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Original research

Readmissions following elective radical total gastrectomy for early gastric cancer: A case-controlled study

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ABSTRACT

Background: Readmission after gastrectomy is one of the factors that reflect quality of life. Therefore, we analyzed the several factors related to readmissions after total gastrectomy for early gastric cancer.

Methods: From January 2002 through December 2009, 102 consecutive patients who underwent radical total gastrectomy for early gastric cancer were enrolled in this study. We evaluated the incidence, cause, time point, and type of treatment for readmission after discharge; we compared the readmission and non-readmission groups in regard to clinicopathologic features and postoperative outcomes.

Results: The readmission rate during the five years after total gastrectomy was 22 of 102 (21.6%). The most common cause for readmission was esophagojejunostomy stricture (5 cases). The treatment given for 31 readmissions included 23 conservative therapies, 3 radiologic or endoscopic interventions, and 5 re-operations. No significant differences were detected in the clinicopathologic feature, postoperative outcomes, or 5-year survival rates between the readmission and non-readmission group. No specific risk factor was found to be associated with readmission.

Conclusion: Although we could not determine a specific risk factor associated with readmission after radical total gastrectomy, prevention of readmission by evaluating the causes and treatments after radical total gastrectomy can improve the patient's quality of life.

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1. Introduction

Worldwide, more than 800,000 patients are diagnosed with gastric cancer each year. The second most common cause of cancer-related death worldwide is gastric cancer.¹ Surgical resection for gastric cancer is the only therapeutic modality that may be curative.² The incidence of early gastric cancer in Korea has been increasing because of recent improvements in early diagnosis.³

There are several methods of treatment for early gastric cancer, including endoscopic treatment (e.g., endoscopic submucosal dissection and endoscopic mucosal resection).⁴ However, many cases of early gastric cancer require radical subtotal gastrectomy or total gastrectomy for the treatment of potential lymph node metastasis. In addition, minimally invasive subtotal gastrectomy or total gastrectomy is performed for early gastric cancer.⁵

Currently, many surgeons as well as patients have focused on quality of life after gastrectomy.^{6–8} Readmission after gastrectomy

is one of the factors that impact the quality of life. While the literature contains some studies regarding readmission after discharge,^{9–13} reports on readmission after gastrectomy for gastric cancer are extremely limited.¹⁴ Moreover, the literature contains no reports regarding readmission after radical total gastrectomy for early gastric cancer.

Therefore, we analyzed the incidence and cause of readmissions after radical total gastrectomy for early gastric cancer and investigated the risk factors associated with readmission after surgery.

2. Patients and methods

From January 2002 through December 2009, 102 consecutive early gastric cancer patients who underwent radical total gastrectomy performed by three surgeons (Min-Chan Kim, Ki-Han Kim, and Ghap-Joong Jung) at Dong-A University Medical Center were enrolled in this study.

A Dong-A gastric data base has been prospectively accumulated since 2002. Data were prospectively retrieved from surgical and pathological reports, with follow-up data obtained from the outpatient clinical data base. We excluded 291 advanced gastric cancer patients because postoperative chemotherapy can affect

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readmission. The hospital admission records were reviewed to identify readmissions associated with only gastric cancer or surgery. During the first five postoperative days, 15 patients died of other diseases. We reviewed the clinicopathological characteristics, postoperative outcomes, postoperative morbidities and mortalities, and survival related to readmission after radical total gastrectomy for early gastric cancer. We divided the readmission into 4 periods (<1 month, 1–3 months, 3 months to 1 year, and >1 year). In addition, the causes for readmission, the time point of readmission, the number of readmissions, the types of treatment, and the risk factors associated with readmission were evaluated. In this study, gastric cancer stage was classified according to the 7th edition of the American Joint Committee on Cancer (AJCC) staging criteria.¹⁵ All values were expressed as mean \pm standard deviation (SD).

