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ORIGINAL ARTICLE

Complications Requiring Reoperation after Gastrectomy for Gastric Cancer: 17 Years Experience in a Single Institute

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Abstract
Introduction Morbidity and mortality rates following gastric cancer surgery are still high. The present study documented complications requiring reoperation after gastrectomy for gastric cancer and described surgical management for each complication.
Materials and Methods Between 1987 and 2004, 8,033 patients underwent gastrectomy at the Department of Surgery, College of Medicine, Yonsei University, and the records were reviewed.
Results and discussion The most frequent complication was intestinal obstruction (88 patients, 54.3%), followed by intraabdominal bleeding (15, 9.3%), wound dehiscence or evisceration (15, 9.3%), incisional hernia (15, 9.3%), anastomotic leakage (seven, 4.2%), acalculous cholecystitis (five, 3.1%), duodenal stump leakage (five, 3.1%), intraabdominal abscess without leakage (five, 3.1%), bowel perforation (five, 3.1%), bile peritonitis due to hepatic duct injury (one, 0.6%), and biliary stricture (one, 0.6%). There were ten cases of hospital mortality (6.2%) from intraabdominal bleeding (four patients), intestinal obstruction (four patients), and anastomotic leakage (two patients). The most common long-term complication requiring reoperation was intestinal obstruction (69, 75.8%) due to adhesive formation rather than technical failure, while short-term complications were surgery-related and associated with high hospital mortality (14.1%).
Conclusion Proper preoperative preparation and faultless surgical skills are required during initial surgery to reduce complications and the need for reoperation.

Keywords Gastric cancer · Complication · Reoperation · Mortality

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Introduction

Gastric cancer is the second most common cause of cancer death worldwide, and surgical resection with lymphadenectomy is the only curative treatment.[1] Although surgical skills, anesthesiology, antibiotics, nutritional support, and radiological intervention have improved remarkably in recent years, significant morbidity and mortality still occur following gastric cancer surgery. Western countries have reported morbidity and mortality rates of 35–46% and 4–16%, respectively, after D2 lymph node dissection.[2–4] Major complications include anastomotic leakage, intraabdominal bleeding, intraabdominal abscess, intestinal obstruction, pancreatitis, and wound dehiscence. Indeed, the reoperation rate for these complications ranges from 2.8% to 10%.[4–6] However, a study of a large series of complications requiring reoperation has not been reported in the literature.

The present study reviewed our experience with patients who experienced complications requiring reoperation fol-

lowing gastrectomy for gastric cancer over a 17-year period. The study assessed the frequency of the major complications, surgical outcomes, and surgical management. Longer life expectancy and better quality of life are expected outcomes of optimal management of complications following gastric cancer surgery.

Materials and Methods

The records of 8,033 patients who had undergone gastrectomy for pathologically confirmed gastric adenocarcinoma from January 1987 to December 2004 at the Department of Surgery, College of Medicine, Yonsei University were reviewed retrospectively, and 162 patients with complications requiring reoperation were identified for this study. Patients who underwent reoperation due to recurrence or complications related to recurrence, positive resection margin, and patients with chronic (>1 month) gallbladder disease after gastrectomy were excluded because the focus of this study was on surgery-related complications requiring reoperation.

Complications were categorized as either short-term or long-term according to the time of reoperation, and then further subdivided into three groups: group A, within 1 week; group B, from 1 week to 1 month; and group C, after 1 month. Hospital mortality was defined as death within 30 days or during the same hospitalization. All patients in the study underwent the following standard operations: (1) total or distal subtotal gastrectomy, depending on the location and macroscopic appearance of the primary tumor, and (2) D2 or higher than D2 lymphadenectomy according to the rules of The Japanese Research Society for Gastric Cancer.[7] All statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 13.0 for Windows (SPSS, Chicago, IL, USA). The clinicopathological variables were analyzed using the chi-square test for discrete variables or the one-way analysis of variance for continuous variables. A P value of <0.05 was considered to indicate a significant difference.

