The impact of surgical case order on short-term and long-term outcomes in patients undergoing laparoscopic gastrectomy: a propensity matched study

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Research Article

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Abstract

Background and aim: Whether the surgical case order is an important factor affecting the short- and long-term outcomes of patients with GC has always been a concern. This study aimed to compare the short- and long-term outcomes of different surgical case orders

Methods: We included patients who underwent laparoscopy-assisted radical gastrectomy at the Union Hospital of Fujian Medical University (Fuzhou, China) between January 2016 and December 2017. In total, 1235 patients (No.1 (n=497), No.2 (n=426), and Other groups (n=312)) were included in the propensity score matching (PSM, 1:1:1).

Results: After PSM, there were no significant differences in clinicopathological characteristics between the No.1, No.2, and the Other groups. The operative duration in the Other group was significantly longer than that in groups No.1 and No.2. The volume of blood loss in the No.2 and the Other group was significantly higher than that in the No.1 group. Kaplan-Meier survival analysis revealed similar five-year overall survival (OS) and disease-free survival (DFS) rates among the three groups. Multivariate Cox regression analysis showed that surgical case order was not independent risk factors for 5-year OS and DFS. Further analysis showed no significant difference in the 5-year OS and DFS among patients with different surgical case orders, regardless of age, pT stage, or range of gastrectomy ($P > 0.05$).

Conclusions: In high-volume centers, different surgical case orders can only affect operative time and intraoperative bleeding but not short- or long-term outcomes. Surgeons should reasonably schedule surgeries to provide better medical services and to improve patient motivation and care.

Introduction

Gastric cancer (GC) is the fifth most common cancer and fourth leading cause of cancer-related death worldwide, accounting for 8.8% of cancer-related deaths[1]. In recent decades, despite improved survival of patients with GC in many countries, the prognosis remains unsatisfactory, with only about half of patients surviving for more than 3–5 years after surgery[2]. Despite recent advances in the comprehensive treatment of GC, radical gastrectomy remains the cornerstone of treatment for resectable GC[3, 4]. Since Kitano first described laparoscopic gastrectomy (LAG) in 1994, the number of patients undergoing laparoscopic gastrectomy for GC has gradually increased[5]. Multicenter randomized controlled trials have confirmed that LAG has superior short- and long-term outcomes similar to open surgery[6–8]. However, there are still technical limitations to LAG, such as intraoperative location and spatial depth determination, which depend heavily on operator experience[9, 10]. Owing to the complex perigastric vascular anatomy and lymphatic drainage areas, experienced surgeons may face greater challenges when performing standard D2 lymph node dissection[11]. Previous studies have shown that adequate lymph node dissection is critical to the long-term survival of patients with GC and that performing gastrectomies mainly in high-volume centers can effectively reduce postoperative mortality, highlighting that surgeon performance may affect prognosis[12–14]. However, in technologically sophisticated high-volume centers, it is often necessary to perform multiple laparoscopic radical GC operations on the same day. Prolonged consecutive surgeries can lead to intraoperative operator fatigue, which may reduce surgical precision, increase the risk of tumor margins, reduce the range of lymph node clearance, and increase the risk of postoperative complications, all of which may affect the long-term prognosis of patients and increase the risk of tumor recurrence. Previous studies have shown that survival after surgical procedures is often influenced by the day of surgery; two large cohort studies found that short-term mortality was higher if elective surgery was performed in the latter part of the week, and survival was worse for patients who underwent surgery in the latter part of the week than for those who underwent surgery in the beginning of the week[15, 16]. It is speculated that this may be related to poorer surgical quality due to decreased motivation and care by staff associated with surgery on adjacent weekends. Although most reports show higher short-term mortality in patients who underwent surgery later than in those who underwent surgery earlier, it is noteworthy that no study has yet reported the effect of same-day surgical procedures on the long-term prognosis of patients. Therefore, this study aimed to analyze the effect of different surgical case orders on perioperative outcomes and long-term survival in patients who underwent laparoscopic radical gastrectomy and to analyze subgroups of the population to provide a reference for surgeons to adjust the appropriate surgical case order for these groups.

