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Robotic gastrectomy versus laparoscopic gastrectomy for gastric cancer: comparison of surgical performance and short-term outcomes

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Abstract
Purpose This study was designed to compare robot-assisted gastrectomy with laparoscopy-assisted gastrectomy in surgical performance and short-term clinical outcomes for gastric cancer and evaluate the safety and feasibility of robotic surgery.
Methods A retrospective database of patients who underwent robotic or laparoscopic gastrectomy for gastric cancer between March 2010 and May 2013 was examined. After screening, 514 patients who underwent gastrectomy for gastric cancer were enrolled in this study: 120 robotic and 394 laparoscopic surgery. Patient demographics, surgical performance, and short-term clinical outcomes were examined.
Results All operations were performed successfully. The clinicopathologic characteristics were similar between the two groups. Compared with the laparoscopic group, the robotic group had less intraoperative blood loss (118.3 ± 55.8 vs. 137.6 ± 61.6 ml, $P < 0.001$), more lymph nodes dissection (34.6 ± 10.9 vs. 32.7 ± 11.2, $P = 0.013$), and longer operation time (234.8 ± 42.4 vs. 221.3 ± 44.8 min, $P = 0.003$). The survival rates were 90.2 % at 1 year, 78.1 % at 2 years, and 67.8 % at 3 years in the RAG group compared with 87.3 % at 1 year, 77.1 % at 2 years, and 69.9 % at 3 years in the LAG group. The difference in overall survival rate between the two groups was not statistically significant ($P = 0.812$). In view of lymph node involvement, the 3-year survival rates for patients with negative nodal metastasis were 84.4 % in the RAG group versus 82.6 % in the LAG group ($P = 0.972$) and 57.5 % in the RAG group versus 60.3 % in the LADG group ($P = 0.653$) for those with positive nodal metastasis.
Conclusions Comparing well with laparoscopic gastrectomy, robot-assisted gastrectomy is a feasible and safe surgical procedure with clear operation field, precise dissection, minimal trauma, and fast recovery. Longer follow-up time and randomized, clinical trials are needed to evaluate the clinical benefits and long-term oncological outcomes of this new technology.

Keywords Surgical performance · Short-term clinical outcomes · Laparoscopy-assisted gastrectomy · Robot-assisted gastrectomy · Robotic surgery · Gastric cancer

The use of laparoscopy-assisted gastrectomy (LAG) for gastric cancer has become widely accepted in the field of minimally invasive surgery (MIS) because of its advantages, including less invasiveness and pain, better cosmetic results, faster recovery, and shorter hospital stays compared with open gastrectomy [1, 2]. Moreover, the long-term outcomes of LAG, such as morbidity and mortality, are comparable to those of the open gastrectomy in several prospective and randomized, controlled studies [3, 4]. However, LAG also has the disadvantages of two-dimensional (2-D) visualization, restricted range of motion, amplified physiologic tremor, and the uncomfortable position forced upon surgeons [5]; thus, the Da Vinci surgical system (Intuitive Surgical Inc., Sunnyvale, CA) was invented to overcome these limitations. Following the earliest experiences of robot-assisted gastrectomy (RAG) published by Hashizume [6] and Giulianotti et al. [7] in

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2003, more and more reports appeared. And among them, Song et al. [8] in 2009 and Woo et al. [9] in 2011 published more consistent series and both confirmed the safety and feasibility of RAG with lymphadenectomy for the treatment of gastric cancer by making a retrospective analysis to evaluate the perioperative outcomes and oncologic adequacy. Although there are so many reports about RAG, few robotic studies [10] present an equivalent surgical quality comparison of RAG and LAG. Therefore, we conducted a nonrandomized, controlled trial with more cases to compare the short-term surgical outcomes of robotic gastrectomy with that of laparoscopic gastrectomy for gastric cancer and evaluate the safety and feasibility of robot-assisted surgery system.