Results

Of the 8,033 gastrectomy patients, 162 (2.0%) underwent reoperation because of postoperative complications. Of those, 129 (79.6%) were male and 33 (20.4%) were female, and the mean patient age was 57.7 years (range, 30–77 years). The clinicopathological characteristics are shown in Table 1. There were significant differences between the reoperation and nonreoperation groups in terms of age and gender.

Comparison of Incidence, Mortality, Time to Reoperation

The most frequent complication requiring reoperation after gastrectomy for gastric cancer was intestinal obstruction in 88 patients (54.3%), followed by intraabdominal bleeding in 15 patients (9.3%), incisional hernia in 15 (9.3%), and wound dehiscence or evisceration in 15 (9.3%). Other complications requiring reoperation were anastomotic leakage in seven (4.2%), acalculous cholecystitis in five (3.1%), duodenal stump leakage in five (3.1%), bowel perforation in five (3.1%), intraabdominal abscess without leakage in five (3.1%), bile peritonitis due to hepatic duct injury in one (0.6%), and biliary stricture in one (0.6%) (Table 2). The mean interval to reoperation for each complication is shown in Table 2. Hospital mortality occurred in ten of the 162 patients (6.2%), and these occurred in patients who underwent reoperation due to intraabdominal bleeding (four patients), intestinal obstruction (three patients), anastomotic leakage (two patients), and wound evisceration (one patient) (Table 3). The main cause of reoperation in the immediate short-term (group A) was intraabdominal bleeding (13 patients, 54.2%), while intestinal obstruction was the main reason for reoperation in the long-term (69 patients, 75.0%; group C, Table 4).

Treatment

Reoperative management according to each complication is summarized in Table 5. Of 88 patients with intestinal obstruction, 40 (45.5%) were treated for bandlysis, 31 (35.2%) with bowel strangulation were treated using segmental resection of small bowel, and 17 (19.3%) underwent bypass surgery.

Postoperative bleeding developed in 15 patients (9.3%). The most common bleeding site was branch of the splenic artery (six patients, 40%). The mean decrease in hemoglobin was 4.1 g/dL (from 12.9 to 8.8 g/dL) before reoperation. The mean blood loss in the abdominal cavity was 1,673 mL and the mean perioperative packed red blood cell transfusion volume was 8.3 U. The source of bleeding was identified at reoperation and a bleeder ligation was created, except for one patient with in whom the bleeding source had an unknown focus. Total gastrectomies with Roux-en-Y esophagojejunostomy were performed in two patients with bleeding at the gastrojejunostomy site after subtotal gastrectomy. One patient who was bleeding due to a spleen laceration was treated with a splenectomy.

Wound disruption occurred in 15 patients with a mean onset of 8 days (range, 4–12 days). Wound evisceration which protruded into the small bowel through the wound occurred in ten patients and was managed using primary closure of the wounds, while wound dehiscence (separation of the fascial layer) developed in five patients and was cured by secondary closure.

Table 1 Patient Characteristics

Variables	Reoperation group (n=162) (%)	Nonreoperation group (n=7,871) (%)	P value
Mean age (years)±SD	57.7±11.6	55.5±11.9	0.024
Gender			<0.001
Male	129 (79.6)	5,225 (66.4)	
Female	33 (20.4)	2,646 (33.6)	
Mean size (cm)±SD	4.3±2.8	4.5±3.0	0.589
Tumor location			0.346
Upper	23 (14.2)	1,195 (15.2)	
Middle	41 (25.3)	2,409 (30.6)	
Lower	94 (58.0)	4,146 (52.7)	
Diffuse	4 (2.5)	121 (1.5)	
Gross appearance			0.389
Borrmann type I	9 (5.6)	307 (3.9)	
II	24 (14.8)	1,293 (16.4)	
III	65 (40.1)	2,747 (34.9)	
IV	10 (6.2)	689 (8.8)	
EGC	54 (33.3)	2,835 (36.0)	
Histologic type			0.192
Differentiated	73 (45.1)	3,147 (40.0)	
Undifferentiated	89 (54.9)	4,724 (60.0)	
Depth of invasion			0.561
T1	54 (33.3)	2,835 (36.0)	
T2	32 (19.8)	1,320 (16.8)	
T3	68 (42.0)	3,182 (40.4)	
T4	8 (4.9)	534 (6.8)	
Lymph node metastasis			0.652
Negative	85 (52.5)	3,989 (50.7)	
Positive	77 (47.5)	3,882 (49.3)	
Combined resection			0.609
No	126 (77.8)	6,251 (79.4)	
Yes	36 (22.2)	1,620 (20.6)	
Type of operation			0.210
Total	38 (23.5)	2,197 (27.9)	
Subtotal	124 (76.5)	5,674 (72.1)	

