Original Article

Comparisons of nutritional status and complications between patients with and without postoperative feeding jejunostomy tube in gastric cancer: a retrospective study

Kang Li[1#], Ziyang Zeng[2#], Zimu Zhang[2], Xin Ye[2], Jianchun Yu[2], Weiming Kang[2]

[1]Department of Vascular Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China; [2]Department of General Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Contributions: (I) Conception and design: W Kang, J Yu, X Ye; (II) Administrative support: None; (III) Provision of study materials or patients: None; (IV) Collection and assembly of data: K Li; (V) Data analysis and interpretation: Z Zhang, Z Zeng; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Weiming Kang, MD. Department of General Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, No. 1 of Shuaifuyuan, Dongcheng District, Beijing 100730, China. Email: kangweiming@163.com.

Background: Feeding jejunostomy tube (FJT) enables early postoperative nutritional supply for gastric cancer patients undergoing surgery. However, the nutritional benefit of FJT may be accompanied by potential risk of increased complications, so both the nutritional improvement and the complication rates associated with FJT should be assessed.

Methods: From January 2009 to December 2014, 715 consecutive patients underwent gastric cancer resection at the Peking Union Medical College Hospital in China. The perioperative nutritional index and incidence of complications in patients with FJT placement were retrospectively compared to those in patients without FJT placement. Nutritional data including albumin, prealbumin, hemoglobin, and high sensitivity C-reactive protein, the neutrophil-to-lymphocyte ratio (NLR), and Onodera's prognostic nutrition index (OPNI) were recorded at the following 3 timepoints: preoperatively, 1-week postoperatively, and 1-month postoperatively. Postoperative complications including surgical site infection, intra-abdominal infections, anastomotic leaks and gastroparesis were assessed. Multivariate logistic regression was used to study the association between FJT and complications.

Results: A total of 715 patients were included in the study. The mean age was 60.4 years and 72.2% were male. The overall characteristics between FJT and no-FJT groups were comparable. Of the 247 total gastrectomy cases, 98 (39.7%) had a FJT placed. Compared to the total gastrectomy patients without a FJT, the 98 patients with a FJT had a lower hemoglobin level (P=0.048) and NLR (P=0.030) preoperatively, and higher albumin (P=0.005), prealbumin (P<0.001), and hemoglobin (P=0.014) levels, a higher OPNI (P=0.027), and a lower NLR (P=0.005) 1-month postoperatively. Of the 468 subtotal gastrectomy cases, 87 (18.6%) had a FJT placed. Compared to the subtotal gastrectomy patients without a FJT, these 87 patients had a lower NLR (P=0.006) 1-week postoperatively, and a higher albumin level (P=0.009) 1-month postoperatively. In the multivariate analysis, FJT placement was not associated with postoperative adverse outcomes, including surgical site infection [odds ratio (OR) =1.21, P=0.79], intra-abdominal infection (OR =0.38, P=0.11), anastomotic leak (OR =0.58, P=0.53), reoperation (OR =0.22, P=0.23), gastroparesis (OR =6.35, P=0.08), or hospitalization for more than 30 days (OR =0.58, P=0.32).

Conclusions: Early enteral nutritional support by FJT after gastrectomy tended to improve the nutritional status of patients, while it did not appear to increase the incidence rate of postoperative complications.

© Journal of Gastrointestinal Oncology. All rights reserved.

Keywords: Feeding jejunostomy tube (FJT); gastric cancer; gastrectomy; early enteral nutrition; complication

Submitted May 16, 2022. Accepted for publication Feb 02, 2023. Published online Feb 23, 2023.
doi: 10.21037/jgo-22-847
View this article at: https://dx.doi.org/10.21037/jgo-22-847

Introduction

The incidence of gastric cancer has decreased in recent decades, but it remains a major public health concern worldwide (1). It was estimated to be 1,089,103 newly diagnosed cancer cases and 768,793 cancer-related deaths of gastric cancer in 2020 worldwide (2). Gastric cancer is the 2nd leading cause of cancer-related mortality in both Chinese males and Chinese females (3). Surgery continues to be the most effective therapy for gastric cancer (4).

Nutrition is considered a significant risk factor for poor outcomes in gastric cancer patients (5,6). Notably, malnourished patients are at greater risk of adverse clinical outcomes (e.g., longer hospital stays) and have a higher incidence of complications (e.g., wounds and infectious complications) than well-nourished patients (7,8). Malnutrition is common in advanced gastric cancer patients due to the poor absorption of essential nutrients after surgery (9). Nutritional assessment and counseling have been added to the National Comprehensive Cancer Network (NCCN) Guidelines for Gastric Cancer, which recommend monitoring surgically resected patients for nutritional deficiency and treating as indicated (10).