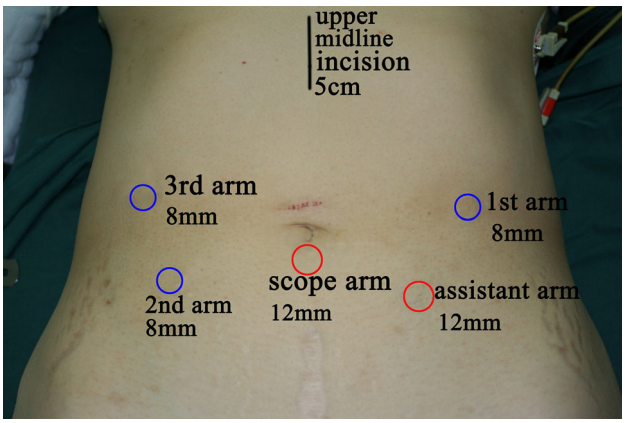

Fig. 1 Trocar placement and size for robotic surgery

Materials and methods

Population studied

This study comprised 120 patients who underwent robot-assisted gastrectomy (RAG) and 394 patients who underwent LAG for gastric cancer from a single institution (Department of General Surgery & Center of Minimally Invasive Gastrointestinal Surgery, Southwest Hospital, Third Military Medical University) during the period from March 2010 to May 2013. The patients who had gastric stump cancer, synchronous malignancy in other organs, serious cardiovascular or respiratory disorders, or hepatic or renal failure were not included. Additionally, patients with preoperative chemotherapy or radiotherapy or diagnosed with clinical stage IV based on the 7th version of the pathologic classification of the International Union Against Cancer (UICC) [11] were excluded, and cases that needed conversion (robotic to conventional laparoscopic, robot to open, conventional laparoscopic to open) during the operation also were eliminated so that it could be more comparable. Furthermore, all patients with gastric cancer were diagnosed preoperatively by barium meal and gastroscope examine and confirmed by biopsy; then, they were examined by preoperative routine chest X-ray, abdominal ultrasound, and upper abdominal CT examination to evaluate if they had metastases in other organs. Finally, the gastrectomy was recommended by the Japanese Gastric Cancer Treatment Guidelines [12]. After the operation, we routinely administered 5-fluorouracil and oxaliplatin intravenous chemotherapy. The follow-up period was 3–41 (median 17) months.

Operation procedures

The procedures of RAG for gastric cancer are not different from those of LAG except for the use of articulating robotic instruments. The preoperative surgical techniques also were similar. Induction of general anesthesia plus epidural anesthesia was achieved with endotracheal intubation, and a gastric tube and a catheter were placed. The patients were positioned in supine position with legs apart. The surgical technique of LAG included five ports, as previously described [13] and one upper middle incision for taking the resected stomach out. The placement of trocars in RAG was almost same, but the size of them was somewhat different [14, 15] because of the instruments of robotic system (Fig. 1). The operation procedures of RAG or LAG were just like what we had described elsewhere [13, 16, 17]. The lymphadenectomy was according to the Japanese Gastric Cancer Treatment Guidelines [12] and the Japanese Classification of Gastric Carcinoma [18]. Digestive tract reconstruction also was similar between both groups. For esophagogastric anastomosis, the esophagus was transected and an anvil was placed into the esophageal stump with the purse-string suture. Then, an extracorporeal end-to-end esophagus and gastric stump anastomosis was completed using a 25-mm circular stapler. Billroth I or Billroth II was mostly conducted with a linear cutter used to accomplish the gastrojejunal anastomosis and then necessary extracorporeal hand-assisted suture was performed. For Roux-en-Y esophagojejunostomy in total gastrectomy, the esophagus was transected with an anvil in it and then the Roux-en-Y limb was brought up to complete an esophagojejunostomy, using a 25-mm circular stapler while the jejunal stump was closed and side-to-side jejunojejunostomy (Y-anastomosis) was established, both using an endoscopic linear stapler, and then necessary hand-assisted suture was performed.

In brief, we conducted total or partial gastric resection with D1 or D2 lymph node dissection using esophagogastric anastomosis, Billroth I anastomosis, Billroth II anastomosis, or Roux-en-Y reconstruction for adenocarcinoma due to different tumor stages and locations.