Incisional hernias developed in 15 patients (9.3%) and were treated with hernioplasties. Two of those patients had incisional hernias with intestinal obstruction. One was treated with a hernioplasty plus segmental resection due to a strangulated bowel. The other was treated with a hernioplasty alone.

Of 80 patients with postoperative intraabdominal abscess (0.9%), 63 were treated using ultrasono-guided aspiration

Table 2 Incidence and Mean Interval to Reoperation After Gastrectomy

Causes	Number (n=162) (%)	Mean interval to reoperation, range (days)	Mortality (n=10)
Intestinal obstruction	88 (54.3)	592 (4–3,957)	3
Intraabdominal bleeding	15 (9.3)	4 (0–17)	4
Wound dehiscence or evisceration	15 (9.3)	9 (4–17)	1
Incisional hernia	15 (9.3)	457 (57–1,267)	0
Anastomotic leakage	7 (4.2)	12 (1–27)	2
Duodenal stump leakage	5 (3.1)	18 (10–28)	0
Acalculous cholecystitis	5 (3.1)	14 (2–31)	0
Intraabdominal abscess without leakage	5 (3.1)	46 (10–77)	0
Bowel perforation	5 (3.1)	213 (10–460)	0
Bile peritonitis due to hepatic duct injury	1 (0.6)	2	0
Biliary stricture	1 (0.6)	534	0

Table 3 Details of the Ten Patients Who Died within 30 Days of Reoperation

Procedure	Age (years)/sex	Stage	Cause of reoperation	Cause of death	Time to death (days)
TG, Sp	65/M	IV	A-loop obstruction	Sepsis	11
STG B II	46/F	II	E-loop obstruction	Sepsis	17
STG B II	64/M	IIIa	E-loop obstruction	Sepsis	25
STG B I	70/F	I	Gastroduodenal a. bleeding	DIC	2
STG B II	70/M	IIIa	Anastomosis site bleeding	DIC	5
STG B I	49/M	I	Splenic a. bleeding	DIC	14
STG B II	72/M	II	Mesentery bleeding	DIC	17
TG, Sp	60/M	IV	Anastomotic leakage	Sepsis	2
STG B II	62/M	IV	Anastomotic leakage	Sepsis	6
STG B II	72/M	IIIb	Wound evisceration	Aspiration pneumonia	1

TG total gastrectomy, *STG* subtotal gastrectomy, *B* Billroth, *A* afferent, *E* efferent, *Sp* splenectomy, *DIC* disseminated intravascular coagulation

drainage (78.8%). Seven patients with anastomotic leakage were treated with primary closure and feeding jejunostomy, revision of anastomosis site, and total gastrectomy with uncut Roux-en-Y esophagojejunostomy. Five patients with duodenal stump leakage who were clinically septic were not cured by the interventional procedure and underwent reoperation for primary closure of the duodenal stump and tube duodenostomy. Five patients with intraabdominal abscesses without leakage were treated using irrigation and drainage.

Acalculous cholecystitis requiring reoperation occurred in six patients (3.7%). Cholecystectomy was performed in four patients. One underwent a tube cholecystostomy and a diverting ileostomy on postoperative day 24 due to an enterocutaneous fistula.