Method and patients

Study Design and Patients

We retrospectively analyzed the clinicopathological data of 1286 patients diagnosed with primary GC who underwent laparoscopic-assisted radical gastrectomy at the Department of Gastric Surgery, Fujian Medical University Union Hospital (Fuzhou, China), between January 2016 and December 2017. The inclusion criteria were primary gastric adenocarcinoma confirmed by gastroscopy, laparoscopy-assisted radical gastrectomy, and complete clinicopathological data. Individuals with gastric stump cancer, other tumors, distant metastasis on operative examinations, history of previous upper abdominal surgery, and those who received neoadjuvant chemotherapy were excluded. A total of 1235 patients with GC who underwent laparoscopic-assisted radical gastrectomy were included, and the patients were divided into the first (No.1 group, n = 497), second (No.2 group, n = 426), and subsequent (Other group, n = 312) groups according to the surgical case order (Fig. 1). Written informed consent was obtained from all the patients. This study was approved by the Institutional Review Board of the Fujian Medical University Union Hospital.

Propensity Score Matching

Propensity score matching (PSM) was used to eliminate potential bias owing to the lack of equal distribution among the three groups in this non-randomized study[17]. These results provide a theoretical framework for the application of this technique and clinical experience. The propensity scores were calculated using a logistic regression model with the following covariates: age, sex, BMI, ASA score, tumor location, tumor size, cT, cN, cTNM, pT, pN, and pTNM. Nearest neighbor matching was performed in a 1:1:1 ratio without replacement and a caliper width with a 0.01 standard deviation (SD) was specified. A total of 921 patients were included in the study after matching.

Definitions and Procedure

All surgeries were performed by the same two experienced surgeons, both of whom had performed over 50 laparoscopic surgeries; the surgical case order was arranged after consultation between the surgeon and the patient. Laparoscopic surgery adhered to the principles of gastrectomy extent and lymphadenectomy, which were determined according to the **Japanese GC treatment guidelines 2014 (ver.4)** and reported in previous research[18]. Operative time was measured from the time of trocar insertion to the time of abdominal closure. The amount of intraoperative blood loss was determined according to the volume and weight of the suction pumps and surgical gauze used during gastrectomy. The blood count from the gauze was directly measured by weighing every set of 10 gauzes or every hour prior to closure of the abdominal wall[19]. Surgical complications developing within the scope of surgery, such as wounds or intra-abdominal cavities, and complications associated with surgery, such as bleeding, digestive tract fistula, ileus, gastroplegia, wound infections, abdominal infections, and lymphatic fistula, were considered. Non-surgical complications: Complications unrelated to the surgical field, such as pneumonia and damage to the cardiovascular, liver, and urinary systems, were considered non-surgical complications[20]. Staging was performed according to the criteria described in the 8th AJCC stage[21].

Follow-Up

Overall survival (OS) was calculated from the date of surgery to death from any cause. Disease-free survival (DFS) was calculated from the date of surgery to any locoregional or distant recurrence, other primary tumors, or death from any cause. Postoperative follow-up was performed every 3–6 months for the first 3 years and every 6–12 months from years 3 to 10. Most routine patient follow-up appointments include physical examinations, laboratory tests, chest radiography, abdominal ultrasonography or CT, and annual endoscopic examinations. The follow-up period was updated in December 2022.

Statistical Analysis

We performed a one-to-one-to-one matching analysis between the No.1, No.2 and Other groups. The χ^2 test or Fisher's exact test was used to compare the categorical variables of clinical characteristics and perioperative indicators, and a paired t-test or the Wilcoxon signed-ranks test was used for continuous variables. Survival rates were calculated using the Kaplan-Meier method and compared using the log-rank test. The Cox proportional risk model was used for multivariate prognostic analysis. All data were analyzed using SPSS Statistics (version 26.0; IBM Corp., Armonk, NY, USA) and R (version 4.0.2; The R Foundation for Statistical Computing). Statistical significance was set at $p < 0.05$

Results

Patient Characteristics

Before PSM, significant differences were observed among the three groups in terms of pN and pTNM stage (eTable 1, P>0.05). After PSM, no significant differences among the No.1 (n=497), No.2 (n=426), and Other groups (n=312) were observed in terms of clinicopathological characteristics, such as age, sex, BMI, ASA score, ECOG score, Charlson score, range of gastrectomy, tumor size, tumor location, cT stage, cN, cTNM, pT, pN, and pTNM stages (all P > 0.05, all Std < 0.25) (Table 1).

