing (2.7 days vs. 3.5 days, p<0.01) and soft diet (4.2 days vs. 5.4 days, p<0.01) and hospital (8.6 days vs. 10.6 days, p<0.01 compared to open group, while operation time and rate of postoperative complications were comparable between the two groups. There was no death caused by surgical complication.

The residual tumor was founded 55.6% in open group, and 68.9% in laparoscopic group (p=0.2). Depth of residual tumor was not different between two groups. (p=0.06) The metastatic lymph nodes were founded in 13.9% of open gastrectomy and 9.5% of laparoscopic group (P=0.80). The number of lymph nodes retrieved in the laparoscopic group did not differ from those dissected during the convetional open group (P=0.46).

Table 2 Short-term postoperative clinical outcomes of 110 gastrectomy patients

| Type of operation       | Open (n=36) | Lap (n=74 ) | p-value |
|-------------------------|-------------|-------------|---------|
| Type of operation       | STG         | 25(69.4)    | 60(81.1) | 0.23* |
|                         | TG          | 11(30.6)    | 14(18.9) |       |
| Extent of LN dissection | D1+β        | 30(83.3)    | 55(74.3) | 0.34* |
|                         | D2          | 6(16.7)     | 19(25.7) |       |
| Operation time (min)    |             | 161.8±66.3  | 155.1±50.3 | 0.80† |
| Gas passing (Day)       |             | 3.5±1.0     | 2.7±0.7  | <0.01† |
| Day of soft diet        |             | 5.4±1.7     | 4.2±1.7  | <0.01† |
| Hospital stay           |             | 10.6±6.3    | 8.6±18.9 | <0.01† |
| Surgical complication   |             | 5(13.9)     | 11(14.9) | 1.0*  |
Table 3 Postoperative pathologic outcomes of 110 gastrectomy patients

|                                      | Open (n=36) | Lap (n=74) | p-value |
|--------------------------------------|-------------|------------|---------|
| Residual tumor                       |             |            |         |
| No                                   | 16(44.4)    | 23(31.1)   | 0.20*   |
| Residual                             | 20(55.6)    | 51(68.9)   |         |
| Depth of residual tumor              |             |            |         |
| Mucosa                               | 7(19.4)     | 22(29.7)   | 0.06*   |
| Sub mucosa                           | 9(25.0)     | 26(35.1)   |         |
| Proper muscle                        | 1(2.8)      | 3(4.1)     |         |
| Sub serosa                           | 3(8.3)      | 0(0)       |         |
| N stage                              |             |            |         |
| 0                                    | 31(86.1)    | 67(90.5)   | 0.8*    |
| 1                                    | 2(5.6)      | 4(5.4)     |         |
| 2                                    | 2(5.6)      | 2(2.7)     |         |
| 3                                    | 1(2.8)      | 1(1.4)     |         |
| Number of retrieved LNs              | 31.6±10.9   | 35.1±14.1  | 0.16†   |
| Final stage                          |             |            |         |
| IA                                   | 30(83.3)    | 65(87.8)   | 0.47*   |
| IB                                   | 2(5.6)      | 5(6.8)     |         |
| IIA                                  | 1(2.8)      | 3(4.1)     |         |
| IIB                                  | 1(2.8)      | 1(1.4)     |         |
| IIIA                                 | 1(2.8)      | 0(0)       |         |
| IIIB                                 | 1(2.8)      | 0(0)       |         |

4. Long-term oncologic outcomes

There was 3 recurrence. All of the recurrence were distant metastasis, and there was no local recurrence. Six patients died during the median follow-up period of 47 months. Among 6 patients, three patients died of recurred gastric cancer (1 in laparoscopic and 2 in open gastrectomy group) while but the other three patients died due to other malignancies of malignant lymphoma, renal pelvis cancer and breast cancer. There were no statistical difference in recurrence rate (1.4% for laparoscopic and 5.6% for open, $P=0.25$) and in overall ($P=0.22$) and disease-free
survival ($P=0.19$) between the two groups. (Figure 2) In the univariate and multivariate logistic analysis, type of approach was not an independent risk factor for recurrence. In the Cox regression hazard model, T stage and N stage were the significant prognostic factors associated with disease free survival. However, type of approach was not an independent risk factor for disease free survival of the patients underwent additional gastrectomy after endoscopic resection.

