ORIGINAL ARTICLE

Survival Analysis of Optimal Management in Incurable Gastric Cancer with Gastric Outlet Obstruction: A Two-Center Retrospective Study in Thailand

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Background: Gastric cancer frequently detected at an incurable stage, is often accompanied by gastric outlet obstruction (GOO). The optimal management of GOO in patients with incurable gastric cancer remains controversial.

Objective: To evaluate the surgical outcomes of different treatment approaches to explore optimal procedures to manage this condition.

Materials and Methods: A retrospective review was conducted on incurable gastric cancer patients with GOO at Ramathibodi Hospital, and at the National Cancer Institute of Thailand. Patients were categorized into three groups, namely resection, gastrojejunostomy, and feeding jejunostomy (FJ) or naso-jejunostomy (NJ) tube placement. Overall survival (OS), overall complications, Gastric Outlet Obstruction Scoring System (GOOSS) results after the operation and other relevant variables were recorded.

Results: Of 44 patients included in the final analysis, the median OS was ten months for the resection group, six months for the FJ/NJ group, and 13 months for the gastrojejunostomy group (p=0.228). Postoperative complications were similar across the groups, although tube-related complications were notably higher in the FJ/NJ group. GOOSS scores were similar between the resection and the bypass groups. No treatment-related mortality was observed in any of the procedures.

Conclusion: Among incurable gastric cancer patients who underwent resection, gastrojejunostomy, or FJ/NJ tube placement for GOO relief, the present study found no significant difference in the OS or overall complications. Both resection and gastrojejunostomy bypass are effective in relieving obstruction and yield comparable outcomes.

Keywords: Gastric cancer; Incurable; Gastric outlet obstruction; Resection; Gastrojejunostomy; feeding jejunostomy; Naso-jejunostomy tube

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Gastric cancer is a highly aggressive disease constituting the fifth leading cause of cancer deaths worldwide[1]. As the screening programs are conducted in only a small number of countries, multiple gastric cancer patients are diagnosed at the incurable advanced-stage or at metastatic diseases[2]. Gastric outlet obstruction (GOO) is one of the most common complications that occur in advanced gastric cancer. The presence of GOO not only causes obstructive symptoms, but also leads to a severe physical decline, including dehydration, electrolyte imbalance, and malnutrition. These complications can significantly hinder a patient's ability to tolerate further chemotherapy or any major operations[3]. Management of GOO in these patients is challenging and individualized, depending on the extent of the disease, the patient's status, and the patient's desire, as well as on the expertise of the physicians and their teams[4]. Treatment options exist including endoscopic stent placement, feeding jejunostomy (FJ)/naso-jejunostomy (NJ) tube insertion, gastric resection, and gastrojejunostomy bypass. However, consensus on the optimal approach has yet to be reached[5]. Endoscopic stent placement has shown to be an ideal choice to alleviate the obstruction, allowing patients to have oral intake with a short length of hospital stay. However, complications can and do occur including perforation, stent migration, and restenosis, leading to a high re-intervention rate[6]. Tube enterostomy via FJ/NJ tube is a minimally invasive procedure with minimal risk of

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major complications, but it is not physiological, and an additional gastric decompression tube may be required to relieve obstruction. Gastric resection and gastrojejunostomy are the potential options to manage GOO in incurable gastric cancer cases. Comparative studies have shown their effectiveness with regard to relieving obstruction and complications although there have been conflicting results[3]. Therefore, the present study aimed to examine the outcomes of different procedures performed to manage GOO in patients with incurable gastric cancer at the present study institutes. Endoscopic stent placement was not included in this study because of the low number of cases performed.