Table 1 Summary of patients' clinicopathological characteristics

Clinicopathological characteristics	RAG ($n = 120$)	LAG ($n = 394$)	P value
Age	54.7 ± 10.1	55.6 ± 11.8	0.421
Sex (male/female)	90/30	276/118	0.294
BMI	21.6 ± 2.8	21.7 ± 2.6	0.838
Previous abdominal surgery (%)	8 (6.7 %)	45 (11.4 %)	0.184
Medical co-morbidities (%)	12 (10 %)	48 (12.2 %)	0.624
Tumor location (upper third/middle third/lower third)	17/30/73	77/99/218	0.378
Histological type (differentiated/poorly differentiated)	41/79	166/228	0.119
T stage (1/2/3/4)	26/25/29/40	91/77/70/156	0.382
N stage (0/1/2/3)	51/12/14/43	187/25/43/139	0.522
TNM stage			0.891
Ia	20	86	
Ib	9	29	
IIa	21	59	
IIb	15	39	
IIIa	17	60	
IIIb	35	111	
IIIc	3	10	

Surgical performance and short-term clinical outcomes

The surgical performance and postoperative short-term clinical outcomes, including resection type, reconstruction type, the operation time, lymph node (LN) dissection numbers of retrieved LNs, proximal resection margin and distal resection margin, estimated blood loss, incidence rate of complications, the time of first flatus and days to eating liquid diet, and length of postoperative hospital stay were evaluated to compare LAG and RAG. We also did a short-term follow-up ranging from 3 to 41 months for both groups.

Statistical analysis

All statistical calculations were performed with statistical software SPSS 13.0 for Windows (SPSS, Inc., Chicago, IL). Data were expressed as the mean ± standard deviation. The Mann-Whitney test or independent sample t test was used for continuous variable after normality tests, and the Chi-square test was used for categorical variables to determine the significance of intergroup differences. $P < 0.05$ based on two-sided statistical tests was considered statistically significant. Survival curves were calculated by the Kaplan–Meier method. The log-rank test was used to analyze survival differences.

Results

Clinicopathologic characteristics

Table 1 provides a summary of patients' clinicopathological characteristics. The patients in the two groups were well matched with no significant differences ($P > 0.05$) in age, body mass index, sex, previous abdominal surgery, medical comorbidities (such as diabetes, hypertension, and contagious disease), tumor location, histological type, T stage, N stage, and the TNM stage of tumor.

Surgical performance and postoperative evaluation

All operations were completed successfully without injuries to important organs or large blood loss, and there was no death during the operation. Postoperative clinical outcomes are detailed in Table 2. Mean operation time was longer (234.8 ± 42.4 vs. 221.3 ± 44.8 min, $P = 0.003$), intraoperative blood loss was less (118.3 ± 55.8 vs. 137.6 ± 61.6 ml, $P < 0.001$), and LN dissection number of retrieved LNs was more (34.6 ± 10.9 vs. 32.7 ± 11.2, $P = 0.013$) in the RAG group. However, no significant difference was found between the two groups in terms of resection type, reconstruction type, proximal resection margin and distal resection margin, complications, the time of first flatus and days to eating liquid diet, the incidence of complications, and length of postoperative hospital stay.

Surgical quality of robotic lymph node dissection

To evaluate the technical feasibility of robotic lymph node dissection further, we also compared the numbers of lymph nodes collected at each lymph node tier in the two groups (Fig. 2). Although the numbers of collected lymph nodes at tier 1 (22.2 ± 10.7 vs. 21.7 ± 10.8; $P = 0.773$) and 3 (0.025 ± 0.144 vs. 0.048 ± 0 .155; $P = 0.148$) did not significantly differ between the two groups, the numbers of

Table 2 Surgical performance and postoperative evaluation

Variable	RAG ($n = 120$)	LAG ($n = 394$)	P value
Resection type (total/proximal subtotal/distal subtotal)	26/2/92	118/15/261	0.071
Reconstruction type (esophagogastric anastomosis/ B-I/B-II/RY)	2/1/91/26	15/7/254/118	0.103
OP time (min)	234.8 ± 42.4	221.3 ± 44.8	**0.003**
Number of retrieved LNs	34.6 ± 10.9	32.7 ± 11.2	**0.013**
Evaluated blood loss (ml)	118.3 ± 55.8	137.6 ± 61.6	**<0.001**
PRM (cm)	5.5 ± 1.2	5.6 ± 2.2	0.727
DRM (cm)	5.2 ± 1.2	5.6 ± 2.2	0.072
Days of first flatus	3.1 ± 1.1	3.3 ± 0.9	0.064
Days of eating liquid diet	3.9 ± 1.0	4.1 ± 0.9	0.067
Postoperative complication (%)	5.8 %	4.3 %	0.998
Bleeding	1	2	
Stasis	1	2	
Anastomotic fistula	2	5	
Postoperative infection of lung	1	2	
Postoperative infection of incision	2	6	
Length of postoperative hospital stay	7.8 ± 3.0	7.9 ± 2.3	0.699