The placement of a feeding jejunostomy tube (FJT) at the time of gastrectomy provides alternative and supplementary access to early postoperative enteral nutrition. Enteral nutrition is superior to total parenteral nutrition postoperatively, as it significantly improves clinical and immunological outcomes, and is also cost effective, as it reduces the duration of hospitalization, and reduces the incidence of postoperative infections and complications (11-13).

While the safety regarding FJT in gastric cancer patients has been previously studied (14-16), few studies have examined the nutritional benefit associated with early nutritional supply with FJT. This clinical study sought to explore the nutritional benefit of FJT placement and potential complications in patients undergoing gastric cancer resection. We present the following article in accordance with the STROBE reporting checklist (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-847/rc).

Highlight box

Key findings

- Early enteral nutritional support by FJT after gastrectomy tended to improve the nutritional status of patients with gastric cancer, and did not increase the incidence rate of postoperative complications.

What is known and what is new?

- It has been suggested that FJT can provide additional access to early enteral nutritional support after gastrectomy and does not increase adverse events.
- The nutritional benefit measured by albumin, prealbumin, hemoglobin, Hs-CRP, NLR and OPNI was assessed in patients with FJT support.

What is the implication, and what should change now?

- This retrospective study showed an improvement of nutritional status in patients with FJT compared with patients without FJT, and FJT did not increase postoperative complications postoperatively. FJT should be considered as a useful alternative for early enteral nutritional support after gastrectomy.

Methods

Patients

A total of 715 consecutive patients underwent resection of gastric cancer from January 2009 to December 2014 at the Peking Union Medical College Hospital in China. We retrospectively analyzed data on patients' sex, age, body mass index (BMI), history, tumor-node-metastasis (TNM) stage, preoperative adjuvant therapy, and complications. The TNM classification of gastric cancer was determined using the Union for International Cancer Control 6 system. Total gastrectomy was defined as the resection of the entire stomach, while subtotal gastrectomy included proximal and distal gastrectomy. Safety outcomes included the assessment of major postoperative complications including surgical site infection, intra-abdominal infections, anastomotic leaks, reoperation and gastroparesis. Surgical site infection was defined as superficial and deep surgical site infection.

© Journal of Gastrointestinal Oncology. All rights reserved.

Intra-abdominal infection was defined as the presence of abnormal fluid on radiological examination associated with infectious symptoms. Anastomotic leak was diagnosed when extra-intestinal leakage of orally administered contrast media was observed by radiology or through the abdominal drain. Gastroparesis was diagnosed by upper digestive tract radiography showing residual contrast agent in the stomach, which indicated no mechanical obstruction in gastrointestinal anastomosis and delayed gastric emptying. The perioperative nutritional index and incidence of complications in patients with a FJT were compared to those in patients without a FJT. The levels of albumin, prealbumin, hemoglobin, high sensitivity C-reactive protein (hs-CRP), the neutrophil-to-lymphocyte ratio (NLR), and Onodera's prognostic nutrition index (OPNI) were recorded at the following 3 timepoints: preoperatively, 1-week postoperatively, and 1-month postoperatively. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the institutional review board of Peking Union Medical College Hospital (No. K1447). Informed consent was waived due to the retrospective nature of this study.

Statistical analysis

The analysis of the data was performed using IBM SPSS Statistics (Version 19.0), and the statistical significance was determined with a 5% two-sided significance level. Comparative analyses between 2 groups were performed using an independent samples t-test for the continuous variables and a chi-squared test or Fisher's exact test for the categorical variables. Univariate and multivariate logistic regression analyses were conducted to evaluate the association of FJT placement with postoperative complications. A subset analysis of patients who underwent total or subtotal gastrectomy was also performed.

Results

Baseline characteristics

A total of 715 gastric cancer patients underwent resection at our institution during the study period. The patients had a mean age of 60.4±11.7 years, and 516 were male (72.2%) and 199 were female (27.8%). Of the 715 patients, 247 (34.5%) underwent total gastrectomy, and 468 (65.5%) underwent subtotal gastrectomy. *Table 1* presents details of patients' characteristics. The majority of baseline variables were comparable between patients with and without FJT, except that there was more total gastrectomy, preoperative adjuvant chemotherapy, occurrence of gastroparesis and longer hospital stay in the FJT group (*Table 1*).