Materials and Methods

The medical records of patients histologically diagnosed with gastric adenocarcinoma with GOO at Ramathibodi Hospital, and the National Cancer Institute of Thailand between January 2019 and June 2022 were retrospectively reviewed. Only patients having incurable gastric cancer were included in the analysis. The condition of GOO was defined as 1) the presence of obstructive symptoms such as abdominal pain, fullness, and vomiting, and 2) luminal narrowing at the pylorus, antrum, or gastric body with a dilatation of the proximal part seen on computed tomography (CT) scan and/or endoscopy. Incurable disease was defined as one or more of the following parameters 1) gross tumor invasion of the adjacent organs that were unable to achieve R0 resection, 2) gross peritoneal metastasis, 3) positive peritoneal cytology without peritoneal metastasis seen, and 4) distant metastasis. Those patients with insufficient clinical data, active bleeding, or tumor perforation were excluded from the study. Eligible patients were divided into three groups according to the initial surgical interventions, namely 1) resection, 2) insertion of FJ/NJ tube with or without naso-gastric or gastrostomy tube for decompression, and 3) gastrojejunostomy bypass. Diagnostic laparoscopy or laparotomy, along with peritoneal washing cytology, was performed at the time of the initial intervention. In patients with visible gross peritoneal metastases, peritoneal washing was typically not performed. Since cytologic study results were not available on the day of surgery, some patients without visible peritoneal or distant metastases, if the primary physician considered it appropriated to initiate systemic treatment first, underwent NJ tube placement as the initial intervention, if feasible, while awaiting the results of peritoneal washing cytology.

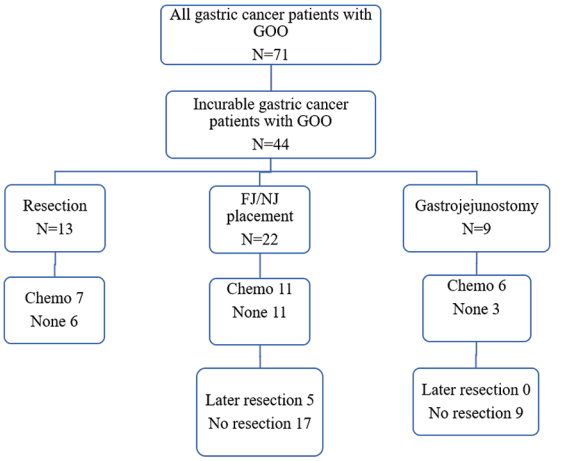


Figure 1. The flow diagram shows the clinical course of incurable gastric cancer patients with gastric outlet obstruction (GOO).

In other cases, the choice of interventions to relieve GOO depended on the surgeon's expertise and the patient's condition, as illustrated in Figure 1.

Delayed cytoreductive surgery (CRS) with hyperthermic intraperitoneal chemotherapy (HIPEC) was considered for patients who met the following criteria: 1) they had received systemic treatment and showed no evidence of other distant metastases, 2) the primary gastric tumor was considered potentially resectable, and 3) repeat diagnostic laparoscopy revealed either positive peritoneal washing cytology or visible peritoneal carcinomatosis, with a peritoneal cancer index (PCI) of less than 12. If feasible, resection of the primary gastric cancer was planned to be performed concurrently with CRS and HIPEC.

Overall survival (OS) as the primary outcome, and overall complications as well as clinical improvement of the obstruction after treatment using the Gastric Outlet Obstruction Scoring System (GOOSS) as the secondary outcomes were measured, and compared, among three different interventions. Since the GOOSS was originally designed to assess the effectiveness of interventions targeting obstruction relief[7], and the FJ/NJ procedures were not specifically intended to restore oral intake, patients in this group were excluded from the comparison of GOO symptom improvement in the present study.

The Ethics Committees of Ramathibodi Hospital, Mahidol University (027/2566), and the National Cancer Institute of Thailand (2023/284) approved the present study.

Statistical analysis

Categorical variables were reported as percentages while continuous variables were reported as mean with standard deviation (SD), or median with interquartile range (IQR). Comparisons among variables were done using the chi-square test and Fisher's exact test. OS was measured from the date of definite diagnosis to the most recent follow-up date, or the date of death. Survival analysis was conducted using the Kaplan-Meier method and the log-rank test. All p-values were two-tailed, and statistical significance was considered by p-value less than 0.05. Univariable and multivariable Cox regression analyses were applied to examine the possible factors that may influence the OS of the patients. Variables with a p-value less than 0.1 in the univariable analysis were entered into the multivariable model. Data analyses were performed using Stata, version 14.1 (StataCorp LP, College Station, TX, USA).