Bold values are statistically significant ($p < 0.05$)

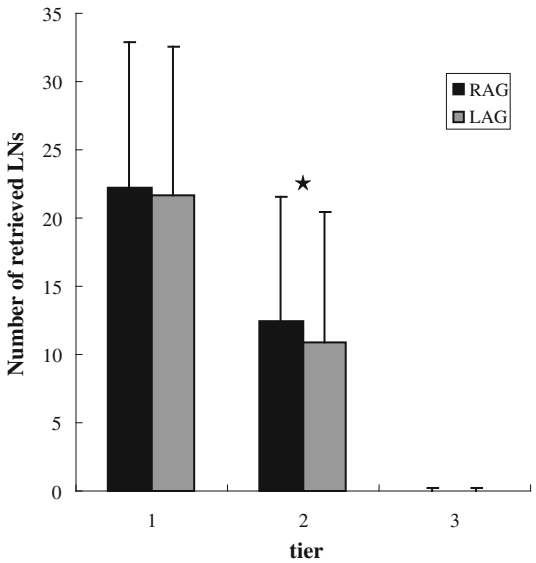

Fig. 2 Number of lymph nodes collected in the RAG and LAG group at each lymph node tier (★$P < 0.05$)

tier 2 (12.4 ± 9.1 vs. 10.9 ± 9.5; $P = 0.039$) were significantly higher in the RAG group.

Comparison of the two surgery methods in different resection types

As we all know, total gastrectomy takes more time and has more blood loss than subtotal gastrectomy, including distal and proximal subtotal gastrectomy. In this study, we respectively analysed the differences of the two surgery methods in each resection type. We compared them in terms of major preoperative characteristics and clinical outcomes as Table 3 shows.

From Table 3, we could find that they matched well with each other in major preoperative characteristics (all $P > 0.05$), and excluding the shorter operation time, RAG was similar with LAG no matter in which resection type. There were no significant differences in days of first flatus, days of eating liquid diet, and length of postoperative hospital stay between the two surgery methods in both subgroups. But robot-assisted gastrectomy had inconspicuous advantages over laparoscopy-assisted gastrectomy in terms of number of retrieved LNs and evaluated blood loss (although all of the P values < 0.05).

Comparison of the two surgery methods in different age-related groups

Because some reports [19] indicated that age might have influence on the short-term outcomes, we analyzed the impact of age on operation-related factors by grouping the patients according to their ages (Table 4).

The two surgical methods matched well in other basic characteristics so that they could be comparable in terms of operation-related factors. The days of first flatus, days of eating liquid diet, and length of postoperative hospital stay were not significantly different between the two types of surgeries in either the elder or younger subgroups (Table 4). However, younger patients who underwent RAG had significantly more lymph nodes retrieved and less evaluated blood loss than those who underwent LAG (34.9 ± 10.8 vs. 32.6 ± 11.3, $P = 0.027$; 122.3 ± 56.8