Comparison of nutritional status in patients with and without FJT

Of the 247 total gastrectomy cases, 98 (39.7%) had a FJT placed and 149 (60.3%) did not. The FJT group had a lower hemoglobin level (117.15±15.82 versus 122.73±21.24 g/L, P=0.048) and a lower NLR (2.16±1.26 versus 3.05±3.56, P=0.030) than the non-FJT group preoperatively; however, there was no significant difference between the 2 groups 1-week postoperatively. The FJT group had a higher albumin level (39.63±5.31 versus 36.13±5.07 g/L, P=0.005), prealbumin level (181.00±48.32 versus 146.00±38.65 mg/L, P<0.001), hemoglobin level (117.76±17.14 versus 112.05±13.56 g/L, P=0.014), OPNI (47.94±8.02 versus 45.55±5.96, P=0.027) and a lower NLR (1.96±0.95 versus 2.50±1.59, P=0.005) than the non-FJT group 1-month postoperatively (*Table 2*).

Of the 468 subtotal gastrectomy cases, 87 (18.7%) had a FJT placed and 381 (81.2%) did not. There was no significant difference between the 2 groups preoperatively. However, the FJT group had a lower NLR (5.01±2.94 versus 6.71±4.97, P=0.006) than the non-FJT group 1-week postoperatively. The FJT group also had a higher albumin level (39.12±4.05 versus 37.09±4.72 g/L, P=0.009) than the non-FJT group 1-month postoperatively (*Table 3*).

Association between FJT and postoperative outcomes

In all patients, the multivariate regression analysis demonstrated that there was no association between FJT placement and an increased risk of surgical site infection [OR (odds ratio) =1.21, P=0.79], intra-abdominal infection (OR =0.38, P=0.11), anastomotic leak (OR =0.58, P=0.53), reoperation (OR =0.22, P=0.23) and gastroparesis (OR =6.35, P=0.08). There was no significant association between FJT and hospitalization for more than 30 days (OR =0.58, P=0.32) (*Table 4*). In subgroup analysis of subtotal gastrectomy and total gastrectomy, FJT did not appear to increase postoperative complications or hospitalization for more than 30 days (*Table 5,6*).

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 1 Patients' preoperative demographic information

Variables	Total (n=715)	FJT (n=185)	No FJT (n=530)	P value
Gender				0.63
Male	516 (72.2)	131 (70.8)	385 (72.6)	
Female	199 (27.8)	54 (29.2)	145 (27.4)	
Age (year)	60.4±11.7	60.2±11.5	60.4±11.8	0.85
BMI (kg/m^2)	23.0±3.2	22.8±3.1	23.1±3.2	0.47
Hypertension	131 (18.3)	33 (17.8)	98 (18.5)	0.84
Diabetes mellitus	86 (12.0)	22 (11.9)	64 (12.1)	0.95
Cardiac disease	67 (9.4)	18 (9.7)	49 (9.2)	0.85
Smoking history	304 (42.5)	79 (42.7)	225 (42.5)	0.95
TNM stage				0.29
Stage I	176 (24.6)	41 (22.2)	135 (25.5)	
Stage II	264 (36.9)	64 (34.6)	200 (37.7)	
Stage III	275 (38.5)	80 (43.2)	195 (36.8)	
Operation type				<0.001
Total gastrectomy	247 (34.5)	98 (53.0)	149 (28.1)	
Subtotal gastrectomy	468 (65.5)	87 (47.0)	381 (71.9)	
Preoperative adjuvant therapy	159 (22.2)	76 (41.1)	83 (15.7)	<0.001
Surgical site infection	44 (6.2)	13 (7.0)	31 (5.8)	0.56
Intra-abdominal infection	38 (5.3)	10 (5.4)	28 (5.3)	0.95
Anastomotic leak	23 (3.2)	7 (3.8)	16 (3.0)	0.61
Gastroparesis	25 (3.5)	12 (6.5)	13 (2.5)	0.015
Reoperation	15 (2.1)	4 (2.2)	11 (2.1)	1
Length of stay (days)	20.9±9.6	24.7±10.5	20.0±9.1	<0.001
Hospitalized for more than 30 days	116 (16.2)	47 (25.4)	69 (13.0)	<0.001

Data are presented as mean ± standard deviation and n (%). FJT, feeding jejunostomy tube; BMI, body mass index; TNM, tumor-node-metastasis.

Discussion

Malnutrition can be detected in up to 50% of patients with gastrointestinal cancer (17). Poor nutritional status leads to postoperative morbidity and mortality (18). Total gastrectomy has a profound effect on nutritional status, and can potentially result in weight loss, malabsorption, maldigestion, shortened intestinal transit time, and bacterial overgrowth (19-22). This surgical intervention reduces the reservoir into which patients can eat, alters the physiology of digestion, and leads to malnutrition in approximately 80% of patients (23). Further, the severity of malnutrition is increased by radical gastric cancer adjuvant therapies, such as radiotherapy and chemotherapy (6).