![Figure 2 Comparison of disease free survival for patients after laparoscopic and conventional open gastrectomy](image)

Figure 2 Comparison of disease free survival for patients after laparoscopic and conventional open gastrectomy
### Table 4 Univariate and Multivariate analyses of risk factors for recurrence after gastrectomy

| Variable                                    | Univariate analysis | Multivariate analysis |
|----------------------------------------------|---------------------|-----------------------|
|                                              | OR (95% CI)         | P                     | OR (95% CI)         | P                     |
| Age (≤65yr vs. >65)                         | 3.6(0.32-41.4)      | 0.3                   | 3.6(0.2-62.48)      | 0.38                  |
| Sex(male vs. female)                        | 3.78(0.3-43.1)      | 0.28                  | 2.9(0.18-49.75)     | 0.45                  |
| Op method(open vs. lap)                     | 0.23(0.02-2.66)     | 0.24                  |                       |                       |
| Extent of resection(subtotal vs. total)     | 1.73(0.15-19.9)     | 0.67                  |                       |                       |
| Extent of LN dissection(D1+b vs. D2)        | -                   | -                     |                       |                       |
| Differentiation(Diff vs. undiff)            | -                   | -                     |                       |                       |
| Lymph vascular invasion                     | 2.32(0.2-26.87)     | 0.50                  |                       |                       |
| Size(<25mm vs.≥25mm)                        | -                   | -                     |                       |                       |
| T stage (1 vs. 2,3)                         | 33.67(2.67-425.95)  | <0.01                 | 11.14(0.57-218.95)   | 0.11                  |
| N stage (0 vs. 1,2,3)                       | 19.4(1.61-233.32)   | 0.02                  | 8.9(0.43-188.44)     | 0.16                  |

### Table 5 Univariate and Multivariate analysis of prognostic factors for relapse free survival

| Variable                                    | Univariate analysis | Multivariate analysis |
|----------------------------------------------|---------------------|-----------------------|
|                                              | HR (95% CI)         | P                     | HR (95% CI)         | P                     |
| Age (≤65yr vs. >65)                         | 3.9(0.36-43.37)     | 0.26                  | 15.52(0.52-465.4)   | 0.11                  |
| Sex(male vs. female)                        | 3.6(0.33-39.78)     | 0.30                  | 1.06(0.06-17.60)    | 0.96                  |
| Op method(open vs. lap)                     | 0.23(0.02-2.54)     | 0.23                  |                       |                       |
| Extent of resection(subtotal vs. total)     | 1.65(0.15-18.20)    | 0.68                  |                       |                       |
| Extent of LN dissection(D1+b vs. D2)        | 0.03(0-3561.8)      | 0.57                  |                       |                       |
| Differentiation(Diff vs. undiff)            | 79.2(0-908347)      | 0.36                  |                       |                       |
| Lymph vascular invasion                     | 2.16(0.2-23.84)     | 0.53                  |                       |                       |
| Size(<25mm vs.≥25mm)                        | 0.03(0-1813.67)     | 0.53                  |                       |                       |
| T stage (1 vs. 2,3)                         | 31.15(2.82-343.89)  | <0.01                 | 17.17(1.17-251.93)   | 0.04                  |
| N stage (0 vs. 1,2,3)                       | 18.28(1.66-201.63)  | 0.02                  | 24.78(0.97-633.74)   | 0.05                  |
V. DISCUSSION

In this study, we compared the short-term postoperative outcomes and long-term oncologic outcomes between conventional open and laparoscopic gastrectomy in the patients who previously resected with endoscopy for clinically early gastric cancer. We found that the short-term outcomes, such as hospital day, time to gas passing and time to soft diet showed favorable results in laparoscopic gastrectomy group. The oncologic outcomes of laparoscopic gastrectomy were comparable to those of conventional open gastrectomy. The adequate lymph node dissection and favorable long-term outcomes, measured by disease free survival and recurrence were achieved by laparoscopic surgery for patients previously treat by endoscopic resection.

Endoscopic resection has been established as one of treatment options for early gastric cancer. Endoscopic resection provides a survival rate of 90% comparable to that of surgery if it is applied with appropriate indications.(14-16) It also can avoid morbidity and mortality associated with surgery and maintain the patients’ quality of life after treatment. However, additional gastrectomy is needed after endoscopic resection for early gastric cancer when pathology confirmed any possibility of lymph node metastasis or margin involvement.(7-11) While there have been several reports regarding the necessity of additional surgery after endoscopic resection, no studies depicted the optimal type of surgery to apply in these patients.