Perioperative Outcomes

Before PSM, the Other group had a longer operative duration compared to the No.1 and No.2 groups (No.1 vs Other = 167.9±44.8 vs 179.6±52.4; No.2 vs Other = 168.9±43.6 vs 179.6±52.4, P<0.05) (Table 2 and eTable 2). Intraoperative bleeding was significantly higher in the No.2 and Other groups compared with the No.1 group (No.1 vs No.2 = 42.1±32.3 vs 49.0±57.4; No.1 vs Other = 42.1±32.3 vs 48.6±52.1, P<0.05). There were no significant differences among the three groups in terms of lymph node harvest, time to ambulation, flatus passage, liquid diet, soft diet, or hospital stay (all P>0.05). No significant differences were found among the three groups in terms of overall, surgery-related, or non-surgery-related complications (all P>0.05). After matching, the Other group had a longer operative duration compared to the No.1 and No.2 groups (No.1 vs Other = 168.1±45.0 vs 178.5±50.9; No.2 vs Other = 172.3±53.5 vs 178.5±50.9, P<0.05). Intraoperative bleeding was significantly higher in the No.2 and Other groups compared with the No.1 group (No.1 vs No.2 = 42.8±32.3 vs 47.6±48.1; No.1 vs Other = 42.8±32.3 vs 48.5±52.4, P<0.05) **(Table 2 and eTable 2)**. Postoperative complications were observed in 69 (22.6%), 65 (21.6%), and 67 (21.8%) patients in the No.1, No.2 and Other groups, respectively, with no significant difference in the overall complication rate among the three groups (P>0.05). Further stratified analysis showed that 38 (12.3%), 42 (13.6%), and 38 (12.3%) patients in the No.1, No.2, and Other groups, respectively, had surgery-related complications, and 31 (10.2%), 29 (9.6%), and 31 (10.2%) had non-surgery-related complications, with no statistically significant differences **(eTable 3, all** P>0.05**)**.

Long-term Prognosis

The median follow-up period was 52 months (range,1–90 months). The Kaplan-Meier survival curve revealed comparable five-year OS (83.7%, 80.3%, and 82.8%, P=0.312) and DFS (78.6%, 76.2%, and 77.2%, P=0.437) in the No.1, No.2, and Other groups, respectively (Fig. 2). Univariate Cox regression analysis revealed that age, range of surgery, tumor size, tumor location, pT stage, and pN stage were significant risk factors for OS (all P<0.05), and age, range of surgery, pT stage, and pN stage were significant risk factors affecting DFS in patients with GC (all P<0.05). Further multivariate Cox analysis suggested that age >65 years, total gastrectomy, and pT2-4 stage were independent risk factors for poor OS and DFS (P<0.05), whereas surgical case order was not an independent factor affecting the 5-year OS and DFS in patients with GC (P>0.05) **(Table 3 and 4).**

Survival After Surgery in High-Risk Patients

Further subgroup analyses were based on independent risk factors affecting patient OS in terms of age, gastrectomy range, and pT stage. The Kaplan-Meier survival curve showed no significant difference in 5-year OS and DFS among the three groups in those aged >65 years (eFig1); no significant difference in 5-year OS and DFS among the three groups in patients with pT stage 2–4 (eFig2); and no significant difference in 5-year OS and DFS among the three groups in patients who underwent total gastrectomy **(eFig3,** all P>0.05**)**.

Discussion

In this high-volume center propensity matching study, despite the differences in operative time and intraoperative bleeding among patients with different surgical case orders, no evidence was found to suggest that surgical case order had a significant effect on short- and long-term postoperative outcomes in patients who underwent laparoscopic radical GC resection.