Perioperative nutritional support is of great significance in reducing postoperative complications, shortening the duration of hospitalization, and reducing the costs of hospitalization (24). Early enteral nutrition support after gastrointestinal surgery is recommended in the European Society for Clinical Nutrition and Metabolism guidelines as grade of recommendation A (25). A randomized, multicenter, clinical trial of patients with gastrointestinal cancer who were malnourished and were candidates for

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 2 Comparison of the albumin, prealbumin, and hemoglobin levels, the NLR, hs-CRP level, and OPNI in patients undergoing total gastrectomy

Total gastrectomy (n=247)	FJT (n=98)	No FJT (n=149)	P value
Pre-operation			
Albumin, g/L	39.47±4.12	38.89±4.34	0.285
Prealbumin, mg/L	208.08±44.96	203.86±55.48	0.596
Hemoglobin, g/L	117.15±15.82	122.73±21.24	0.048
Hs-CRP, mg/L	7.62±3.02	9.34±2.94	0.112
NLR	2.16±1.26	3.05±3.56	0.030
OPNI	47.57±5.08	46.37±5.92	0.140
1-week post-operation			
Albumin, g/L	34.57±4.15	34.44±4.87	0.838
Prealbumin, mg/L	142.70±60.69	142.91±52.95	0.983
Hemoglobin, g/L	109.34±16.60	111.52±15.75	0.369
Hs-CRP, mg/L	45.62±15.23	59.37±14.72	0.302
NLR	6.06±8.92	7.97±6.76	0.111
OPNI	40.98±4.83	40.46±7.73	0.600
1-month post-operation			
Albumin, g/L	39.63±5.31	36.13±5.07	0.005
Prealbumin, mg/L	181.00±48.32	146.00±38.65	<0.001
Hemoglobin, g/L	117.76±17.14	112.05±13.56	0.014
NLR	1.96±0.95	2.50±1.59	0.005
OPNI	47.94±8.02	45.55±5.96	0.027

Data are presented as mean ± standard deviation. NLR, neutrophil-to-lymphocyte ratio; hs-CRP, high sensitivity C-reactive protein; OPNI, Onodera's prognostic nutrition index; FJT, feeding jejunostomy tube.

major elective surgery reported that patients fed enterally had significantly fewer postoperative complications than those fed parenterally (26). The duration of postoperative hospitalization was also significantly shorter in the enteral nutrition group than the parenteral nutrition group. Further, patients fed enterally experienced significantly more adverse effects than those fed parenterally (26).

The technique used for FJT placement is simple, and the procedure can be conducted during the resection of gastric cancer to provide access to early postoperative enteral nutrition (27). The NCCN guidelines recommend that consideration be given to FJT placement to increase the use and completion rate of adjuvant therapy (28).

The present study compared the postoperative early nutrition and complications of patients who underwent a FJT placement during the resection of gastric cancer to a control group who did not undergo a FJT placement. We found nutritional improvement in the FJT group and did not observe major effects on postoperative adverse outcomes. The NLR was measured as an indicator of systemic inflammation (29); the gradual increase in lymphocytes and the gradual decline in neutrophils occurs with systemic inflammatory reaction improvement (30). The OPNI is a simple and effective nutritional assessment and surgical risk prediction index that is currently widely used in gastrointestinal surgery (31,32).

Of the total gastrectomy cases, those with a FJT had a significantly lower hemoglobin level preoperatively than those without a FJT; however, there was no significant difference between the 2 groups 1-week postoperatively,

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 3 Comparison of albumin, prealbumin, and hemoglobin levels, the NLR, hs-CRP level, and OPNI in patients undergoing subtotal gastrectomy

Subtotal gastrectomy (n=468)	FJT (n=87)	No FJT (n=381)	P value
Pre-operation			
Albumin, g/L	39.41±4.45	39.58±5.75	0.786
Prealbumin, mg/L	209.68±55.98	213.24±94.76	0.692
Hemoglobin, g/L	124.77±15.17	129.13±24.96	0.264
Hs-CRP, mg/L	3.72±3.28	8.25±4.01	0.215
NLR	2.77±2.11	3.00±3.18	0.459
OPNI	47.39±6.01	45.81±9.22	0.080
1-week post-operation			
Albumin, g/L	34.01±3.71	34.75±5.12	0.266
Prealbumin, mg/L	146.57±50.10	152.53±52.43	0.462
Hemoglobin, g/L	112.53±16.93	114.97±18.37	0.621
Hs-CRP, mg/L	38.93±11.32	50.24±13.16	0.187
NLR	5.01±2.94	6.71±4.97	0.006
OPNI	40.22±5.07	39.95±7.30	0.730
1-month post-operation			
Albumin, g/L	39.12±4.05	37.09±4.72	0.009
Prealbumin, mg/L	187.79±64.69	176.33±36.71	0.306
Hemoglobin, g/L	117.78±15.94	118.47±16.20	0.803
NLR	2.78±1.38	2.32±1.75	0.088
OPNI	47.27±5.67	46.62±5.25	0.499

Data are presented as mean ± standard deviation. NLR, neutrophil-to-lymphocyte ratio; hs-CRP, high sensitivity C-reactive protein; OPNI, Onodera's prognostic nutrition index; FJT, feeding jejunostomy tube.