Results

Demographic data

Seventy-one gastric cancer patients with GOO were identified, and 44 incurable patients were eligible for analysis (Figure 1). The mean age of the patients was 60.7 (SD 12) years old. Twenty-four patients (54.5%) were male. The most common histologic grade of the tumor was poorly/undifferentiated adenocarcinoma in 56.8%. GOO was detected by CT scan in 38 patients (86.4%), and endoscopy in 34 patients (77.3%). Incurable parameters of these patients included 14 patients (31.8%) with tumor invasion to adjacent organs, 32 patients (72.7%) with gross peritoneal metastasis including five patients (11.4%) with distant metastasis, and five patients (11.4%) with occult peritoneal metastasis, or positive peritoneal cytology without peritoneal metastasis seen. The surgical interventions to manage GOO included resection in 13 patients (29.5%) insertion of FJ/NJ tube with or without nasogastric or gastrostomy tube in 22 patients (50%), and gastrojejunostomy bypass in nine patients (20.5%).

Five patients (11.4%) underwent placement of an FJ/NJ tube followed by systemic chemotherapy, and then underwent tumor resection thereafter, with a later resection. No patients in gastrojejunostomy bypass group underwent later resection after receiving systemic chemotherapy. All subsequent resections were performed as total gastrectomy. Three patients (6.8%) underwent HIPEC, two patients in resection group and one patient in FJ/NJ group. Other patients' clinicopathologic and therapeutic data are

Table 1. Demographic and clinicopathological features of GOO in patients with incurable gastric cancer

Demographic and clinicopathological features	n=44
Age (years); mean [SD]	60.7 [12.4]
Sex: male; n (%)	24 (54.5)
Histologic grade; n (%)	
Well	0 (0.0)
Moderate	10 (22.7)
Poor/undifferentiated	25 (56.8)
Unknown	9 (20.5)
Signet ring cells; n (%)	17 (38.6)
Clinical T stage; n (%)	
T2	0 (0.0)
T3	13 (29.6)
T4	31 (70.4)
Clinical N stage; n (%)	
N0	3 (6.8)
N positive	41 (93.2)
M stage; n (%)	
M1	35 (79.6)
Serosal invasion; n (%)	30 (68.2)
Ascites; n (%)	14 (31.8)
GOO on CT; n (%)	38 (86.4)
GOO on endoscopy; n (%)	34 (77.3)
Size tumor (cm); mean [SD]	5.69 [2.5]
Incurable parameters; n (%)	
Tumor invasion to adjacent organ (T4b)	14 (31.8)
Peritoneal metastasis	32 (72.7)
Occult peritoneal metastasis (positive cytology)	5 (11.4)
Distant metastasis	5 (11.4)
Initial procedures; n (%)	
Resection	13 (29.5)
FJ/NJ placement	22 (50.0)
Gastrojejunostomy	9 (20.5)
Resection status; n (%)	
Upfront resection	13 (29.6)
Later resection	5 (11.4)
No resection	26 (59.1)
Chemotherapy; n (%)	
None	20 (45.5)
Post-operation	24 (54.5)
Radiation; n (%)	1 (2.3)
HIPEC; n (%)	3 (6.8)
Surgical procedure; n (%)	
Total gastrectomy	4 (9.1)
Partial gastrectomy	9 (20.5)
Gastrojejunostomy	9 (20.5)
NJ tube	5 (11.4)
FJ tube	17 (38.6)

CT=computed tomography; FJ=feeding jejunostomy; GOO=gastric outlet obstruction; HIPEC=hyperthermic intraperitoneal chemotherapy; NJ=naso-jejunostomy; SD=standard deviation

Table 2. Demographic and clinicopathological features of GOO in patients with incurable gastric cancer listed by surgical interventions