All patients were managed routinely by a standardized perioperative protocol, as follows: (1) no nasogastric intubation or preoperative mechanical bowel preparation; (2) minimal spillage of gastric contents; (3) use of two closed suction drains; (5) sips of water 72 h postoperatively; (6) a clear liquid diet 4 days postoperatively; (7) hospital discharge 8 or 9 days postoperatively after a soft diet with no abnormal clinical symptoms. All patients underwent total gastrectomy with Roux en Y esophagojejunostomy and lymphadenectomy for no. 1, 2, 3, 4, 5, 6, 7, 8a, 9, 11p, and 11d lymph nodes.

Follow-up results were obtained from patient hospital records and telephone survey. Recurrence was determined primarily by endoscopy, computed tomography, and positron emission tomography. All tracked patients were monitored postoperatively by a routine analysis of blood tests, tumor markers [carcinoembryonic antigen (CEA) and carbohydrate antigen 19-9(CA19-9)], chest radiography, endoscopy, and computed tomography. Follow-up studies were conducted every six months for two years, and every year thereafter for the next three years.

For statistical analysis, we used SPSS software version 18.0 (SPSS, Inc, an IBM Company, Chicago, Illinois, USA). The chi-square test or Fisher's exact test and Student's independent *t*-test, or the Mann–Whitney *U*-test were used to compare the clinicopathologic factors of patients in the readmission and non-readmission groups of radical total gastrectomy for early gastric cancer. Null hypotheses of no difference were rejected if *p*-values were <0.05. Survival curves were calculated by the Kaplan–Meier method. In addition, we evaluated the univariate and multivariate risk factors for readmission.

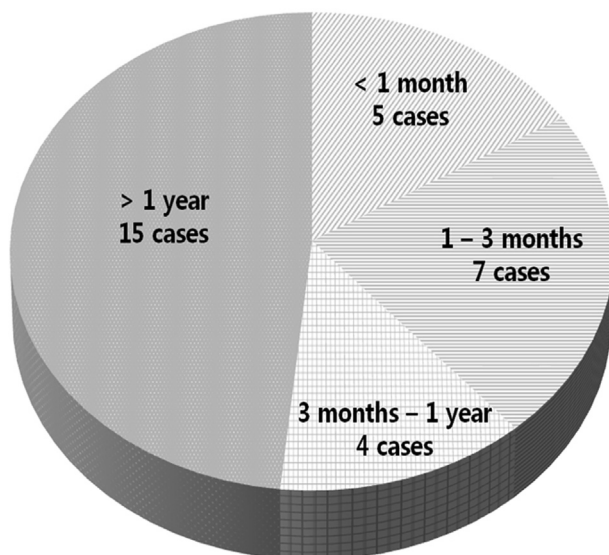


Fig. 1. The incidence of readmission according to time point. Thirty-one readmissions occurred among 22 patients after radical total gastrectomy for early gastric cancer.

Table 1

Causes and time point of 31 readmissions after radical total gastrectomy for early gastric cancer.

Reason for readmission	<1 month	1–3 months	3 months–1 year	>1 year	Total
EJ stricture	2	2	1		5
General weakness	1	1	1	1	4
Diarrhea	1	1	2		4
Intestinal obstruction	1			2	3
Ileus				3	3
GB stone			2		2
Short bowel syndrome			2		2
CBD stone			1		1
Acute cholecystitis		1			1
Anemia				1	1
Internal herniation				1	1
Small bowel strangulation				1	1
Afferent loop syndrome				1	1
Pneumonia		1			1
Others		1			1
Total	5	7	4	15	31

EJ; esophagojejunostomy.

3. Results

Among 22 patients, 31 readmissions occurred (22 of 102; 21.6%) after radical total gastrectomy for early gastric cancer.

3.1. Analysis of readmission

Fig. 1 present the time point of readmission for the 22 patients. The reasons and time points of readmission for the 22 patients are presented in Table 1. The most common cause for readmission was esophagojejunostomy stricture (5 cases). One year postoperatively, ileus was the most common cause of readmission. Among the 22 patients, four were readmitted more than once (seven times for one patient; two times for three patients).