Bile peritonitis due to an intrahepatic duct injury developed on postoperative day 2 due to a liver biopsy at the first operation, and suture ligation was performed at the reoperation. A biliary stricture occurred in one patient at 17.8 months postoperatively due to iatrogenic transection of the common bile duct during lymph node dissection around the hepatoduodenal ligament. This was treated with a choledochoduodenostomy and T-tube insertion.

The incidence of bleeding were not significantly different between total and subtotal gastrectomy (10.5% vs. 8.9%) while the reoperative rate for anastomotic leakage in total gastrectomy was higher than that of subtotal gastrectomy (10.5% vs. 2.4%), although it was only marginally significant (P=0.053).

Discussion

Postoperative complications requiring reoperation after gastric cancer surgery are stressful to both patient and surgeon. Such complications can affect both quality of life and patient survival. The rate of complication rate follow-

Table 4 Causes According to the Time to Reoperation

	Time to reoperation		
	Short-term		Long-term
	Group A (n=25) (within 1 week)	Group B (n=46) (1 week–1 month)	Group C (n=91) (after 1 month)
Intraabdominal bleeding	13 (52.0)	2 (2.2)	0
Wound dehiscence or evisceration	5 (20.0)	10 (21.7)	0
Acalculous cholecystitis	3 (12.0)	2 (2.2)	0
Anastomotic leakage	2 (8.0)	5 (10.9)	0
Intestinal obstruction	1 (4.0)	18 (39.1)	69 (75.8)
Intraabdominal abscess without leakage	0	2 (2.2)	3 (3.3)
Duodenal stump leakage	0	5 (10.9)	0
Bowel perforation	0	2 (2.2)	3 (3.3)
Incisional hernia	0	0	15 (16.5)
Bile peritonitis due to hepatic duct injury	1(4.0)	0	0
Biliary stricture	0	0	1 (1.1)

Values in parentheses are percentages

Table 5 Name of operation according to postoperative complication

Complications	Name of operation	No.
Intestinal obstruction	Bandlysis	40
	Segmental resection of bowel	31
	Bypass surgery	17
Intraabdominal bleeding	Bleeder ligation	12
	Total gastrectomy with Roux-en-Y esophagojejunostomy	2
	Splenectomy	1
Wound evisceration	Primary closure	10
Wound dehiscence	Secondary closure	5
Incisional hernia	Hernioplasty	9
	Hernioplasty with prolene mesh	5
	Segmental resection of small bowel with hernioplasty	1
Anastomotic leakage	Primary closure and feeding jejunostomy	4
	Revision of anastomosis site	2
	Total gastrectomy with uncut Roux-en-Y esophagojejunostomy	1
Duodenal stump leakage	Primary closure of duodenal stump and tube duodenostomy	5
Acalculous cholecystitis	Cholecystectomy	4
	Tube cholecystostomy	1
Intraabdominal abscess without leakage	Irrigation and drainage	5
Bowel perforation	Primary closure and bypass surgery	2
	Segmental resection of small bowel	2
	Transverse loop colostomy	1
Bile peritonitis due to hepatic duct injury	Ligation of bile duct	1
Biliary stricture	Choledochoduodenostomy with T-tube insertion	1

ing reoperation was lower in the present study compared to previous studies.[2,4–6] However, short-term complications requiring reoperation were associated with a high mortality. In this study, we believe that the total of 162 patients who required reoperation in our hospital is a conservative estimate because there could have been some patients who underwent resurgery due to late complications in other hospital. Although this is a limitation of our study, our major goal was to describe the types of complications requiring reoperation, time to reoperation, and surgical treatment according to each complication.