Variables	Resection (n=13)	FJ/NJ (n=22)	Gastrojejunostomy (n=9)	p-value
Age (years); mean [SD]	66.5 [11.6]	60.0 [11.7]	54.2 [12.7]	0.510
Sex; n (%)				0.355
Female	8 (61.5)	9 (40.9)	3 (33.3)	
Male	5 (38.5)	13 (59.1)	6 (66.7)	
Tumor characteristics; n (%)				0.009
Protruding	1 (7.7)	0 (0.0)	0 (0.0)	
Localized ulcer	1 (7.7)	5 (22.7)	2 (22.2)	
Infiltrative ulcer	10 (76.9)	5 (22.7)	5 (55.6)	
Diffuse infiltration	1 (7.7)	12 (54.6)	2 (22.2)	
GOO on endoscopy; n (%)	12 (92.3)	15 (68.2)	7 (77.8)	0.099
GOO on CT; n (%)	12 (92.3)	19 (86.4)	7 (77.8)	0.449
Histologic grade; n (%)				0.389
Moderate	5 (38.5)	4 (18.2)	4 (44.4)	
Poor	8 (61.6)	18 (81.8)	5 (55.6)	
Signet ring cells; n (%)				0.295
Neg	5 (38.5)	15 (68.2)	6 (66.7)	
Pos	8 (61.5)	7 (31.8)	3 (33.3)	
Serosal invasion; n (%)				0.020
No	8 (61.5)	5 (22.7)	1 (11.1)	
Yes	5 (38.5)	17 (77.3)	8 (88.9)	
Ascites; n (%)				0.306
No	9 (69.2)	13 (59.1)	8 (88.9)	
Yes	4 (30.8)	9 (40.9)	1 (11.1)	
Clinical T; n (%)				0.197
cT2 to 3	6 (46.2)	6 (27.3)	1 (11.1)	
cT4	7 (53.8)	16 (72.7)	8 (88.9)	
Clinical N; n (%)				0.579
cN0	0 (0.0)	2 (9.1)	1 (11.1)	
cN positive	13 (100)	20 (90.9)	8 (88.9)	
Clinical M; n (%)				0.295
cM0	4 (30.8)	4 (18.2)	1 (11.1)	
cM1	9 (69.2)	18 (81.8)	8 (88.9)	
Incurable factors; n (%)				0.082
Tumor invasion to adjacent organ	2 (15.4)	7 (31.8)	5 (55.6)	
Peritoneal metastasis	9 (69.2)	16 (72.7)	7 (77.8)	
Occult peritoneal metastasis	3 (23.1)	2 (9.1)	0 (0.0)	
Distant metastasis	0 (0.0)	4 (18.2)	1 (11.1)	
Post-operative chemotherapy; n (%)				0.359
No	6 (46.2)	11 (50.0)	3 (33.3)	
Yes	7 (53.8)	11 (50.0)	6 (66.7)	
HIPEC; n (%)				0.999
Not done	12 (92.3)	20 (90.9)	9 (100)	
Done	1 (7.7)	2 (9.1)	0 (0.0)	
ECOG pre-treatment; n (%)	(n=11)	(n=12)	(n=6)	0.978
0 to 1	3 (27.3)	2 (16.7)	1 (16.7)	
2	5 (45.4)	7 (58.3)	4 (66.6)	
3	3 (27.3)	3 (25.0)	1 (16.7)	
4	0 (0.0)	0 (0.0)	0 (0.0)	

CT=computed tomography; ECOG=Eastern Cooperative Oncology Group performance status; FJ=feeding jejunostomy; GOO=gastric outlet obstruction; GOOSS=Gastric Outlet Obstruction Scoring System; HIPEC=hyperthermic intraperitoneal hemotherapy; NJ=naso-jejunostomy; SD=standard deviation

Table 2. (continued)