3.2. Outcomes and type of treatments for readmission

The mean number of readmissions was 1.4 ± 1.3 and the mean length of hospital stay when readmitted was 6.2 ± 4.0 days. The type of treatment for 31 readmissions included 23 conservative therapies, 3 radiologic or endoscopic interventions, and 5 re-operations (Table 2). In 5 re-operations, there was 1 case of intestinal obstruction, 1 case of cholelithiasis, 1 case of internal herniation, 1 case of small bowel strangulation, and 1 case of afferent loop syndrome.

3.3. Clinicopathologic characteristics in both groups (readmission and non-readmission)

Table 3 presents the clinicopathological features in the readmission and non-readmission groups. The comorbidities differed statistically between the two groups ($p = 0.044$).

Table 2

Outcomes of 31 readmissions among 22 patients after radical total gastrectomy for early gastric cancer.

Outcomes	
Number of re-admissions ^a (range)	1.4 ± 1.3 (1–7)
Hospital stay ^a (range)	6.2 ± 4.0 (1–18)
Type of treatment	
Conservative therapy (%)	23 (74.2)
Radiologic or endoscopic intervention (%)	3 (9.7)
Re-laparotomy (%)	5 (16.1)

^a All values are the mean and standard deviation.

3.4. Postoperative outcomes, recurrences, and survival between the two groups

Table 4 presents the postoperative outcomes and recurrences among the readmission and non-readmission groups. There were no significant differences between the groups in regard to operative method, operative time, initial hospital stay, postoperative complications, median follow-up period, and recurrence. During the median follow-up period, tumor recurrence was detected in one case (4.5%) in the readmission group and six cases (7.5%) in the non-readmission group.

Fig. 2 presents the 5-year overall and disease free survival rates. The 5-year overall survival rates were 93.8% in the readmission group and 96.0% in the non-readmission group ($p = 0.896$). The disease-free survival rates were 95.2% in the readmission group and 93.1% in the non-readmission groups ($p = 0.702$).

3.5. Predictive factors associated with readmission

Univariate analysis of factors related to readmission demonstrated that comorbidities were associated with readmission. However, there was no single risk factor associated with readmission after radical total gastrectomy based on multivariate analysis (Table 5).

4. Discussion

Despite improvement of the survival of patients with gastric cancer, it is one of the most common causes of cancer-related death worldwide.^{16,17} Recently, laparoscopic surgery for gastric cancer has become an alternative treatment option. As the popularity of laparoscopic surgery grows, with the advantages of quicker recovery, improved cosmetics, and reduced wound complications,

Table 3
Clinicopathological features of readmission (RG) and non-readmission groups (NRG).

	RG (n = 22)	NRG (n = 80)	p-Value
Age (years) ^a	62.0 ± 12.0	58.6 ± 11.0	0.217
Gender			
Male	14	60	0.294
Female	8	20	
BMI (kg/m ²) ^a	22.9 ± 3.4	23.3 ± 2.8	0.598
Co-morbidities			
No	10	56	0.044
Yes	12	24	
Size of main lesion (mm) ^a	3.6 ± 2.5	3.7 ± 2.8	0.956
Tumor location			
Lower	1	8	0.715
Middle	8	29	
Upper	13	43	
Resection margin (cm)			
Proximal	2.7(0.5–11.0)	3.7 (0.5–12.0)	0.149
Distal	13.0 (3.0–21.0)	12.5 (4.0–23.5)	0.612
T stage ^b			
T0	1	1	0.583
T1a	9	37	
T1b	12	42	
N stage ^b			
N0	22	69	0.115
N1	0	11	
Retrieved lymph nodes (number) ^a	41.6 ± 18.1	41.6 ± 17.0	0.995

RG, readmission group; NRG, non-readmission group.
p-Values of less than 0.05 were considered to be statistically significant and are represented in bold.

^a All values are the mean and standard deviation.

^b Based on the AJCC 7th TNM classification.

