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Combined Aggressive Distal Gastrectomy and Double-Tract Reconstruction for Palliation of Incurable Locally Invasive Distal Gastric Cancer With Gastric Outlet Obstruction

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Objective: To evaluate combined aggressive distal gastrectomy (ADG) and double-tract (DT) reconstruction (ADGDTR) for palliative treatment of gastric cancer with gastric outlet obstruction (GOO).

Summary of Background Data: An effective standard palliation procedure has not been identified for patients with incurable gastric cancer.

Methods: I retrospectively evaluated patients presenting to my clinic with GOO secondary to locally invasive distal gastric cancer between March 1996 and March 2011. Following a complete workup, patients underwent ADGDTR. ADG included the gastric tumor in whole or in part. DT reconstruction consisted of gastrojejunostomy, jejunoduodenostomy, and jejunojejunostomy.

Results: In the enrolled patients (n = 7; 5 male; mean age, 71 years [range, 60–83 years]), preoperative comorbidities included anemia (7), diabetes mellitus (2), hepatic cirrhosis (1), cardiac ischemia (1), and Parkinson disease (1). The lesion invaded the pancreas in all patients, and the transverse mesocolon, liver, and mesentery were each involved in 1 patient. Metastatic disease affected the lymph nodes in 5 patients, liver in 1, and peritoneal cavity in 4. Peritoneal lavage cytology was positive in 3 patients and untested in 4. The mean operation time was 207 minutes (range, 150–295 minutes), and mean blood loss was 290 g (range, 110–480 g). Six patients had no postoperative complications, but 1 died of abdominal sepsis. The mean length of hospitalization was 43 days (range, 28–73 days), and mean survival was 8.3 months (range, 2–22 months). Six patients tolerated a low-residue or regular diet postoperatively.

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Conclusions: ADGDTR provided effective, low-risk palliation and long-term oral ingestion in patients with incurable, locally invasive distal gastric cancer with GOO.

Key words: Palliative care – Stomach neoplasms – Gastroenterostomy – Gastric outlet obstruction – Gastrectomy – Postoperative complications

Advanced cancer of the distal stomach invades directly to adjacent structures (*e.g.*, pylorus, duodenum, pancreas) and occasionally metastasizes to distant organs. Thus, patients with distal gastric cancer typically experience unpleasant disease manifestations, such as gastric outlet obstruction (GOO), gastrointestinal hemorrhage, and a palpable mass. Because this malignant disease is frequently incurable at the time of diagnosis, many palliative treatments, including nonresection gastric bypass (NRGB) and endoscopic stent placement, have been developed to address these problems.[1–3] However, the procedures often fail to eliminate unpleasant symptoms even after reestablishing a route for food passage. Thus, even today, patients with GOO secondary to incurable, locally invasive (T4) gastric cancer still require a clinically effective method for palliation. Therefore, I designed a new surgical palliative procedure that combines aggressive distal gastrectomy (ADG) and double-tract (DT) reconstruction (ADGDTR). ADG serves to eliminate unpleasant symptoms caused by the tumor mass, whereas DT reconstruction reestablishes a food passage. My objective in this study was to evaluate the efficacy and safety of ADGDTR in patients with GOO secondary to T4 gastric cancer.

Patients and Methods

Patients

I retrospectively evaluated patients presenting to my clinic for palliative surgical treatment of GOO secondary to T4 distal gastric cancer between March 1996 and March 2011. All patients provided written informed consent to undergo ADGDTR. The local Institutional Review Board approved this study. Baseline patient characteristics were recorded from the clinical records. Preoperative cancer staging included physical examination, gastroduodenal endoscopy, endoscopic biopsy, and barium study. Barium examinations showed the degree of GOO and the extent of gastric cancer invasion (Fig. 1A). Abdominal ultrasound and whole-body computed tomography studies revealed the presence of metastatic disease and the degree of gastric cancer invasion to adjacent structures.