Variables	Resection (n=13)	FJ/NJ (n=22)	Gastrojejunostomy (n=9)	p-value
ECOG at 2 weeks post-treatment; n (%)	(n=10)	(n=10)	(n=6)	0.117
0 to 1	0 (0.0)	1 (10.0)	3 (50.0)	
2	4 (40.0)	4 (40.0)	2 (33.3)	
3	6 (60.0)	3 (30.0)	1 (16.7)	
4	0 (0.0)	2 (20.0)	0 (0.0)	
ECOG at 4 weeks post-treatment; n (%)	(n=10)	(n=9)	(n=6)	
0 to 1	2 (20.0)	3 (33.3)	3 (50.0)	0.631
2	6 (60.0)	2 (22.2)	2 (33.3)	
3	2 (20.0)	3 (33.3)	1 (16.7)	
4	0 (0.0)	1 (11.1)	0 (0.0)	
ECOG at 12 weeks post-treatment; n (%)	(n=9)	(n=7)	(n=5)	
0 to 1	5 (55.5)	2 (28.6)	3 (60.0)	0.538
2	1 (11.1)	1 (14.3)	1 (20.0)	
3	3 (33.3)	3 (42.8)	0 (0.0)	
4	0 (0.0)	1 (14.3)	1 (20.0)	
GOOSS pre-treatment; n (%)	(n=11)		(n=8)	
1	8 (72.7)	-	8 (100)	0.228
2	3 (27.3)	-	0 (0.0)	
GOOSS at 2 weeks post-treatment; n (%)	(n=11)		(n=8)	
1	2 (18.2)	-	0 (0.0)	0.485
2	9 (81.8)	-	8 (100)	
GOOSS at 4 weeks post-treatment; n (%)	(n=11)		(n=8)	
1	0 (0.0)	-	0 (0.0)	0.999
2	8 (72.7)	-	5 (62.5)	
3	3 (27.3)	-	3 (37.5)	
GOOSS at 12 weeks post-treatment; n (%)	(n=9)		(n=6)	
1	0 (0.0)	-	1 (16.7)	0.229
2	3 (33.3)	-	0 (0.0)	
3	6 (66.7)	-	5 (83.3)	
Post-operative complications; n (%)				
Bleeding	0 (0.0)	1 (4.6)	1 (11.1)	0.126
Atelectasis/Pneumonia	0 (0.0)	2 (9.1)	0 (0.0)	
Urinary tract infection	1 (7.7)	0 (0.0)	0 (0.0)	
Feeding tube malfunction/dislodgement	0 (0.0)	6 (27.3)	0 (0.0)	
Other complications	3 (23.1)	0 (0.0)	1 (11.1)	
No complication	9 (69.2)	13 (59.1)	6 (66.7)	

CT=computed tomography; ECOG=Eastern Cooperative Oncology Group performance status; FJ=feeding jejunostomy; GOO=gastric outlet obstruction; GOOSS=Gastric Outlet Obstruction Scoring System; HIPEC=hyperthermic intraperitoneal hemotherapy; NJ=naso-jejunostomy; SD=standard deviation

summarized in Table 1.

A comparison of demographic data and surgical outcomes by different surgical interventions was demonstrated in Table 2. There was no significant difference among each procedure in terms of mean age, gender, histologic grade, clinical TNM stage, and the pre-and post-treatment Eastern Cooperative Oncology Group (ECOG) scores. A significant proportion of patients with diffuse infiltrative tumors underwent placement of an FJ/NJ tube in 54.6%, which was in contrast to the patients having other tumor characteristics in which resection and bypass were more likely to be performed. Insertion of an FJ/NJ tube was also more frequently performed in patients with serosal invasion by the tumor at 77.3%. Regarding incurable parameters, there were five patients (11.4%) who had a positive peritoneal cytology without gross peritoneal metastasis seen in which resection was performed in three patients, and the placement of an FJ/NJ tube was performed in two

patients. These three patients with occult positive peritoneal cytology initially underwent resection with curative intent, as the cytology results were only available seven days after surgery, and HIPEC and staging laparoscopy were not available at one of the hospitals at that time. In two patients with occult positive peritoneal cytology in the FJ/NJ group, the cytology samples were obtained during diagnostic laparoscopy conducted in conjunction with the FJ/NJ procedure. One of them subsequently underwent tumor resection with HIPEC. There was no significant difference in pre-treatment GOOSS scores between the resection and the bypass groups. However, following the initial operations, patients in both groups showed considerable improvement in GOOSS scores for two to twelve weeks postoperatively.

Complications after the procedures included two patients (4.5%) with bleeding, two patients (4.5%) with atelectasis or pneumonia, six patients (13.6%) with feeding tube malfunction or dislodgement, and four patients (9%) with other minor complications. There was no significant difference in the rate of complication regarding the type of the operation (p=0.126). However, patients who underwent insertion of an FJ/NJ tube had a remarkably high rate of complications from tube malfunction or dislodgement with six out of 22 patients (27.2%). There were no deaths attributable to any of the procedures.

Survival

The median follow-up interval was 9.5 months for the entire group of the patients, with 11 months for the resection group, 13 months for gastrojejunostomy group, and six months for FJ/NJ group. The median OS was 10 months in the resection group, 13 months in the gastrojejunostomy group, and six months in the FJ/NJ group. As demonstrated in Figure 2, there was no statistically significant difference of the OS among the three groups (p=0.228).