Table 4 Multivariate analysis of the risk factors for adverse postoperative outcomes in all patients (n=715)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Surgical site infection	Age	1.06	0.99–1.13	0.11
	Gender	1.35	0.26–7.02	0.73
	BMI	1.07	0.85–1.34	0.59
	TNM stage	0.69	0.13–3.78	0.67
	Operation type	1.91	0.29–12.62	0.50
	Preoperative adjuvant therapy	0.78	0.14–4.30	0.77
	FJT placement	1.21	0.30–4.89	0.79

Table 4 (*continued*)

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 4 (*continued*)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Intra-abdominal infection	Age	1.02	0.96–1.09	0.45
	Gender	1.45	0.36–5.90	0.60
	BMI	0.86	0.71–1.05	0.14
	TNM stage	1.27	0.35–4.58	0.71
	Operation type	0.76	0.21–2.77	0.67
	Preoperative adjuvant therapy	0.56	0.11–2.86	0.48
	FJT placement	0.38	0.11–1.25	0.11
Anastomotic leak	Age	1.05	0.96–1.15	0.28
	Gender	0.82	0.13–4.97	0.83
	BMI	0.92	0.69–1.23	0.57
	TNM stage	0.85	0.13–4.97	0.96
	Operation type	0.65	0.10–4.27	0.65
	Preoperative adjuvant therapy	1.27	0.20–8.09	0.80
	FJT placement	0.58	0.11–3.21	0.53
Gastroparesis	Age	1.01	0.96–1.07	0.64
	Gender	0.34	0.09–1.24	0.10
	BMI	1.24	1.00–1.53	0.04
	TNM stage	8.98	0.45–177.53	0.15
	Operation type	0.52	0.03–8.38	0.65
	Preoperative adjuvant therapy	2.20	0.56–8.65	0.26
	FJT placement	6.35	0.80–50.51	0.08
Reoperation	Age	1.01	0.91–1.11	0.84
	Gender	0.84	0.07–10.04	0.89
	BMI	1.12	0.77–1.63	0.55
	TNM stage	0.46	0.05–4.28	0.50
	Operation type	2.52	0.16–38.90	0.51
	Preoperative adjuvant therapy	1.62	0.13–20.53	0.71
	FJT placement	0.22	0.02–2.63	0.23
Hospitalized for more than 30 days	Age	0.95	0.91–1.00	0.02
	Gender	1.88	0.77–4.58	0.17
	BMI	1.04	0.89–1.20	0.65
	TNM stage	0.15	0.03–0.76	0.02
	Operation type	4.00	0.88–18.10	0.07
	Preoperative adjuvant therapy	0.55	0.21–1.41	0.21
	FJT placement	0.58	0.20–1.70	0.32

BMI, body mass index; TNM, tumor-node-metastasis; FJT, feeding jejunostomy tube.

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 5 Multivariate analysis of the risk factors for adverse postoperative outcomes in patients who underwent subtotal gastrectomy (n=468)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Surgical site infection	Age	1.02	0.95–1.10	0.59
	Gender	2.29	0.25–21.28	0.47
	BMI	0.99	0.75–1.30	0.94
	TNM stage	1.37	0.10–18.11	0.81
	Preoperative adjuvant therapy	1.02	0.11–9.89	0.99
	FJT placement	1.05	0.17–6.70	0.96
Intra-abdominal infection	Age	1.02	0.95–1.08	0.60
	Gender	0.50	0.12–2.17	0.36
	BMI	0.85	0.67–1.07	0.17
	TNM stage	2.25	0.31–16.18	0.42
	Preoperative adjuvant therapy	0.42	0.04–4.17	0.46
	FJT placement	0.31	0.06–1.56	0.16
Anastomotic leak	Age	1.15	0.95–1.40	0.16
	Gender	1.00	0.07–15.45	0.99
	BMI	0.77	0.50–1.17	0.22
	TNM stage	0.64	0.10–9.79	0.83
	Preoperative adjuvant therapy	2.18	0.13–36.02	0.59
	FJT placement	0.11	0.01–1.81	0.12
Gastroparesis	Age	0.98	0.92–1.04	0.43
	Gender	0.34	0.07–1.76	0.20
	BMI	1.14	0.84–1.54	0.42
	TNM stage	0.48	0.03–9.66	0.63
	Preoperative adjuvant therapy	4.31	0.77–24.14	0.10
	FJT placement	2.93	0.31–27.82	0.35
Reoperation	Age	1.00	0.89–1.13	0.98
	Gender	0.75	0.12–4.57	0.76
	BMI	1.00	0.60–1.64	0.98
	TNM stage	0.57	0.03–12.92	0.73
	Preoperative adjuvant therapy	5.02	0.34–72.72	0.24
	FJT placement	0.49	0.03–10.11	0.65