Clinicopathologic factors

I recorded sex, age, comorbidities, surgery (elective or emergent), tumor size, local invasion (T), lymph node metastasis (N), hepatic metastasis (H), peritoneal metastasis (P), peritoneal lavage cytology results (CY), macroscopic and histologic tumor type, operation time, blood loss, complication score, hospitalization length, survival time, and preoperative and postoperative oral intake. I scored postoperative complications using the scale developed by Martin *et al*.[4] Briefly, this system assigns a score ranging from 0 (no complications) to 5 (death due to complications) based on outcomes and interventions. I also used the GOO scoring system described by Adler and Baron which classifies the level of oral ingestion on a scale of 0 (no intake) to 3 (low-residue or full diet).[5] Clinicopathologic evaluations were performed according to the Japanese Gastric Cancer Association classification of gastric carcinoma.[6]

Operative indications

I performed ADGDTR whenever I determined that ADG was possible based on my findings at the time of laparotomy, even in the presence of incurable local or distant organ metastases, peritoneal metastasis, or malignant ascites (Fig. 1B).

Operative procedure

ADG included the tumor even in cases where part of the lesion could not be removed (Fig. 1C). I began the DT reconstruction by developing the jejunal limb 20 cm distal to the ligament of Treitz. After that, I performed an end-to-side gastrojejunostomy and then created a side-to-end jejunoduodenostomy 20 cm distal to the gastrojejunostomy. I then developed an end-to-side jejunojejunostomy 30 cm distal to the jejunoduodenostomy (Fig. 2A and 2B). Several weeks after surgery, the reconstructed gastrointestinal tract was examined by barium study (Fig. 2C).