Despite significant advances in the diagnosis and treatment of GC, the prognosis of GC patients remains unsatisfactory[22]. Surgeons are devoted to identifying key factors that improve the long-term prognosis of patients with GC. Previous studies have found that the rate of postoperative complications in GC is closely related to surgical quality, and that patients who underwent laparoscopic radical gastrectomy in high-volume centers had a significantly lower rate of postoperative complications[23–25]. However, surgeons in high-volume centers tend to perform high-load tasks. For the same surgeon, as the number of surgeries increases on the same day, it may affect the intraoperative operations in subsequent surgeries, thus reducing the quality of the next surgery. Our results showed that the operative time and intraoperative bleeding were significantly higher in patients with a later number of surgeries than in patients with a former number of surgeries. This may be due to the mental fatigue accumulated from consecutive surgeries, which makes the attending surgeon less sensitive to anatomical structures and special high-risk sites, thus leading to a decrease in the degree of operative refinement, increasing the incidence of events that damage peripheral vessels, and increasing intraoperative bleeding[26]. In addition, the increased frequency of intraoperative hemostasis prolongs operative time to a certain extent. However, muscle fatigue due to continuous mechanical manipulation delays the intraoperative precision of the chief surgeon and response time to intraoperative adverse events, leading to longer operative times[27]. However, our results showed that the surgical case order did not affect the number of surgical lymph node dissections for GC or the postoperative recovery outcomes. A large part of the reason may be that the team members of our center for gastrectomy have successfully overcome the learning curve of laparoscopic surgery and have extensive clinical surgical experience to successfully complete lymph node dissection, even under load. The procedural process ensures thorough intraoperative lymph node dissection and fewer intraoperative adverse events, and the specialized care team improves the quality of postoperative care and effectively reduces the impact of surgical case order on patients' postoperative recovery. It is worth noting that based on good intraoperative and perioperative care, the postoperative complication rate of patients was effectively reduced, and our results also showed that surgical case order did not affect the postoperative complication rate of patients.

The long-term prognosis of cancer patients has been the focus of both surgeons and patients. In comparison with previous studies on weekly surgery[28, 29], our study found similar results in that there was no significant difference in five-year OS and DFS of patients with GC between surgical case orders. Further stratified analysis showed that for specific groups of patients, such as those with advanced age, progressive GC, and total gastrectomy, the surgical case order had no effect on the five-year OS and DFS. Our results suggest that for experienced high-volume centers, surgical scheduling is not limited by the general condition and oncologic characteristics of the patients and that the surgical case order for specific populations can be rationalized by surgeons according to the actual clinical requirements.

To the best of our knowledge, this is the first study to compare whether different surgical case orders affect the short- and long-term outcomes of patients with GC using propensity matching. However, this study had some limitations. First, this was a single-center retrospective study conducted in the East, and selection bias was unavoidable. Second, the time of surgery varied among individual patients based on intraoperative tumor characteristics, and the time of day corresponding to the surgical case order may be influenced by the time of surgery; therefore, we could not evaluate in detail the impact of the time point of surgery on the short- and long-term outcomes of patients with GC. Finally, all surgical procedures were performed by a team of surgeons with experience in skilled laparoscopic surgery at a high-volume specialized GC treatment center; therefore, the generalizability of our findings to surgeons with different levels of experience may be limited. Nevertheless, a strict PSM approach was used in this study to minimize bias between the clinical and pathological data of the three groups, further confirming that there were no significant differences among the three groups in terms of short-term postoperative and long-term prognostic outcomes. In the future, we expect to conduct a prospective randomized controlled study of different surgical case orders for laparoscopic gastrectomy to confirm our findings and provide high-level evidence-based medicine.

Conclusion

For laparoscopy-assisted radical gastrectomy in high-volume centers, there was no significant impact on short-term postoperative outcomes or long-term prognostic outcomes, although patients with former surgical case orders performed better in terms of operative time and intraoperative bleeding. Surgeons should schedule their surgeries appropriately and improve surgical motivation and care to provide higher-quality care.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of the Fujian Medical University Union Hospital.

Consent for publication

This manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors have no conflict of interest and no potential benefits. The institutional review boards of all the participating institutions approved the study. The authors have no other disclosures to report.

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Authors' contributions

Min Shao, Jun-Yu Chen and Qing Zhong conceived the study, analyzed the data, and drafted the manuscript, Chang-Ming Huang, Chao-Hui Zhenghelped critically revise the manuscript for important intellectual content. Tao-Yuan Qiu, Zhi-Yu Liu, Guang-Tan Lin, Yi-Hui Tang, Li-Na Zheng, Jia-Bin Wang, Jian-Xian Lin, Jun Lu, Qi-Yue Chen, Jian-Wei Xie, Ping Li helped collect data and design the study.