Table 5 (*continued*)

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 5 (*continued*)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Hospitalized for more than 30 days	Age	0.94	0.89–1.00	0.03
	Gender	1.18	0.34–4.10	0.79
	BMI	0.99	0.82–1.19	0.90
	TNM stage	0.80	0.06–10.05	0.88
	Preoperative adjuvant therapy	0.90	0.21–3.81	0.89
	FJT placement	0.24	0.05–1.26	0.09

BMI, body mass index; TNM, tumor-node-metastasis; FJT, feeding jejunostomy tube.

Table 6 Multivariate analysis of the risk factors for adverse postoperative outcomes in patients who underwent total gastrectomy (n=247)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Surgical site infection	Age	1.04	0.98–1.10	0.16
	Gender	1.62	0.33–7.99	0.56
	BMI	1.07	0.88–1.30	0.51
	TNM stage	0.53	0.10–6.78	0.34
	Preoperative adjuvant therapy	0.89	0.03–23.66	0.94
	FJT placement	1.15	0.30–4.48	0.84
Intra-abdominal infection	Age	1.02	0.91–1.13	0.77
	Gender	0.74	0.11–5.21	0.77
	BMI	0.87	0.61–1.24	0.43
	TNM stage	0.41	0.02–9.07	0.57
	Preoperative adjuvant therapy	1.21	0.16–9.13	0.85
	FJT placement	0.37	0.03–4.99	0.45
Anastomotic leak	Age	1.02	0.89–1.17	0.76
	Gender	0.90	0.07–11.94	0.94
	BMI	1.01	0.69–1.48	0.96
	TNM stage	0.89	0.15–4.01	0.23
	Preoperative adjuvant therapy	0.76	0.06–10.50	0.84
	FJT placement	0.24	0.02–3.46	0.29

Table 6 (*continued*)

© Journal of Gastrointestinal Oncology. All rights reserved.

Table 6 (*continued*)

Complications	Variable	Odds ratio	95% CI for odds ratio	P value
Gastroparesis	Age	1.24	0.98–1.55	0.07
	Gender	0.08	0.01–2.09	0.13
	BMI	1.28	0.83–1.98	0.26
	TNM stage	0.16	0.01–5.73	0.32
	Preoperative adjuvant therapy	3.23	0.23–44.98	0.38
	FJT placement	0.15	0.01–3.66	0.24
Reoperation	Age	1.01	0.94–1.09	0.81
	Gender	0.75	0.12–4.57	0.76
	BMI	1.13	0.88–1.46	0.34
	TNM stage			
	Preoperative adjuvant therapy	1.78	0.29–10.97	0.54
	FJT placement	0.16	0.01–1.78	0.14
Hospitalized for more than 30 days	Age	0.97	0.89–1.04	0.38
	Gender	3.84	0.84–17.58	0.08
	BMI	1.10	0.83–1.45	0.52
	TNM stage	0.21	0.01–4.50	0.32
	Preoperative adjuvant therapy	0.20	0.04–1.02	0.05
	FJT placement	2.18	0.16–30.03	0.56

BMI, body mass index; TNM, tumor-node-metastasis; FJT, feeding jejunostomy tube.

which indicates that the FJT group had a postoperative increase in hemoglobin. Patients with a FJT also had a significantly lower NLR preoperatively than those without a FJT; this could be explained by the high rate of preoperative adjuvant chemoradiotherapy, which may have caused side effects associated with bone marrow suppression. At 1-month postoperatively, the total gastrectomy FJT group had significantly higher albumin, prealbumin, and hemoglobin levels and OPNI, and a significantly lower NLR than the total gastrectomy non-FJT group. Patients who underwent total gastrectomy and received postoperative early enteral nutrition had an improved nutritional index, reduced inflammation, and an improved OPNI 1-month postoperatively.

Of the subtotal gastrectomy cases, there was no significant difference between the FJT group and the non-FJT group preoperatively. Patients with a FJT had a significantly reduced NLR 1-week postoperatively compared to those without a FJT. Early postoperative enteral nutrition reduces the NLR, which may indicate a reduction in the postoperative inflammatory reaction. The nutritional index and OPNI were not significantly improved by FJT placement 1-week postoperatively. The patients with FJT placement had a significantly higher albumin level 1-month postoperatively than the subtotal gastrectomy patients without a FJT.