Table 3 Comparison of the two surgery methods in different resection types

Variable	Subtotal gastrectomy			Total gastrectomy		
	RAG ($n = 94$)	LAG ($n = 276$)	P value	RAG ($n = 26$)	LAG ($n = 118$)	P value
Age	53.5 ± 10.2	55.1 ± 12.2	0.245	58.8 ± 9.0	56.7 ± 10.7	0.363
Sex (male/female)	67/27	187/89	0.525	23/3	89/29	0.148
BMI	21.6 ± 3	21.7 ± 2.5	0.723	21.6 ± 2.3	21.5 ± 2.9	0.911
Previous abdominal surgery (%)	5 (5.3 %)	34 (12.3 %)	0.056	3 (11.5 %)	11 (9.3 %)	>0.999
Medical co-morbidities (%)	8 (8.5 %)	36 (13 %)	0.241	4 (15.4 %)	12 (10.2 %)	0.674
OP time (min)	222.8 ± 41.8	203.5 ± 38.6	**<0.001**	278.1 ± 38.0	262.9 ± 43.3	0.100
Number of retrieved LNs	34.0 ± 9.8	32.3 ± 11.1	**0.036**	36.9 ± 10.3	33.5 ± 10.4	**0.047**
Evaluated blood loss (ml)	114.4 ± 52.1	129.2 ± 56.5	**0.026**	132.3 ± 59.8	157.3 ± 54.6	**0.039**
Days of first flatus	3.1 ± 1.2	3.3 ± 1.0	0.113	3.3 ± 1.1	3.4 ± 0.9	0.721
Days of eating liquid diet	3.9 ± 1.2	4.1 ± 1.1	0.139	4.1 ± 1.0	4.0 ± 1.0	0.727
Length of hospital stay	7.6 ± 3.6	7.7 ± 2.4	0.761	8.5 ± 3.5	8.4 ± 2.6	0.868

Bold values are statistically significant ($p < 0.05$)

Table 4 Comparison of the two surgery methods in different age-related groups

Variable	Age <65 year			Age ≥65 year		
	RAG ($n = 97$)	LAG ($n = 298$)	P value	RAG ($n = 23$)	LAG ($n = 96$)	P value
Sex (male/female)	70/27	202/96	0.418	20/3	74/22	0.448
BMI	21.6 ± 2.8	21.8 ± 2.6	0.567	21.7 ± 2.9	21.3 ± 2.8	0.617
Previous abdominal surgery (%)	6 (6.2 %)	34 (11.4 %)	0.139	2 (8.7 %)	11 (11.5 %)	0.993
Medical co-morbidities (%)	11 (11.3 %)	36 (12.1 %)	0.845	1 (4.3 %)	12 (12.5 %)	0.451
Resection type (total/subtotal)	20/77	92/206	0.052	6/17	26/70	0.923
OP time (min)	232.8 ± 41	219.8 ± 43.1	**0.009**	243 ± 48.8	225.9 ± 45.6	0.113
Number of retrieved LNs	34.9 ± 10.8	32.6 ± 11.3	**0.027**	33.4 ± 10.5	32.9 ± 10.2	0.295
Evaluated blood loss (ml)	122.3 ± 56.8	139.6 ± 51.6	**0.005**	101.4 ± 54.1	131.4 ± 53.5	**0.017**
Days of first flatus	3.1 ± 1	3.2 ± 0.9	0.365	3.3 ± 1.2	3.4 ± 1	0.760
Days of eating liquid diet	3.8 ± 1	4.0 ± 1.1	0.081	4.1 ± 1.2	4.2 ± 1.1	0.701
Length of hospital stay	7.5 ± 2.8	7.6 ± 2.5	0.740	9.4 ± 3.6	9 ± 2.4	0.519

Bold values are statistically significant ($p < 0.05$)

vs. 139.6 ± 51.6, $P = 0.005$). In contrast, elder patients who underwent RAG had a similar number of lymph nodes retrieved but also a smaller amount of evaluated blood loss compared with those underwent LAG (33.4 ± 10.5 vs. 32.9 ± 10.2, $P = 0.295$; 101.4 ± 54.1 vs. 131.4 ± 53.5, $P = 0.017$).

Follow-up results

The median follow-up period for the RAG group was 15 (range, 3–41) months and 19 months for the LAG group. Three cases in RAG group and ten cases in LAG group were lost to follow-up assessment. Tumor recurrence or metastasis were detected before the patients died in 5 cases (4.2 %) in the RAG group and 28 cases (7.1 %) in the LAG group, whereas another 11 cases in RAG group and 42 cases in LAG group died of uncertain reasons. The survival rates were 90.2 % at 1 year, 78.1 % at 2 years, and 67.8 % at 3 years in the RAG group compared with 87.3 % at 1 year, 77.1 % at 2 years, and 69.9 % at 3 years in the LAG group. The difference in overall survival rate between the two groups was not statistically significant ($P = 0.812$; Fig. 3). In view of lymph node involvement, the 3-year survival rates for patients with negative nodal metastasis were 84.4 % in the RAG group versus 82.6 % in the LAG group ($P = 0.972$). For those with positive nodal metastasis, the 3-year survival rates were 57.5 % in the RAG group versus 60.3 % in the LAG group ($P = 0.653$; Fig. 4A, B).