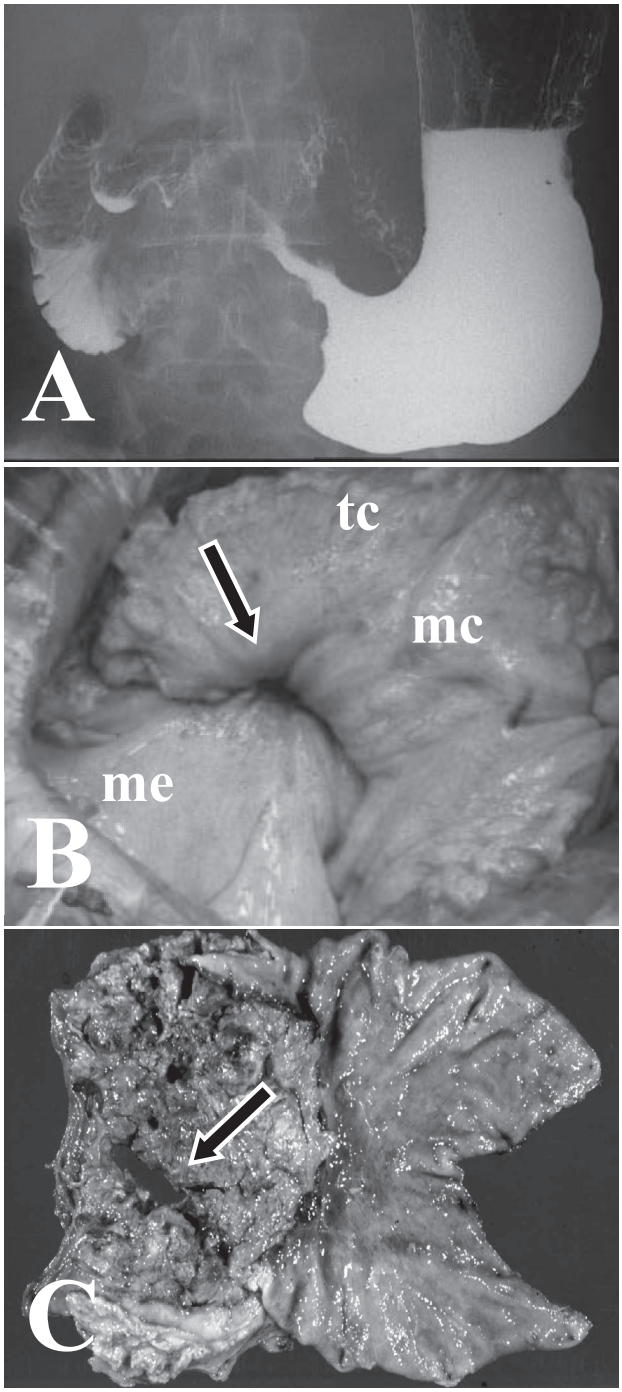

Fig. 1 (A) A barium study in patient No. 6 is typical of advanced distal gastric cancer with gastric outlet obstruction. (B) Intraoperative photograph of the lesion in patient No. 6 (cephalad, upper right): the arrow indicates cancer invasion to the mesentery (me) through the mesocolon (mc). tc, transverse colon. (C) A photograph of the resected stomach in patient No. 4: necrotic tissue entirely covers advanced type 2 cancer. The arrow indicates the site of an intraoperative perforation.

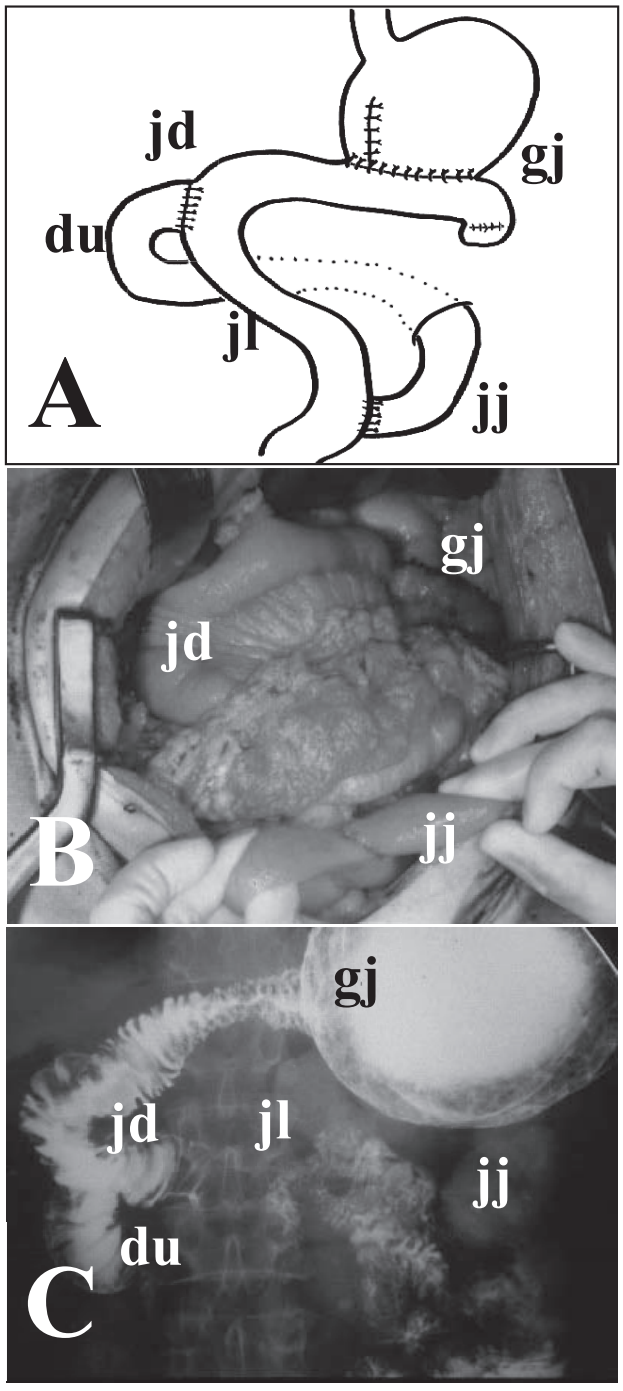

Fig. 2 (A) DT reconstruction, schematic diagram. (B) Intraoperative photograph showing the DT reconstruction in patient No. 6: The jejunal limb between the jejunoduodenostomy (jd) and jejunojejunostomy (jj) crosses the retrocolic route. (C) A postoperative barium study in patient no. 5 shows barium flowing to the distal jejunum with no obstruction. gj, gastrojejunostomy; du, duodenum; jl, jejunal limb.