FJT placement during gastric cancer resection provides access for early postoperative enteral and parenteral sequential enteral nutrition. It avoids the nasal tube nutrition channel, which may cause subjective discomfort and has an increased risk of aspiration. Further, enteral nutrition can still be administered through a FJT to

© Journal of Gastrointestinal Oncology. All rights reserved.

patients with anastomotic leak, gastroparesis, and other postoperative complications. Enteral nutrition contributes to the protection of the intestinal mucosal barrier and reduces the incidence of hepatic dysfunction and infection complications caused by total parenteral nutrition. In the present study, FJT placement was not associated with complications, including surgical site infection, intra-abdominal infection, anastomotic leak, reoperation, gastroparesis, and hospitalization for more than 30 days (33).

The limitation of this study is that the research was conducted in a retrospective cohort and the imbalance between the groups may generate potential bias in the analysis of nutritional outcomes and complication rates. The study was also conducted in a single institute, so the clinical benefit of FJT could be biased by patterns of nutritional supply, tumor stage, ethnicities and standards of clinical evaluation. In a study comparing FJT in gastrectomy or esophagogastrectomy, it was found that FJT complications were more likely to occur with gastrectomy than with esophagogastrectomy (34). So the generalization of the results should be cautious as the optimal nutritional support should be applied depending on clinical settings. Prospective, multi-center clinical studies are warranted to facilitate better clinical decision making.

Conclusions

The application of FJT for early enteral nutritional support can improve the nutritional status of patients after gastrectomy, and it does not significantly increase the incidence rate of postoperative complications.

Acknowledgments

We would like to thank the study patients and their families for the opportunity to review their medical records.
Funding: The study was supported by National High Level Hospital Clinical Research Funding (Nos. 2022-PUMCH-C-048 and 2022-PUMCH-B-005); CAMS Innovation Fund for Medical Sciences (No. 2020-I2M-C&T-B-027).

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-847/rc

Data Sharing Statement: Available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-847/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-847/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the institutional review board of Peking Union Medical College Hospital (No. K1447). Informed consent was waived due to the retrospective nature of this study.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: https://creativecommons.org/licenses/by-nc-nd/4.0/.

References

1. Choi WJ, Kim J. Nutritional Care of Gastric Cancer Patients with Clinical Outcomes and Complications: A Review. Clin Nutr Res 2016;5:65-78.
2. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021;71:209-49.
3. Chen W, Zheng R, Baade PD, et al. Cancer statistics in China, 2015. CA Cancer J Clin 2016;66:115-32.
4. Poston GJ. Global cancer surgery: The Lancet Oncology review. Eur J Surg Oncol 2015;41:1559-61.
5. Voron T, Tselikas L, Pietrasz D, et al. Sarcopenia Impacts on Short- and Long-term Results of Hepatectomy for Hepatocellular Carcinoma. Ann Surg 2015;261:1173-83.
6. Qiu M, Zhou YX, Jin Y, et al. Nutrition support can bring survival benefit to high nutrition risk gastric cancer patients who received chemotherapy. Support Care Cancer

© Journal of Gastrointestinal Oncology. All rights reserved.