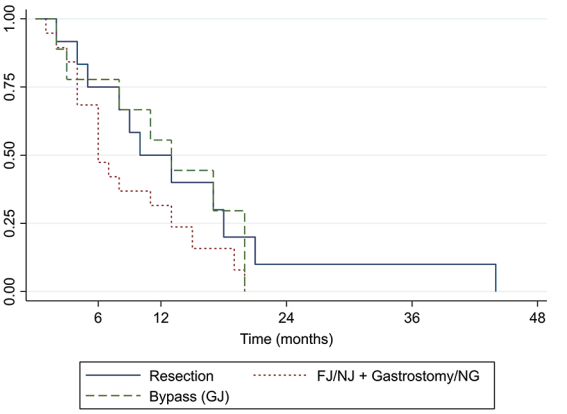
Uni- and multivariable analysis

It was found that only the presence of ascites on CT scan was associated with poor OS in both univariable analysis (HR 2.91, 95% CI 1.63 to 5.22, p<0.001) and multivariable analysis (HR 2.46, 95% CI 1.34 to 4.49, p=0.004). None of the surgical intervention types were associated with OS (Table 3).

Discussion

Gastric cancer patients with GOO are often diagnosed with an incurable disease as seen in previous studies[3,8]. Similarly, the present study found that 62% of gastric cancer patients with GOO were unresectable. The aim of the treatment is, therefore, to palliate the patient, providing a better quality of life and the ability to resume food intake. Nevertheless, safe operation with no major complications along with fast recovery are also pivotal aspects that must be considered when selecting optimal options for palliative procedures[9]. These factors may allow the patients to undergo further systemic therapy, which was shown to have a markedly positive impact on prolonging survival[10].

The operations to relieve GOO in the present study included partial/total gastrectomy with tumor removal, placement of an FJ/NJ tube with or without a nasogastric or gastrostomy tube, and gastrojejunostomy bypass. There was no statistically significant difference in terms of OS and overall complications among the three procedures. Additionally, GOOSS scores did not differ significantly between the bypass and the resection groups. It appears from the present study results that patients underwent resection had the lowest rate of diffuse infiltrative tumor, serosal invasion, and peritoneal metastasis. In contrast, in the FJ/NJ group, diffuse infiltrative tumor was the most frequent tumor characteristic found. This



Variables	Median survival time (months)	95% CI
Resection	10	4, 18
FJ/NJ placement	6	4, 13
Gastrojejunostomy	13	2, -
Overall	9	6, 13

Figure 2. Kaplan-Meier estimates of overall survival in incurable gastric cancer patients with GOO by interventions, p=0.228 (resection vs. FJ/NJ placement, p=0.157; resection vs. gastrojejunostomy, p=0.973; gastrojejunostomy vs. FJ/NJ, p=0.201).
FJ, feeding jejunostomy; GOO, gastric outlet obstruction; NJ, naso-jejunostomy

Table 3. Univariable and multivariable Cox regression analysis of the association between clinicopathologic variables and the overall survival in incurable gastric cancer patients with gastric outlet obstruction

Variables	Univariable			Multivariable		
	HR	95% CI	p-value	HR	95% CI	p-value
Age (years)	0.99	0.96 to 1.02	0.580			
Sex						
Female	1.00	Reference				
Male	0.91	0.48 to 1.71	0.765			
ECOG pre-treatment						
ECOG 0 to 1	1.00	Reference				
ECOG 2	0.74	0.27 to 2.02	0.555			
ECOG 3	1.23	0.38 to 3.99	0.733			
Tumor characteristics						
Protruding	1.00	Reference				
Localized ulcer	0.07	0.01 to 0.72	0.025	17.30	0.59 to 509.85	0.099
Infiltrative ulcer	0.07	0.01 to 0.63	0.018	5.60	0.90 to 35.01	0.065
Diffuse infiltration	0.20	0.02 to 1.76	0.147			
Histologic grade						
Moderate	1.00	Reference				
Poor	1.39	0.60 to 3.26	0.444			
Lauren class						
Diffuse	1.00	Reference				
Intestinal	0.85	0.45 to 1.58	0.600			
Incurable factor						
Tumor invasion to adjacent organ	1.00	Reference				
Peritoneal metastasis	0.95	0.46 to 1.98	0.894			
Occult peritoneal metastasis	1.56	0.34 to 7.16	0.567			
Distant metastasis	1.67	0.52 to 5.31	0.389			
Type of surgery						
Resection	1.00	Reference				
FJ/NJ placement	1.81	0.80 to 4.10	0.155			
Gastrojejunostomy	1.04	0.39 to 2.80	0.939			
GOOSS pretreatment						
1	1.00	Reference				
2	1.15	0.47 to 2.85	0.762			
Ascites						
No	1.00	Reference				
Yes	2.91	1.63 to 5.22	<0.001	2.46	1.34 to 4.99	0.004
Later resection						
No	1.00	Reference				
Yes	0.78	0.30 to 2.00	0.601			
Postoperative Chemotherapy						
No	1.00	Reference				
Yes	0.63	0.43 to 0.93	0.018	0.38	0.09 to 1.61	0.189
HIPEC						
Not done	1.00	Reference				
Done	0.68	0.16 to 2.85	0.599			
ECOG at 2 weeks post-treatment						
ECOG 0 to 1	1.00	Reference				
ECOG 2	0.47	0.14 to 1.61	0.229			
ECOG 3	0.85	0.27 to 2.67	0.779			