Discussion

As we know, surgical resection is still the only curative treatment option for gastric cancer up to now. The use of LAG for gastric cancer has been spreading across the

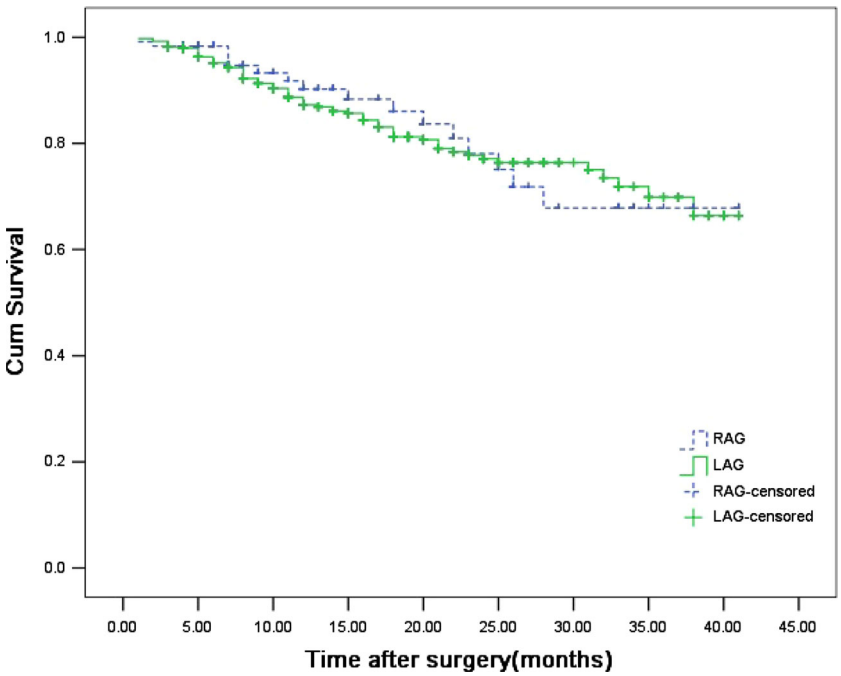

Fig. 3 Comparison of 3-year survival rate between RAG and LAG. There was no statistically difference between both groups ($P = 0.812$). *RAG* robot-assisted gastrectomy; *LAG* laparoscopy-assisted gastrectomy

world. However, laparoscopic surgery still has some limitations, so robotic surgery has been introduced in the field of minimally invasive surgery (MIS). Robotic surgery has advantages over conventional laparoscopic surgery in terms of the eliminated tremor, three-dimensional imaging, and offering improved dexterity with an internal articulated EndoWrist, which allows seven degrees of freedom [6, 20, 21]. These characteristics are especially necessary for more precise or difficult lymph node dissection. However, few studies have demonstrated the safety and feasibility of RAG based on analyses of clinical outcomes [8, 22]. Furthermore, fewer studies have reported the comparison of RAG and LAG [10, 15], and there are some controversies, such as the operation time and the incidence rate of complications. Therefore, we conducted a relevant study to compare the two approaches for the operation.