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Tables

Table 1. Clinicopathologic Description of Propensity-matched Gastric Cancer Patients

Clinical Parameters	Propensity-matched patients(n=921)								
	All patients	%	NO.1	%	NO.2	%	Other	%	*P* value
Total	921	100.0	307	100.0	307	100.0	307	100.0	
Age, year									0.867
≤65	571	62.0	193	62.9	181	59.0	197	64.2	
>65	350	38.0	114	37.1	126	41.0	110	35.8	
Sex									0.594
Female	251	27.3	79	25.7	83	27.0	89	29.0	
Male	670	72.7	228	74.3	224	73.0	218	71.0	
BMI, kg/m^2									0.923
≤18.5	57	6.2	20	6.5	18	5.9	19	6.2	
18.5-25	702	76.2	225	73.3	243	79.2	234	76.2	
>25	162	17.6	62	20.2	46	15.0	54	17.6	
ASA score									0.966
I	239	26.0	85	27.7	72	23.5	82	26.7	
II	631	68.5	205	66.8	217	70.7	209	68.1	
III/IV	51	5.5	17	5.5	18	5.9	16	5.2	
Charlson score[#]									0.837
0	340	36.9	113	36.8	118	38.4	109	35.5	
1-2	547	59.4	184	59.9	178	58.0	185	60.3	
≥3	34	3.7	10	3.3	11	3.6	13	4.2	
ECOG									0.678
0	477	51.8	159	51.8	157	51.1	161	52.4	
1	282	30.6	83	27.0	102	33.2	97	31.6	
2	108	11.7	43	14.0	33	10.7	32	10.4	
3	54	5.9	22	7.2	15	4.9	17	5.5	
Range of gastrectomy									0.761
Total	592	64.3	206	67.1	189	61.6	197	64.2	
Non-Total	329	35.7	101	32.9	118	38.4	110	35.8	
Tumor size, cm									0.695
≤5	585	63.5	204	66.4	188	61.2	193	62.9	
>5	336	36.5	103	33.6	119	38.8	114	37.1	
Tumor location									0.648
Upper	226	24.5	80	26.1	73	23.8	73	23.8	

Middle	188	20.4	62	20.2	60	19.5	66	21.5	
Lower	365	39.6	117	38.1	123	40.1	125	40.7	
Overlapping	140	15.2	48	15.6	49	16.0	43	14.0	
cT stage (AJCC8th)									0.987
T1	192	20.8	61	19.9	64	20.8	67	21.8	
T2	134	14.5	42	13.7	46	15.0	46	15.0	
T3	191	20.7	67	21.8	61	19.9	63	20.5	
T4a/T4b	404	43.9	137	44.6	136	44.3	131	42.7	
cN stage (AJCC8th)									0.997
N0	369	40.1	122	39.7	120	39.1	127	41.4	
N+	552	59.9	185	60.3	187	60.9	180	58.6	
cTNM stage (AJCC8th)									0.990
I	278	30.2	93	30.3	91	29.6	94	30.6	
II	202	21.9	70	22.8	65	21.2	67	21.8	
III	441	47.9	144	46.9	151	49.2	146	47.6	
pT stage (AJCC8th)									0.418
T1	275	29.9	93	30.3	92	30.0	90	29.3	
T2	428	46.5	149	48.5	145	47.2	134	43.6	
T3	200	21.7	58	18.9	64	20.8	78	25.4	
T4a/T4b	18	2.0	7	2.3	6	2.0	5	1.6	
pN stage (AJCC8th)									0.164
N0	420	45.6	141	45.9	134	43.6	145	47.2	
N1	257	27.9	91	29.6	88	28.7	78	25.4	
N2	142	15.4	42	13.7	48	15.6	52	16.9	
N3	92	10.0	33	10.7	27	8.8	32	10.4	
pTNM stage (AJCC8th)									0.268
I	419	45.5	143	46.6	135	44.0	141	45.9	
II	343	37.2	108	35.2	127	41.4	108	35.2	
III	159	17.3	56	18.2	45	14.7	58	18.9	

Charlson score (calculated based on the number and severity of the comorbid condition of patients)

Abbreviations: AJCC, American Joint Committee on Cancer; BMI, body mass index; ASA, American Society of Anesthesiologists; ECOG PS, Eastern Cooperative Oncology performance status; ICG, indocyanine green; cT , clinical T; cN, clinical N; pT , pathological T; pN, pathological N.