ECOG=Eastern Cooperative Oncology Group performance status; FJ=feeding jejunostomy; GOO=gastric outlet obstruction; GOOSS=Gastric Outlet Obstruction Scoring System; HIPEC=hyperthermic intraperitoneal chemotherapy; NJ=naso-jejunostomy; HR=hazard ratio; CI=confidence interval

Table 3. Univariable and multivariable Cox regression analysis of the association between clinicopathologic variables and the overall survival in incurable gastric cancer patients with gastric outlet obstruction

Variables	Univariable			Multivariable		
	HR	95% CI	p-value	HR	95% CI	p-value
ECOG at 4 weeks post-treatment						
ECOG 0 to 1	1.00	Reference				
ECOG 2	0.90	0.32 to 2.58	0.846			
ECOG 3	0.88	0.26 to 3.00	0.837			
ECOG at 12 weeks post-treatment						
ECOG 0 to 1	1.00	Reference				
ECOG 2	1.30	0.27 to 6.32	0.747			
ECOG 3	1.18	0.38 to 3.70	0.773			
GOOSS at 2 weeks post-treatment						
1	1.00	Reference				
2	0.75	0.36 to 1.57	0.441			
GOOSS at 4 weeks post-treatment						
1	1.00	Reference				
2	0.38	0.14 to 1.02	0.054	1.59	0.19 to 13.55	0.673
3	0.50	0.16 to 1.58	0.236			
GOOSS at 12 weeks post-treatment						
1	1.00	Reference				
2	0.32	0.09 to 1.22	0.096	0.20	0.02 to 1.57	0.125
3	0.31	0.10 to 0.95	0.040	0.17	0.02 to 1.33	0.091

ECOG=Eastern Cooperative Oncology Group performance status; FJ=feeding jejunostomy; GOO=gastric outlet obstruction; GOOSS=Gastric Outlet Obstruction Scoring System; HIPEC=hyperthermic intraperitoneal chemotherapy; NJ=naso-jejunostomy; HR=hazard ratio; CI=confidence interval

corresponds with other studies in which multiple factors including the patient status and the extent of the cancer involvement can influence the choice of palliative procedures to relieve GOO[11,12].

The optimal palliative procedure for incurable gastric cancer cases with GOO is still unclear. Most studies are retrospective with a small number of patients recruited; therefore, selection bias and underpowered studies are difficult to avoid[12]. Two widely known surgical interventions, palliative gastrectomy and gastrojejunostomy, have been recommended. Some authors contend that palliative resection may provide benefits in terms of increased OS[8,13] and reduced local complications such as bleeding[14]. On the other hand, the results from other comparative studies including the present study and one meta-analysis did not demonstrate this benefit[3,15]. The outcome discrepancy among these studies may result from variations in patients' characteristics, disease extension, and chemotherapy regimens[16]. Regarding the morbidity after a palliative procedure, there is no significant difference in the complications between the resection and the bypass groups in the present study. However, some authors reported higher rates of complication after palliative gastrectomy, especially in cases with R2 resection compared to those with R1 resection or bypass surgery[17]. Postoperative complications may result in an undesirable impact on the subsequent chemotherapy tolerance of the patient. Therefore, based on the above data, the authors' approach is to prioritize bypass surgery as the first option when there is evidence, either preoperatively or intraoperatively, indicating that the disease is incurable. However, in cases where the patient presents with significant bleeding or the tumor has extended into the proximal stomach, making gastric bypass unfeasible, and if intraoperative findings along with the patient's overall condition indicated that resection could be performed safely, then the selected surgical approach will be resection.