Table 4
Post-Operative outcomes of readmission (RG) and non-readmission groups (NRG).

Post-operative outcomes	RG (n = 22)	NRG (n = 80)	p-Value
Operative method			
Open	17	56	0.601
Laparoscopy	5	24	
Operative times (minutes) ^a	221.6 ± 64.0	226.4 ± 58.2	0.741
Initial hospital stay (days) ^a	10.1 ± 4.5	9.7 ± 4.2	0.525
Post-operative complications			
No	17	68	0.518
Yes	5 (19.2%)	12 (15.0%)	
Median duration of follow-up (months, range)	58.6 (14.8–136.4)	74.9 (14.7–130.1)	0.384
Recurrence			
No	21	74	1.000
Yes	1 (4.5%)	6 (7.5%)	

RG, readmission group; NRG, non-readmission group.

^a All values are the mean and standard deviation.

many surgeons now consider quality of life after gastrectomy. A number of studies have addressed quality of life after gastrectomy.^{6–8}

Radical total gastrectomy is more difficult due to technical aspects and the risk of serious complications. Specifically, if serious complications occur after total gastrectomy, it is more often fatal than it is following gastrectomy for other indications. In most series, the mortality rate is reported to range from 3% to 10%, and morbidity rate is reported to range from 20% to 45%.^{18–20} Lang et al.²¹ reported a postoperative morbidity of 339/1114 (30.4%) among 1114 patients with conventional open total gastrectomy (COTG). However, other studies have reported postoperative morbidity rates of 13–14% for COTG.^{22,23} In addition, in recent years, as laparoscopic surgery has increased, interest has grown in regard to postoperative complications following laparoscopic radical total gastrectomy for gastric cancer. The literature contains a number of reports regarding the postoperative morbidity and mortality of laparoscopic total gastrectomy considering.^{24–26} However, the postoperative morbidity and mortality after laparoscopic total gastrectomy is currently still higher than that of laparoscopic distal gastrectomy.²⁶ Moreover, postoperative readmission due to short- and long-term complications after discharge will impact quality of life.

We previously published an analysis of readmission after radical subtotal gastrectomy for early gastric cancer.¹⁴ It showed that the initial hospital stay was significantly associated with readmission after radical subtotal gastrectomy for early gastric cancer. However, there was no cases of readmission after radical total gastrectomy for gastric cancer.

Readmission after surgery can be affected by the extent of surgery and the patients' preoperative comorbidities. The literature contains some reports of readmission after surgery. Sanjay et al.⁹ reported that, with elective laparoscopic cholecystectomy, the readmission rate within the first 6 weeks was 43 of 1523 (2.8%), and the 5-year readmission rate was 101 of 1523 (6.6%). The most common causes for readmission were non-specific abdominal pain (36%), obstructive jaundice (14%), and peptic ulcer disease (10%). However, the risk factors for readmission were not been shown. Schneider et al.²⁷ reported that, with colorectal surgery for colon cancer, the 30-day readmission rate was 16,753 of 149,622 (11.2%). The most common causes for readmission were operative complications (21.8%), dehydration (21.5%), and postoperative infection (18.3%). The risk factors associated with readmission included age 75 years or older, Charlson comorbidities ≥ 3 , rectal vs. non-rectal procedure, and postoperative complications. Datta et al.²⁸ reported that with ileal pouch-anal anastomoses, the 5-year