Table 2. Intraoperative and Postoperative Description of Propensity-matched Gastric Cancer Patients

Variable	All patients				Propensity-matched patients			
	NO.1 (n=497)	NO.2 (n=426)	Other (n=312)	*P* value	NO.1 (n=307)	NO.2 (n=307)	Other (n=307)	*P* value
Operative time (min)	167.9±44.8	168.9±43.6	179.6±52.4	**<0.001**	168.1±45.0	172.3±53.5	178.5±50.9	**0.009**
Estimated blood loss (mL)	42.1±32.3	49.0±57.4	48.6±52.1	**0.016**	42.8±32.3	47.6±48.1	48.5±52.4	**0.037**
Lymph nodes harvested (n)	38.3±15.0	38.3±14.6	38.5±15.0	0.976	38.6±14.7	39.5±14.7	38.5±15.1	0.670
Times to ambulation (day)	2.2±0.9	2.3±0.9	2.2±0.9	0.806	2.2±1.0	2.3±0.9	2.2±0.9	0.820
Flatus passage (day)	3.4±1.0	3.5±1.0	3.4±0.9	0.064	3.4±1.0	3.5±0.9	3.4±0.9	0.113
Liquid diet (day)	4.9±1.5	4.9±1.6	4.9±1.4	0.789	5.0±1.6	5.0±1.6	4.9±1.4	0.720
Soft diet (day)	6.9±1.6	6.9±1.6	6.7±1.5	0.187	6.9±1.6	6.9±1.6	6.7±1.5	0.248
Hospital stay (day)	16.1±8.0	16.0±7.7	15.6±6.6	0.516	15.9±7.3	15.7±7.2	15.7±7.1	0.833

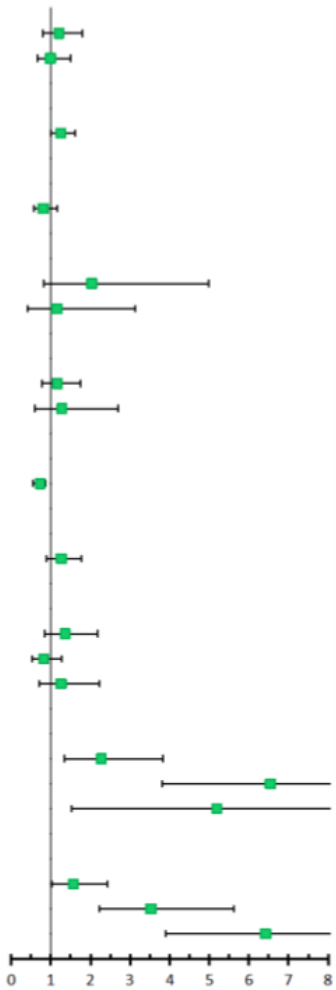
Table 3. Univariable and multivariable analysis of clinical parameters associated with OS

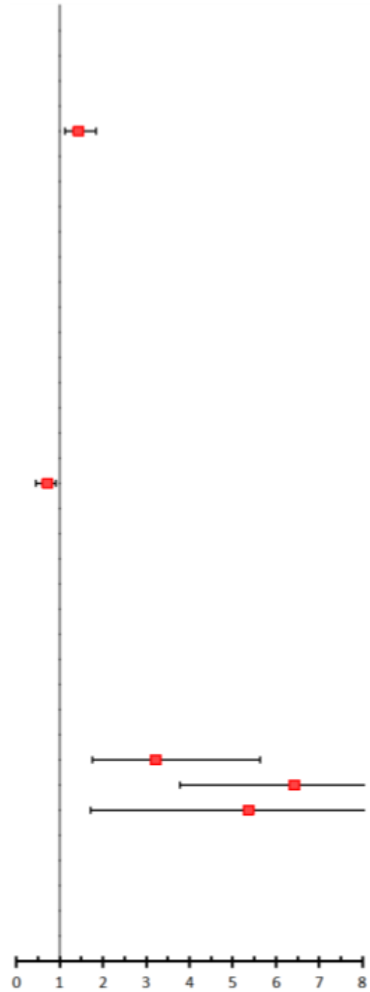
Clinical Parameters	Univariable HR (95%CI)	Univariable P	Multivariable HR (95%CI)	Multivariable P
Surgical order		0.304		
NO.1	Ref			
NO.2	1.423 (0.864,2.343)			
Other	1.029 (0.606,1.747)			
Age, year		**0.017**		**0.023**
≤65	Ref		Ref	
>65	1.362 (1.182,1.572)		1.312 (1.093,1.465)	
Sex		0.243		
Female	Ref			
Male	0.767 (0.492,1.197)			
BMI, kg/m²		0.184		
≤18.5	Ref			
18.5-25	1.549 (0.566,4.238)			
>25	0.927 (0.295,2.911)			
ASA score		0.676		
I	Ref			
II	1.093 (0.654,1.827)			
III/IV	1.498 (0.630,3.564)			
Range of gastrectomy		**0.014**		**0.037**
Total	Ref		Ref	
Non-Total	0.561 (0.346,0.908)		0.572 (0.336,0.932)	
Tumor size, cm		**<0.001**		
≤5	Ref			
>5	2.997 (1.837,4.890)			
Tumor location				
Upper	Ref	**0.029**		
Middle	1.315 (0.708,2.445)			
Lower	2.406 (1.463,5.762)			
Overlapping	2.666 (0.968,7.343)			
pT stage (AJCC8th)		**<0.001**		**<0.001**
T1	Ref		Ref	
T2	4.484 (1.762,11.409)		3.625 (1.870,8.936)	
T3	18.876 (7.473,47.677)		16.424 (7.326,32.566)	
T4a/T4b	18.299 (4.372,76.592)		17.692 (5.425,46.782)	
pN stage (AJCC8th)		**<0.001**		
N0	Ref			
N1	2.275 (1.209,4.283)			
N2	7.270 (3.916,13.496)			
N3	12.333 (6.430,23.656)			