Laparoscopic gastrectomy for gastric cancers has been widely used for early gastric cancer. This approach increased because of its low invasiveness, good cosmesis and
recovery.(17-19) Although there are some unresolved oncologic problems for advanced gastric cancer, in early gastric cancer, laparoscopic gastrectomy is considered to be safe, and the rate of local failure after laparoscopic gastrectomy is comparable to that of open surgery.(20-22) Applications of laparoscopic gastrectomy for patients previously received endoscopic resection in early gastric cancer have been reported. But, these studies were focused on that laparoscopic surgery might be beneficial in regard to short term clinical outcome after surgery. According to our results, oncologic outcomes of laparoscopic gastrectomy were comparable with those of conventional open gastrectomy in the patients who previously received endoscopic resection for gastric cancer. The favorable long-term outcomes, measured by disease free survival and recurrence were achieved by laparoscopic surgery. Also, D2 lymph node dissection was performed in laparoscopic gastrectomy similar to open surgery. The all of recurrences were distant metastases, which means that Adequate local control was achieved by laparoscopic gastrectomy. The complication rates were also acceptable compared to open surgery and there was no mortality. There are some important concerns of the long-term oncologic outcomes of laparoscopic gastrectomy. The first issue is the potential peritoneal recurrence or port site metastasis due to insufflated gas for a pneumoperitoneum. In our study, there were neither port-site metastases nor recurrence at surgical wound. The peritoneal recurrence occurred only in one patient of laparoscopic group. The second is the possible loco-regional recurrence because of inadequate lymph node
dissection. However, our study revealed that D2 dissection was performed similarly in two groups and the number of retrieved lymph nodes in laparoscopic surgery was comparable to that of open surgery. However, the study is limited by the retrospective nature of analyses and possibility of selection bias of applying laparoscopic surgery. Despite these limitations, we analyzed 110 gastric cancer patients who received endoscopic resection before radical gastrectomy and compared the long term oncologic outcome between laparoscopic and open surgery.

In conclusion, our study demonstrated that laparoscopic approach can be safely applied for gastric cancer patients previously treated by endoscopic resection. Laparoscopic gastrectomy after endoscopic resection showed comparable oncologic outcomes to open approach while maintaining benefits of minimally invasive surgery. Thus, laparoscopic gastrectomy can be a treatment of choice for patients previously treated by endoscopic resection.

VI. REFERENCES

1. Jermal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. CA Cancer J Clin. 2011;61:69-90.
2. Jung KW, Park S, Kong HJ, Won YJ, Lee JY, Park EC, et al. Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2008. Cancer Res Treat. 2011;43:1-11.
3. Gotoda T. Endoscopic resection of early gastric cancer. Gastric Cancer 2007;10:1–11.
4. Gotoda T, Yamamoto H, Soetikno RM. Endoscopic submucosal dissection of early gastric cancer. J Gastroenterol. 2006;41(10):929-42.

5. Sugimoto T, Okamoto M, Mitsuno Y, Kondo S, Ogura K, Ohmae T, et al. Endoscopic submucosal dissection is an effective and safe therapy for early gastric neoplasms: a multicenter feasible study. J Clin Gastroenterol. 2012;46:124-9.

6. Ono H, Kondo H, Gotoda T, Shirao K, Yamaguchi H, Saito D, et al. Endoscopic mucosal resection for treatment of early gastric cancer. Gut. 2001;48:225-9.

7. Nagano H, Ohyama S, Fukunaga T, Seto Y, Fujisaki J, Yamaguchi T, et al. Indications for gastrectomy after incomplete EMR for early gastric cancer. Gastric cancer. 2005;8:149–54.

8. Oda I, Gotoda T, Sasako M, Sano T, Katai H, Fukagawa T, et al. Treatment strategy after non-curative endoscopic resection of early gastric cancer. Br J Surg. 2008;95:1495-500.

9. Song KY, Hyung WJ, Kim HH, Han SU, Cho GS, Ryu SW et al. Is gastrectomy mandatory for all residual or recurrent gastric cancer following endoscopic resection? A large scale Korean multicenter study J of Surg Oncol 2008;98:6-10

10. Ryu KW, Choi IJ, Doh YW, Kook MC, Kim CG, Park HJ, et al. Surgical indication for non-curative endoscopic resection in early gastric cancer. Ann Surg Oncol. 2007;14:3428-34.