2015;23:1933-9.
7. Lee H, Cho YS, Jung S, et al. Effect of nutritional risk at admission on the length of hospital stay and mortality in gastrointestinal cancer patients. Clin Nutr Res 2013;2:12-8.
8. Zhang L, Wang S, Gao X, et al. Poor Pre-operative Nutritional Status Is a Risk Factor of Post-operative Infections in Patients With Gastrointestinal Cancer-A Multicenter Prospective Cohort Study. Front Nutr 2022;9:850063.
9. Chen W, Zhang Z, Xiong M, et al. Early enteral nutrition after total gastrectomy for gastric cancer. Asia Pac J Clin Nutr 2014;23:607-11.
10. Ida S, Watanabe M, Yoshida N, et al. Sarcopenia is a Predictor of Postoperative Respiratory Complications in Patients with Esophageal Cancer. Ann Surg Oncol 2015;22:4432-7.
11. Braga M, Gianotti L, Gentilini O, et al. Early postoperative enteral nutrition improves gut oxygenation and reduces costs compared with total parenteral nutrition. Crit Care Med 2001;29:242-8.
12. Moore FA, Feliciano DV, Andrassy RJ, et al. Early enteral feeding, compared with parenteral, reduces postoperative septic complications. The results of a meta-analysis. Ann Surg 1992;216:172-83.
13. Abunnaja S, Cuviello A, Sanchez JA. Enteral and parenteral nutrition in the perioperative period: state of the art. Nutrients 2013;5:608-23.
14. Sun Z, Shenoi MM, Nussbaum DP, et al. Feeding jejunostomy tube placement during resection of gastric cancers. J Surg Res 2016;200:189-94.
15. Deepjyoti K, Bannoth S, Purkayastha J, et al. Nasojejunal Feeding Is Safe and Effective Alternative to Feeding Jejunostomy for Postoperative Enteral Nutrition in Gastric Cancer Patients. South Asian J Cancer 2020;9:70-3.
16. Brenkman HJF, Roelen SVS, Steenhagen E, et al. Postoperative complications and weight loss following jejunostomy tube feeding after total gastrectomy for advanced adenocarcinomas. Chin J Cancer Res 2017;29:333-40.
17. Nicolini A, Ferrari P, Masoni MC, et al. Malnutrition, anorexia and cachexia in cancer patients: A mini-review on pathogenesis and treatment. Biomed Pharmacother 2013;67:807-17.
18. Bachmann J, Müller T, Schröder A, et al. Influence of an elevated nutrition risk score (NRS) on survival in patients following gastrectomy for gastric cancer. Med Oncol 2015;32:204.
19. Maksimaityte V, Bausys A, Kryzauskas M, et al. Gastrectomy impact on the gut microbiome in patients with gastric cancer: A comprehensive review. World J Gastrointest Surg 2021;13:678-88.
20. Iivonen MK, Ahola TO, Matikainen MJ. Bacterial overgrowth, intestinal transit, and nutrition after total gastrectomy. Comparison of a jejunal pouch with Roux-en-Y reconstruction in a prospective random study. Scand J Gastroenterol 1998;33:63-70.
21. Bae JM, Park JW, Yang HK, et al. Nutritional status of gastric cancer patients after total gastrectomy. World J Surg 1998;22:254-60; discussion 260-1.
22. Rogers C. Postgastrectomy nutrition. Nutr Clin Pract 2011;26:126-36.
23. Gangadharan A, Choi SE, Hassan A, et al. Protein calorie malnutrition, nutritional intervention and personalized cancer care. Oncotarget 2017;8:24009-30.
24. Allum WH, Blazeby JM, Griffin SM, et al. Guidelines for the management of oesophageal and gastric cancer. Gut 2011;60:1449-72.
25. Weimann A, Braga M, Carli F, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr 2017;36:623-50.
26. Bozzetti F, Braga M, Gianotti L, et al. Postoperative enteral versus parenteral nutrition in malnourished patients with gastrointestinal cancer: a randomised multicentre trial. Lancet 2001;358:1487-92.
27. Arvanitakis M, Gkolfakis P, Despott EJ, et al. Endoscopic management of enteral tubes in adult patients - Part 1: Definitions and indications. European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy 2021;53:81-92.
28. Wanebo HJ, Kennedy BJ, Chmiel J, et al. Cancer of the stomach. A patient care study by the American College of Surgeons. Ann Surg 1993;218:583-92.
29. Kim EY, Lee JW, Yoo HM, et al. The Platelet-to-Lymphocyte Ratio Versus Neutrophil-to-Lymphocyte Ratio: Which is Better as a Prognostic Factor in Gastric Cancer? Ann Surg Oncol 2015;22:4363-70.
30. Wang C, Huang HZ, He Y, et al. A New Nomogram Based on Early Postoperative NLR for Predicting Infectious Complications After Gastrectomy. Cancer Manag Res 2020;12:881-9.
31. Jian-Hui C, Iskandar EA, Cai ShI, et al. Significance of Onodera's prognostic nutritional index in patients with colorectal cancer: a large cohort study in a single Chinese institution. Tumour Biol 2016;37:3277-83.
32. Hashimoto T, Kurokawa Y, Takahashi T, et al. What is the most useful body composition parameter for predicting

© Journal of Gastrointestinal Oncology. All rights reserved.

toxicities of preoperative chemotherapy for gastric cancer? Surg Today 2020;50:509-15.
33. Okida LF, Salimi T, Ferri F, et al. Complications of feeding jejunostomy placement: a single-institution experience. Surg Endosc 2021;35:3989-97.
34. Choi AH, O'Leary MP, Merchant SJ, et al. Complications of Feeding Jejunostomy Tubes in Patients with Gastroesophageal Cancer. J Gastrointest Surg 2017;21:259-65.

Cite this article as: Li K, Zeng Z, Zhang Z, Ye X, Yu J, Kang W. Comparisons of nutritional status and complications between patients with and without postoperative feeding jejunostomy tube in gastric cancer: a retrospective study. J Gastrointest Oncol 2023;14(1):97-109. doi: 10.21037/jgo-22-847

(English Language Editor: L. Huleatt)

© Journal of Gastrointestinal Oncology. All rights reserved.