The overall incidence of adhesions, regardless of abdominal surgery type, is nearly 95%, and the postoperative severe consequence of adhesions is intestinal obstruction.[8] The present study found that the most frequent complication was intestinal obstruction. Patients underwent surgical management for intestinal obstruction after gastrectomy at a rate of 25.6% during the same hospitalization, 55.6% during the first readmission, and 16.7% during the second readmission (data not shown). Exploratory laparotomy has traditionally been the treatment of choice for patients with recurrent small bowel obstruction. However, a major concern is that patients who are managed surgically may develop more adhesions and obstructions of the small bowel, and this possibility must be minimized. Recently, we have performed gastrectomy through a small abdominal incision (15 cm) and sought to decrease the operation time to reduce the incidence of small bowel adhesions. Moreover, laparoscopic adhesiolysis has been reported to be safe and feasible for assessment and management of recurrent small bowel obstruction.[9,10] We also have applied laparoscopic adhesiolysis safely and effectively for recurrent small bowel obstruction after radical gastrectomy since 2005.[11]

Although most postoperative bleeding is minor, uncontrolled bleeding requiring reoperation which is not responsive to conservative management is associated with high mortality. In carcinoma of the esophagus or cardia of the stomach, reported rates of emergency reoperation and mortality are 0.3–10% and 17–75%, respectively.[12,13] In the current study, a high mortality rate (26.7%) was observed among reoperation patients with postoperative bleeding. However, most postoperative bleeding is preventable and can be controlled by careful and attentive surgical manipulation. Therefore, it is important that precise anatomical lymph node dissection be applied to reduce the bleeding in curative gastrectomy for gastric cancer. Moreover, suture ligation is more effective than cauterization at the site of active bleeding.[13] Recently, if possible, radiological embolization has been an alternative to surgical

management of postoperative bleeding to reduce the surgical stress of reoperation.[14]

The incidence of wound dehiscence has been reported to vary from 0.2% to 10%.[15,16] Wound dehiscence is usually associated with old age, coexisting disease (diabetes mellitus, chronic lung disease, malignancy, chronic renal insufficiency), increased pressure or tension on the closure, malnutrition, drug exposure (chronic steroid use, chemotherapy), or inadequate surgical techniques. For patients at risk of wound dehiscence, the fascial layer of the abdomen should be closed more carefully and retention sutures should be used if necessary.

In general, incisional hernias are associated with old age, male gender, obesity, type of suture, chest infection, abdominal distension, wound infection, and surgical skill.[17,18] The true incidence after abdominal surgery is not clear because data from thorough long-term follow-up studies are not available. The incisional hernia rate is reported to be 2–11% in abdominal surgery patients.[17,19] We could not determine the exact time of incisional hernia development after the first operation. However, attention should be paid to minimize incisional hernias because such patients complain of abdominal discomfort and cosmetic problems.

It is difficult to decide whether to surgically treat intraabdominal abscess after gastric cancer surgery. Clinically, a prolonged ileus, pain, and/or wound infection (i.e., the most important positive peritoneal signs) suggest an intraabdominal abscess[20] and should lead to abdominal cavity evaluation using computed tomographic scans or ultrasonography, which would also show whether there is anastomotic leakage or bowel perforation. Image-guided (computed tomography, ultrasonography) percutaneous drainage of intraabdominal abscesses effectively controls sepsis in 53–64% of intensive care patients.[21,22] In the present study, computed tomography or ultrasonography was performed to identify intraabdominal abscesses in clinically septic patients, and ultrasono-guided percutaneous drainage of such fluid was performed. On follow-up ultrasonography, which showed multiple localized abscess pockets, patients underwent reoperation to remove the abscess effectively. We, therefore, suggest that patients with intraabdominal abscesses be treated with optimal drainage (nonsurgical or surgical) and antibiotics to prevent multiple organ failure.

Conclusion

The present study found that most long-term complications were intestinal obstruction (69, 75.8%) due to adhesive formation rather than technical failure, while most short-term complications requiring reoperation were surgery-related complications and associated with high hospital mortality (14.1%). Proper preoperative preparation and faultless surgical skills are required during the initial surgery to reduce complications and the need for reoperation.

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