In the present study, FJ/NJ was performed in approximately 50% of the patients, primarily due to unfavorable characteristics of the lesions that precluded resection or bypass surgery. The advantage of placing an FJ/NJ tube is that it provides an effective route to improve the patient's nutritional status and supports rapid recovery with minimal complications, thereby increasing the likelihood of successfully receiving subsequent systemic therapy. In some

patients with locally advanced disease, or with a limited number of metastases that may potentially be operable, conversion surgery may be an option in those cases that respond well to chemotherapy[18]. This group of patients can benefit significantly from tube feeding, as it helps avoid serious complications associated with major procedures to relieve GOO and increases the likelihood of undergoing later conversion surgery. In the present study, five out of 22 patients in the FJ/NJ group underwent resection after the initial tube placement, followed by courses of chemotherapy. This low rate of subsequent surgery may be a consequence of a large tumor burden or tumor progression during chemotherapy[5]. Apart from the inability to eat, the major drawback of tube feeding is the discomfort and complications caused by the tube. Moreover, in cases of high-grade gastric obstruction, the patient may require an additional tube for gastric decompression.

Over the past decade, the role of endoscopic stenting for gastric cancer patients with GOO has been fully recognized. Placement of an endoscopic stent offers a minimally invasive way, potentially leading to a return to oral intake and fast recovery. However, a high rate of complications has been reported including migration, perforation, and re-obstruction that causes short patency duration of the stent[19,20]. Therefore, it is recommended that endoscopic stents for the relief of GOO be applied to those patients with an anticipated short life expectancy, or poor medical conditions[21].

The multivariable analysis for OS in the present study demonstrated that only the presence of ascites at the time of diagnosis was associated with poor prognosis. The finding of ascites in gastric cancer patients has been reported to be associated with peritoneal metastasis and poor survival rates[22]. However, other studies have shown that only small amounts of ascites detected by CT scans may not have the same negative impact on survival[23].

The limitations of the present study are listed below:

1. It is a retrospective study, making it difficult to avoid selection bias. Furthermore, the data analysis may be incomplete.

2. The number of patients in each group is small, which may have precluded the detection of significant differences in the results.

3. The number of patients decreased over time, which may have affected the reliability of the results. The loss of data may be a consequence of short patient survival and/or a lack of data recording.

4. Apart from GOOSS, there is a lack of comparison of other aspects of quality-of-life data, which is an important outcome for patients with incurable cancer. A randomized control trial (RCT) may be the gold standard to evaluate the effectiveness of any treatment. However, this will come with challenges when conducting RCT regarding optimal treatment of incurable cancer patients because of the heterogeneity of the disease, and the short life expectancy of the patient. Further research with well-designed prospective comparative studies with a larger number of patients recruited, and by focusing on the unique characteristics of the patient's problem is required to address this issue.

Conclusion

The present study has demonstrated that there is no statistically significant difference in the OS and overall complications among incurable gastric cancer patients underwent resection, gastrojejunostomy bypass, or placement of an FJ/NJ tube for the relief of GOO. Both resection and gastrojejunostomy bypass are effective in relieving obstruction, with comparable outcomes.

What is already known about this topic?

1. Gastric cancer is often diagnosed at an advanced stage, frequently with GOO. The optimal management of this condition is subject of ongoing debate.

2. Systemic chemotherapy is crucial for survival prolongation in these patients.

What does this study add?

This study confirms that there is no significant difference in survival and post-procedural complications among incurable gastric cancer patients with GOO who underwent one of three surgical procedures. Additionally, there was no difference in GOOSS scores between the resection and gastrojejunostomy groups. Notably, patients who underwent resection in this study exhibited lower rates of serosal invasion and diffuse infiltration of the tumor compared to other groups.

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Conflicts of interest

The authors declare the absence of any conflict of interest whatsoever.

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