Abbreviations: HR, hazard ratio; CI, confidence interval; AJCC, American Joint Committee on Cancer; ASA, American Society of Anesthesiology; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); pT, pathological T; pN, pathological N

Table 4. Univariable and multivariable analysis of clinical parameters associated with DFS

Clinical Parameters	Univariable HR (95%CI)	Univariable P	Multivariable HR (95%CI)	Multivariable P
Surgical order		0.555		
NO.1	Ref			
NO.2	1.208 (0.810,1.802)			
Other	0.988 (0.654,1.492)			
Age, year		**0.036**		**0.017**
≤65	Ref		Ref	
>65	1.248 (1.012,1.625)		1.432 (1.117,1.846)	
Sex		0.248		
Female	Ref			
Male	0.81 (0.566,1.159)			
BMI, kg/m²		0.334		
≤18.5	Ref			
18.5-25	2.034 (0.831,4.979)			
>25	1.151 (0.425,3.120)			
ASA score		0.723		
I	Ref			
II	1.163 (0.769,1.759)			
III/IV	1.276 (0.604,2.696)			
Range of gastrectomy		**0.027**		**0.034**
Total	Ref		Ref	
Non-Total	0.735 (0.549,0.876)		0.714 (0.456,0.823)	
Tumor size, cm		0.177		
≤5	Ref			
>5	1.266 (0.864,2.343)			
Tumor location				
Upper	Ref	0.103		
Middle	1.359 (0.850,2.173)			
Lower	0.819 (0.527,1.273)			
Overlapping	1.259 (0.716,2.214)			
pT stage (AJCC8th)		**<0.001**		**<0.001**
T1	Ref		Ref	
T2	2.273 (1.350,3.828)		3.221 (1.765,5.639)	
T3	6.542 (3.820,11.203)		6.424 (3.776,10.526)	
T4a/T4b	5.189 (1.528,17.618)		5.368 (1.717,15.353)	
pN stage (AJCC8th)		**<0.001**		
N0	Ref			
N1	1.572 (1.017,2.430)			
N2	3.526 (2.215,5.615)			
N3	6.421 (3.892,10.595)			





Abbreviations: HR, hazard ratio; CI, confidence interval; AJCC, American Joint Committee on Cancer; ASA, American Society of Anesthesiology; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); pT, pathological T; pN, pathological N