We report the intraoperative and postoperative outcomes of the two groups. We analyzed 120 patients with RAG and 394 patients with LAG during the same period. From the results, we found that the mean operation time was longer in the RAG group compared with LAG, which may be associated with the additional setup time (approximately 20–30 min) and surgeons' less experience of RAG [23]. Nevertheless, the intraoperative blood loss was less, whereas LN dissection number of retrieved LNs was more in the RAG group. More retrieved lymph nodes can improve the accuracy of staging and get more precise prognostic assessment [24]. Meanwhile, more thorough lymph nodes dissection also may get better prognosis [25]. Further analysis of retrieved LNs found lymph node tier 2 had significant difference between the two groups. The reason for it may be that there are more difficult lymph node stations, such as No. 7, No. 8a, No. 9, and No. 11 p in the second tier and robotic surgery can provide better exposure and wider operating field visualization. In our experience, the stereoscopic vision and the eliminated tremor allowed us to drive the vascular dissection along the tunica adventitia so that we can entirely clear the lymphatic tissue and meanwhile avoid injuring blood vessels, such as the common hepatic artery, celiac trunk, portal vein, and splenic artery. The potential superiority in clearing lymph node tier 2 may support the advantages of robotic gastrectomy in D2 lymphadenectomy, which is most used in advanced gastric cancer. Additionally more, there were no significant differences between the two groups in terms of patients' clinicopathologic characteristics, resection type, reconstruction type, proximal resection margin and distal resection margin, complications, the time of first flatus and days to eating liquid diet, and length of hospital stay. In general, robotic surgery is comparable to conventional laparoscopic surgery.

Resection type may be a factor related to surgical outcomes. Therefore, we also performed an analysis of the differences between the two surgery methods in each resection type. We investigated surgical efficacy for both resection-type groups by comparing operation time, estimated blood loss, numbers of retrieved lymph nodes, days of first flatus, days of eating liquid diet, and length of postoperative hospital stay. Whether conducting total or subtotal gastrectomy, robotic surgery is comparable to laparoscopic surgery with respect to short-term results.

Old age may be another factor related to surgical outcomes as several studies have reported. In this study, we