Table 1 Baseline characteristics in patients with distal gastric cancer and gastric outlet obstruction

Patient No.	1	2	3	4	5	6	7
Sex	M	M	F	M	M	M	F
Age, y	73	83	66	80	62	60	73
Comorbidity	an lc	an hi	an	dm pd	dm	none	an
Surgery	es	em	es	es	es	es	es
Tumor size, cm	10.0 × 5.5	8.5 × 8.5	12.0 × 11.0	14.0 × 8.0	6.8 × 5.4	10.3 × 9.4	8.0 × 7.2
Local invasion (T4)[a]	pa	pa, mc	pa, mc	pa, li	pa	pa, mc, me	pa, mc
N[a]	NX	N1	N3	NX	N3	N3	N3
H[a]	H0	H1	H0	H0	H0	H0	H0
P[a]	P0	P0	P1	P0	P1	P1	P1
CY[a]	CYX	CYX	CYX	CYX	CY1	CY1	CY1
Incurability factor,[b] n	1	2	3	1	4	4	4
Histologic type[a]	por	tub	por	por	pap	muc	tub
Operation time, min	295	150	200	180	190	200	235
Blood loss (g)	220	110	280	178	440	325	480
Complication score[c]	0	0	0	5	0	0	0
Hospital stay, days	55	47	38	73	28	29	33
Survival, mo	10.0	3.0	7.0	2.0	12.0	2.0	22.0
Oral ingestion[d]							
Preoperative	1	0	1	1	0	0	1
Postoperative	3	3	3	death	3	3	3

an, anemia; CY, peritoneal cytology results; dm, diabetes mellitus; em, emergent surgery; es, elective surgery; H, hepatic metastasis; hi, heart ischemia; lc, liver cirrhosis; li, liver; mc, mesocolon; me, mesentery; muc, mucinous adenocarcinoma; N, lymph node metastasis; P, peritoneal metastasis; pa, pancreas; pap, papillary adenocarcinoma; pd, Parkinson disease; por, poorly differentiated adenocarcinoma; tub, tubular adenocarcinoma.

[a]Clinicopathologic evaluations were according to the Japanese Gastric Cancer Association classification of gastric carcinoma.[6]

[b]Incurability factors were according to the Japanese Gastric Cancer Association classification of gastric carcinoma.[6]

[c]Complication scores were classified according to postoperative events and interventions.[4]

[d]Oral ingestion was classified according to the Gastric Outlet Obstruction Scoring Sytem.[5]

Results

During the study period, 7 patients underwent ADGDTR (5 male; mean age, 71 years [range, 60–83 years]). The clinical, surgical, and disease characteristics of the patients are shown in Table 1. The mean operation time was 207 minutes (range, 150–295 minutes), and the average blood loss was 290 g (range, 110–480 g). The mean length of hospitalization was 43 days (range, 28–73 days) and mean survival was 8.3 months (range, 2–22 months). There was 1 death due to sepsis, and no other complications occurred. All surviving patients tolerated a low-residue or regular diet postoperatively. The only patient who required emergent surgery (No. 2) was an 83-year-old man. He was hospitalized with GOO secondary to advanced gastric cancer with liver metastasis. He also had ischemic heart disease and severe anemia. He developed acute myocardial ischemia preoperatively and was moved to the cardiovascular department for medical treatment. After he became hemodynamically stable, he was transferred back to me for gastric cancer treatment. Soon thereafter, the patient experienced massive hematemesis and shock caused by gastric hemorrhage, and ADGDTR was performed emergently. He had an uneventful clinical course, tolerated oral intake satisfactorily, and was discharged on the 21st postoperative day.

The patient who died before postoperative hospital discharge (No. 4) was an 80-year-old man who developed abdominal sepsis after surgery. Interoperative findings included necrotic tissue adherent to the entire mucosal surface of his gastric lesion and tumor invasion to both the pancreas and liver (lateral segment). A small volume of necrotic tissue was not completely resected macroscopically. After surgery, intraperitoneal abscess formation was detected at the site of the residual infected necrotic tissue, although this area was electrocauterized as much as possible during the procedure (Fig. 1C). Radiographic examinations, including computed tomography, showed neither fistula formation between the intraperitoneal abscess and gastrointestinal tract nor suture line leakage. He received a diagnosis of systemic sepsis and died 87 days after surgery in spite of our efforts.