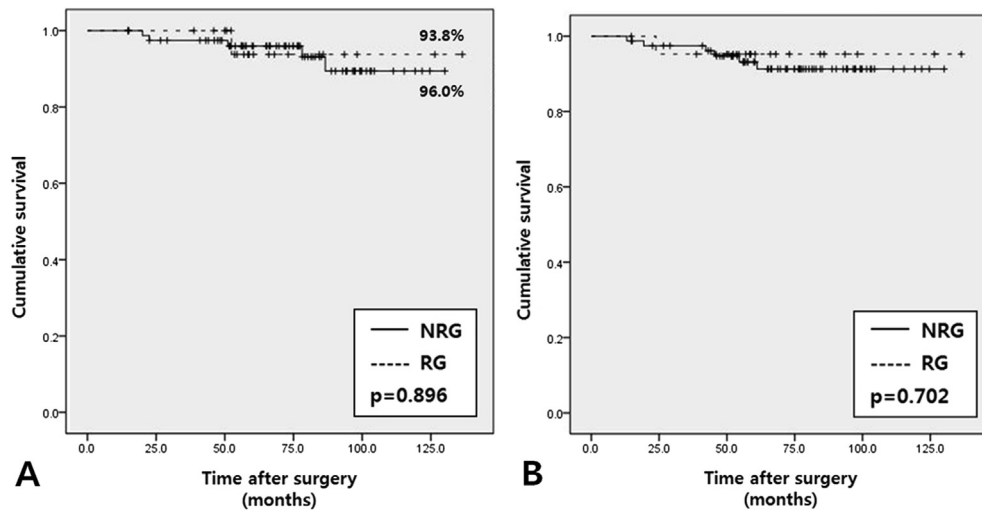


Fig. 2. Comparison of 5-year overall (A) and disease-free (B) survival rates of radical total gastrectomy for early gastric cancer between the readmission and non-readmission groups. There was no statistically significant difference between the groups (A; $p = 0.896$; B; $p = 0.702$). (RG; readmission group, NRG; non-readmission group).

readmission rate was 30%. The common causes of readmission were small bowel obstruction and pelvic sepsis/anastomotic leak; in this study, only perioperative steroid use was a risk factor for readmission. Cima et al.²⁹ reported that in hand-assisted laparoscopic colorectal surgery, the 30-day readmission rate was 7.2%. The common causes for readmission were abscess, ileus/small bowel obstruction and dehydration. The risk factors for readmission were not described.

Two reports showed that the risk factor for patients' readmission was the presence of comorbidities.^{27,30} Both studies were large series that attempted to determine risk factors for readmission. They found that one of risk factors was the presence of comorbidities. Although our study was a small series (102 patients) who underwent a radical total gastrectomy, we found a statistically significant difference in comorbidities with univariate analysis that compared the readmission group and non-readmission group. However, unfortunately, no statistically significant risk factor was found with multivariate analysis.

If our study had included more patients or was a multicenter study, we might have been able to determine the most common risk factors for the readmission after radical total gastrectomy for early gastric cancer.

Table 5
Univariate and Multivariate Logistic Regression Analysis for Predictable Factors associated with Readmission.

Variables	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-Value	OR	95% CI	p-Value
Age (year)						
<60 vs. ≥ 60	2.41	(0.86, 6.80)	0.096	1.93	(0.66, 5.68)	0.230
Gender						
Male/female	1.71	(0.67, 4.69)	0.293			
BMI (Kg/m ²)						
<23.0 vs. ≥ 23.0	1.12	(0.43, 2.93)	0.812			
Comorbidity						
No vs. yes	2.80	(1.07, 7.36)	0.037	2.38	(0.88, 6.47)	0.089
Operation method						
Laparoscopy vs. open	1.46	(0.48, 4.40)	0.505			
Complication						
No vs. yes	1.67	(0.52, 5.38)	0.392			
Tumor recurrence						
No vs. yes	0.59	(0.08, 5.15)	0.631			

OR, odds ratio; CI, confidence interval.

5. Conclusions

This study was a retrospective, observational study. Although we were unable to determine the risk factors associated with readmission after radical total gastrectomy, prevention of readmission via consideration of the causes and treatments after radical total gastrectomy would improve the patient's quality of life.

Ethical approval

None.

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Author contribution

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Analysis and interpretation of data: Yong Deok Kim, Ki Han Kim, Min Chan Kim, Yoo Min Kim.

Writing and Drafting of manuscript: Yong Deok Kim, Min Chan Kim.

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Conflict of interest

All authors disclosed no financial relationships relevant to this publication.

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