11. Chung YS, Park DJ, Lee HJ, Kim SG, Jung HC, Song IS, et al. The role of surgery after incomplete endoscopic mucosal resection for early gastric cancer. Surg Today. 2007;37:114-7.
12. Nakajima T. Gastric cancer treatment guidelines in Japan. Gastric Cancer. 2002;5:1-5.

13. Japanese Gastric Cancer Association. Japanese Classification of Gastric Carcinoma - 2nd English Edition -. Gastric Cancer. 1998;1(1):10-24.

14. Gotoda T, Iwasaki M, Kusano C, Seewald S, Oda I. Endoscopic resection of early gastric cancer treated by guideline and expanded National Cancer Centre criteria. Br J Surg. 2010;97:868-71.

15. Manner H, Rabenstein T, May A, Pech O, Gossner L, Werk D, et al. Long-term results of endoscopic resection in early gastric cancer: the Western experience. Am J Gastroenterol. 2009;104:566-73.

16. Uedo N, Iishi H, Tatsuta M, Ishihara R, Higashino K, Takeuchi Y, et al. Longterm outcomes after endoscopic mucosal resection for early gastric cancer. Gastric Cancer. 2006;9:88-92.

17. Memon MA, Khan S, Yunus RM, Barr R, Memon B. Meta-analysis of laparoscopic and open distal gastrectomy for gastric carcinoma. Surg Endosc. 2008;22:1781-9.

18. Kim Y, Baik YH, Yun YH, Nam BH, Kim DH, Choi IJ, et al. Improved quality of life outcomes after laparoscopy-assisted distal gastrectomy for early gastric cancer: results of a prospective randomized clinical trial. Ann Surg. 2008;248:721-7.

19. Kim HH, Hyung WJ, Cho GS, Kim MC, Han SU, Kim W, et al. Morbidity and mortality of laparoscopic gastrectomy versus open gastrectomy for gastric cancer:
an interim report--a phase III multicenter, prospective, randomized Trial (KLASS Trial). Ann Surg. 2010;251:417-20.

20. Song J, Lee HJ, Cho GS, Han SU, Kim MC, Ryu SW, et al. Recurrence following laparoscopy-assisted gastrectomy for gastric cancer: a multicenter retrospective analysis of 1,417 patients. Ann Surg Oncol. 2010;17:1777-86.

21. An JY, Heo GU, Cheong JH, Hyung WJ, Choi SH, Noh SH. Assessment of open versus laparoscopy-assisted gastrectomy in lymph node-positive early gastric cancer: a retrospective cohort analysis. J Surg Oncol. 2010;102:77-81.

22. Pak KH, Hyung WJ, Son T, Obama K, Woo Y, Kim HI, et al. Long-term oncologic outcomes of 714 consecutive laparoscopic gastrectomies for gastric cancer: results from the 7-year experience of a single institute. Surg Endosc. 2012;26:130-6.
서론: 내시경적 절제술은 조기 위암 절제의 한 방법으로 널리 이용되고 있다. 하지만, 내시경 절제술 후 절제 연 침범이나 임파선 전이의 위험이 있는 경우 수술적 치료가 필요하다. 본 연구는 위암환자에서 내시경 절제술 후 근치적 수술을 할 때 있어서 복강경 수술의 유용성과 종양학적 결과를 분석해 보고자 하였다.

방법: 2003년 1월부터 2010년 12월까지 연세대학교 의과대학 세브란스 병원에서 내시경적 절제술 후 복강경 혹은 개복 위 절제술 및 임파선 절제술을 시행 받은 110명의 환자를 대상으로 복강경 및 개복 수술에서 임상종양학적 특징, 수술 후 임상결과 및 종양학적 결과를 비교하였다.

결과: 110명의 내시경적 절제술을 시행 받은 환자들 중 36명이 개복수술을 받았고 74명이 복강경적 위 절제술을 시행 받았다. 재원기간, 장 운동의 회복 및 식이 섭취 시간이 복강경 수술을 받은 환자에서 유의하게 짧았으며 수술 후 합병증에는 차이가 없었다. 47개월의
추적관찰 기간 동안 수술 후 재발 및 무병 생존율은 두 군에서 두 군에서 유의한 차이가 없었으며, 수술의 방법은 재발과 무병 생존율에 독립적인 위험인자로 작용하지 않았다.

결론: 복강경 위 절제술은 조기위암에서 내시경적 절제술 후 수술이 필요한 환자에게 종양학적으로 안전하고 유용하게 적용할 수 있다.