Discussion

Surgical palliation for patients with GOO secondary to incurable and locally advanced malignant disease (*e.g.*, gastric, pancreatic, and duodenal cancer) has been controversial among surgeons for many years. NRGB is a widely accepted palliative surgery and has some advantages, such as low cost, acceptable morbidity, and simple technique.[7,8] However, this procedure is not always effective, and not all patients recover the ability to tolerate oral intake after undergoing painful surgery. Thus, NRGB has not been recognized as a standard surgical palliation.[9–13]

In patients with GOO secondary to pancreatic cancer, Lucas *et al*[14] found that NRGB led to delayed gastric emptying in 95%, as evidenced by nausea and vomiting. Therefore, they evaluated combined simple distal gastrectomy (excluding the tumor) and gastrojejunostomy in 19 patients with unresectable pancreatic cancer. They reported that all patients tolerated solid food until death and concluded that their combination surgery was the most effective palliative procedure. This combination surgery eliminates the GOO and avoids postoperative delayed gastric emptying. However, their method does not involve surgical removal of the pancreatic lesion and does not address unpleasant tumor-related symptoms (*e.g.*, palpable mass and abdominal pain).

In patients with gastric cancer, DG results in the surgical removal of the primary tumor and relieves unpleasant symptoms, including GOO, delayed gastric emptying, gastrointestinal hemorrhage, and the palpable mass. Many gastric surgeons insist that DG is more effective than NRGB for patients with gastric cancer.[15–20] Stupart *et al*[21] stated that although NRGB offered worthwhile palliation, DG provided more meaningful palliation and longer survival compared with NRGB.[21] Furthermore, several other surgeons concluded that DG is beneficial for patients with incurable disease even in the presence of peritoneal dissemination, provided the degree is slight.[22,23] Kim *et al*[24] recommended DG as a standard method for patients with locally advanced gastric cancer, regardless of the surgical curability, and Geoghegan *et al*[25] stated that DG is the policy in their surgery department whenever feasible.

However, Hartgrink *et al*[26] suggested that the efficacy of DG is conditional. In their evaluation of prognostic factors, including age, liver metastasis, peritoneal dissemination, distant lymph node metastasis, and combinations of these factors, they found that patients with 1 metastatic site only benefitted from DG if they were 70 years or younger.[26] In the present series, my cohort included 3 patients who were 70 years or younger, 2 patients in their seventies, and 2 octogenarians. The oldest patient was age 83 years. All patients had T4 lesions, and 5 had 2 or more incurability factors. I found that ADGDTR was clinically beneficial even in patients who did not meet the criteria proposed by Hartgrink *et al*.

Surgeons need an accurate preoperative assessment of tumor resectability to perform gastric cancer surgery successfully. However, advanced gastric lesions incite a local inflammatory or fibrous reaction, making it difficult to characterize mass resectability preoperatively.[27–29] These reactions are easily misidentified as tumor invasion, and the clinical stage of gastric cancer is often overestimated compared with the histologic stage.[24,30] Some surgeons, relying on the results of the preoperative examination, readily consider an advanced gastric tumor to be unresectable and offer NRGB alone. Thus, patients lose the opportunity to undergo DG and may lose the chance to obtain effective palliation. Hallissey *et al*[31] insisted that only an experienced surgeon can accurately assess tumor resectability at the time of laparotomy and determine the best surgical treatment. Further, they proposed that, even in patients with locally invasive or metastatic gastric cancer, DG should be considered the best choice whenever resection is feasible.[31] In this series, I chose the procedure at the time of laparotomy.