Figures

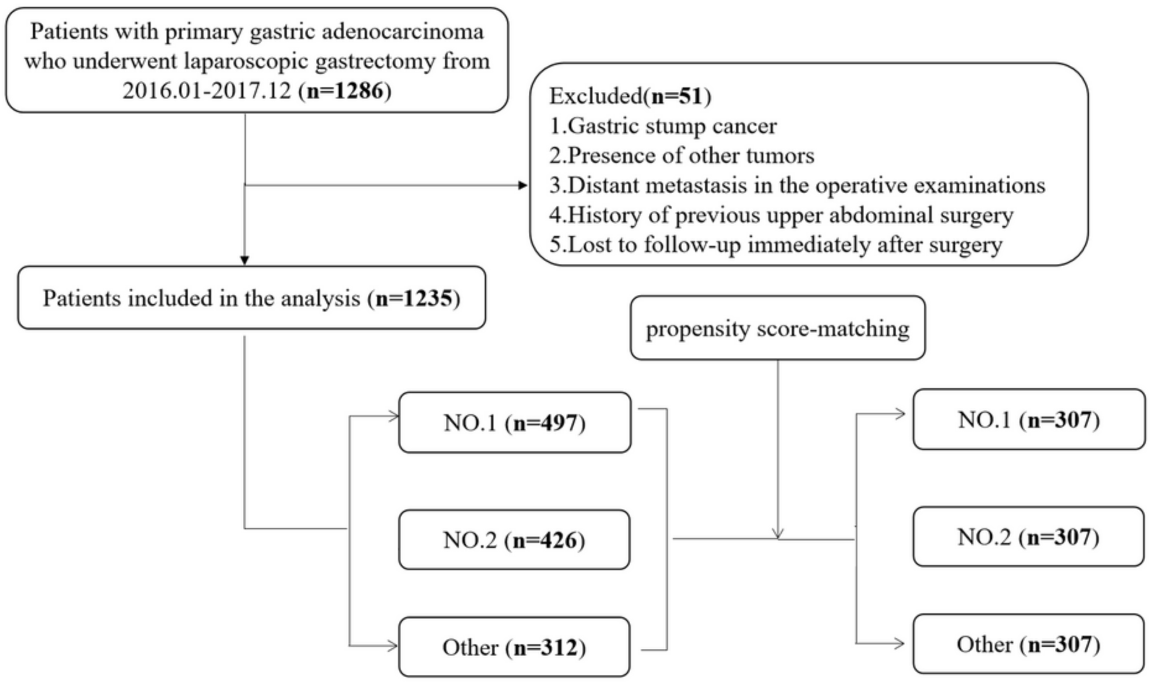


Figure 1

Study Flowchart.

Flowchart depicting the patient selection process.

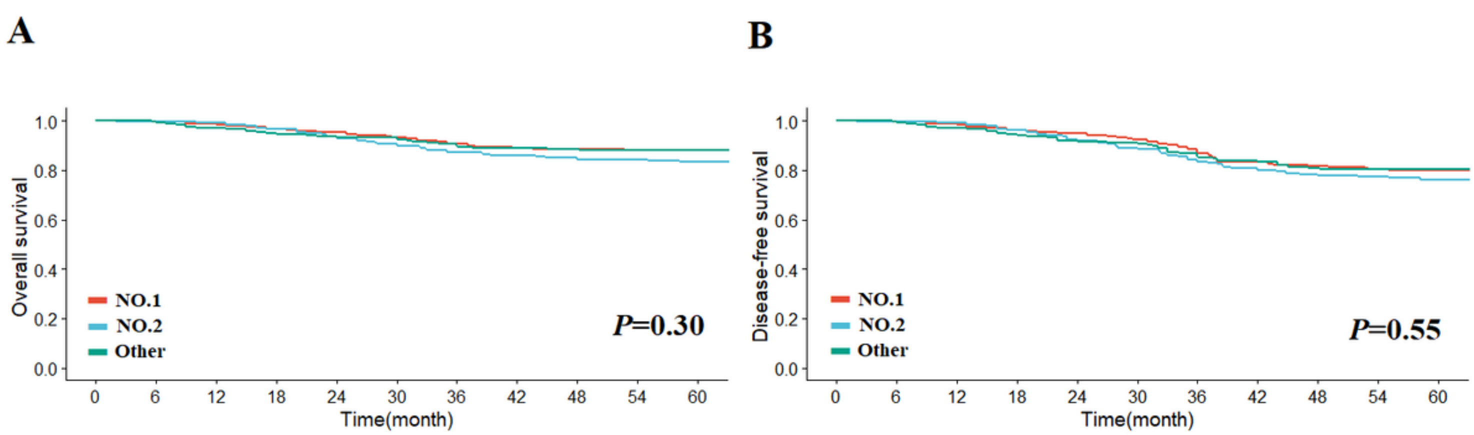


Figure 2

Comparison of A.OS , B.DFS among NO.1, NO.2, and other groups in GC patients.

Overall survival(OS) was calculated from the date of surgery to death from any cause. Disease-free survival (DFS) was calculated from the date of surgery to any loco-regional or distant recurrence, other primary tumor and death from any cause.

Supplementary Files

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