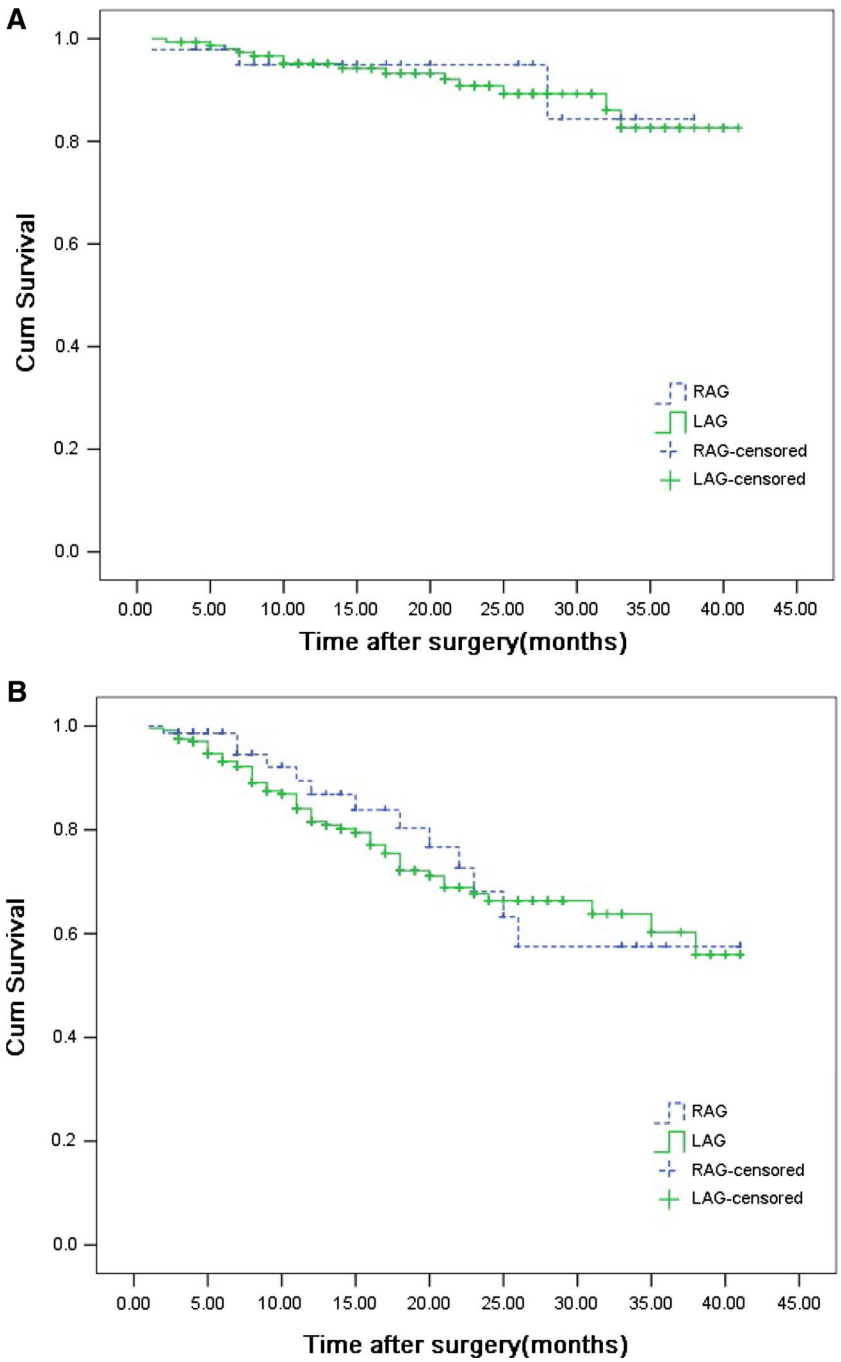

Fig. 4 Comparison of 3-year survival rate between RAG and LAG according to lymph node metastasis. The 3-year survival rates of negative nodal metastasis (**A**) between both groups were 84.4 and 82.6 % ($P = 0.972$), and those of positive nodal metastasis (**B**) were 57.5 and 60.3 % ($P = 0.653$), respectively

divided patients into elder and younger groups based on age. We also compared those items mentioned earlier between the two types of surgery. Except for the longer operation time needed for robotic surgery, whichever group suggested robotic surgery a practical and feasible alternative to laparoscopic surgery. In the younger group, patients who underwent RAG had significantly more lymph nodes retrieved and less evaluated blood loss than those who underwent LAG. In the elder group, patients in the RAG subgroup lost less blood, which is very important for older people to have a shorter and better recovery.

In this study, we also conducted a short-term follow-up (3–41 months, median 17 months) for all patients. Three-year survival rates between the RAG and LAG groups were 67.8 and 69.9 %, respectively. No statistical differences in survival rates were observed between the two groups ($P = 0.812$). We also analysed the survival rate in both groups according to lymph nodes metastasis because lymph node metastasis is one of the most significant prognostic factors for gastric cancer [26–29]. In view of lymph node involvement, the 3-year survival rates for patients with negative nodal metastasis were 84.4 % in the RAG group

versus 82.6 % in the LAG group while 57.5 % in the RAG group versus 60.3 % in the LAG group for those with positive nodal metastasis. No statistically significant differences were found in either subgroup. In our opinion, RAG compares well with LAG considering the curative effect at present and a longer period of follow-up for both groups is needed to analyze the recurrence or survival rate.

Due to the above-mentioned results, we believe that robotic surgery will become more popular when surgeons have enough experience so that it can take a shorter operation time while the cost of robotic surgery is lower so that the majority of patients can afford it.

Our study has several limitations. This study is neither randomized nor double-blind so that there will be some selection bias. Furthermore, the choice of RAG or LAG depended on the patients with informed consent concerning the methods and risks of each procedure while the surgeons also may choose patients in good condition for robotic surgery. Additionally, different surgeons may influence the results despite their similar experiences and skills in open and laparoscopic surgery. Despite these problems, we believe that this is an important study to establish a basis for larger, prospective studies. Therefore, a large-scaled, prospective, randomized, controlled trial with available indications and long-term outcomes is necessary for a precise statistical comparison between the two groups. Nevertheless, we cautiously propose that RAG is a good choice for gastric cancer.

Conclusions

This study shows that robotic surgery compares well with laparoscopic surgery in terms of its technical feasibility and safety, providing clear operation field, precise dissection, minimal trauma, and fast recovery. Also, RAG may be a practical and feasible alternative to LAG for the treatment of gastric cancer in the future. However, we recommend that longer follow-up time and randomized, clinical trials be conducted to evaluate the clinical benefits and long-term oncological outcomes of robotic surgery in gastric cancer.

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Disclosures Zhou Junfeng, Shi Yan, Tang Bo, Hao Yingxue, Zeng Dongzhu, Zhao Yongliang, Qian Feng, and Yu Peiwu have no conflict of interest or financial ties to disclose.

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