Some surgeons believe that ADG is a high-risk surgery and inappropriate for palliation, and, indeed, 1 patient in my cohort died of abdominal sepsis. However, the intraperitoneal abscess that caused this mortality could have been prevented by complete removal of the necrotic mucosa. Thus, ADG is not intrinsically a high-risk surgery. The most severe, refractory, and fatal complication of gastric surgery is abdominal sepsis, often caused by suture line leakage. Especially in patients with locally advanced T4 distal gastric cancer, the duodenal wall is often edematous or friable after resection. This condition, known as the difficult duodenal stump, is the most significant risk factor for suture line leakage. Moreover, a difficult duodenal stump increases the risk of tumor invasion. Invasive cancer may also be associated with suture line leakage, although this has not been proven.[32]

The risk of difficult duodenal stump suture line leakage may depend on the type of gastrointestinal reconstruction after ADG. In patients who undergo Billroth I reconstruction, the difficult duodenal stump is not closed and is anastomosed with the stomach remnant. As a result, the duodenal contents are drained into the stomach through the gastroduodenostomy, and the internal duodenal pressure remains low, as does the risk of gastroduodenostomy suture line leakage. In Billroth II and Roux-en-Y reconstructions, the difficult duodenal stump is closed, forming a blind duodenal stump. Consequently, the duodenum does not drain easily, and internal duodenal pressure is high. Therefore, the risk of difficult duodenal stump suture line leakage is higher after these procedures than after Billroth I reconstruction.

Barnett[33] and Barnett and Tucker[34] conducted laboratory and clinical studies of surgical blind duodenal stump management. They developed a drainage anastomosis between the duodenum and jejunal limb of the Roux-en-Y segment to decrease the risk of difficult duodenal stump suture line leakage, and obtained good results. They concluded that the duodenal drainage procedure helps prevent difficult duodenal stump suture line leakage. A blind duodenal stump is not formed in patients who undergo DT reconstruction. Instead, a side-to-end anastomosis between the jejunal limb and duodenal stump is performed, and the duodenum is drained through the resulting jejunoduodenostomy, allowing internal duodenal pressure to remain low. Consequently, the risk of jejunoduodenostomy suture line leakage is negligible. Both DT and Billroth I procedures are superior to Billroth II and Roux-en-Y reconstructions in that the former minimize the risk of difficult duodenal stump suture line leakage.

All patients who undergo palliative surgery wish to maintain oral intake for as long as possible. However, sooner or later after surgery, tumor invasion will recur at the site of retained cancer tissue. As this tissue gradually grows and invades into the wall of the adjacent upper gastrointestinal tract, it will cause malignant restenosis that clinically manifests as GOO. Some gastrointestinal tract reconstruction methods can delay the onset of malignant restenosis. After the Billroth I reconstruction, food passes through a single route around the site of the primary lesion. Because this site is at high risk for cancer recurrence, malignant gastrointestinal tract restenosis is likely to occur early in patients who undergo Billroth I reconstruction. On the other hand, after Billroth II or Roux-en-Y reconstruction, the route through which food passes is not near the primary cancer site, and early malignant restenosis is unlikely.

After DT reconstruction, the jejunoduodenostomy and jejunojejunostomy form 2 routes for food passage, and neither is near the site at risk for cancer recurrence. Thus, DT reconstruction also delays the onset of malignant restenosis of the gastrointestinal tract. DT, Billroth II, and Roux-en-Y reconstructions are superior to Billroth I reconstruction in that they lower the risk of gastrointestinal tract malignant restenosis.

DT reconstruction has other benefits for patients in addition to surgical palliation of GOO. Noh *et al*[35] proposed a new procedure similar to DT reconstruction that consists of a gastrojejunostomy, jejunoduodenostomy, and jejunojejunostomy, and stated that the incidence of postoperative delayed gastric emptying was lower after their reconstruction than following Roux-en-Y reconstruction. Namikawa *et al*[36] compared the clinical outcomes of DT, Roux-en-Y, and Billroth II reconstructions, and found that only DT reconstruction decreased the severity of reflux esophagitis and remnant gastritis.

In conclusion, ADGDTR is an effective palliative treatment with low surgical and malignant restenosis risks in patients with GOO secondary to incurable, locally invasive distal gastric cancer.

Acknowledgments

This article includes information relating to general principles of medical care, which should not be construed as specific instructions for individual patients. Application of this information in a particular situation remains the professional responsibility of the practitioner. The author assumes no liability or responsibility for any error or omission in such information.

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