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Original Article

Short-term quality of life outcomes after robotic versus laparoscopic sphincter preserving resections for rectal cancer

Jianyong Zheng*, Xiaohua Li*, Jiangpeng Wei*, Yezhou Liu, Guosheng Wu

*State Key Laboratory of Cancer Biology and Xijing Hospital of Digestive Diseases, The Fourth Military Medical University, Xi'an, China. *Equal contributors.*

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Abstract: Background: The aim of the present study was to compare the quality of life (QoL) of Chinese patients after robotic versus laparoscopic total mesorectal excision (TME) surgery for rectal cancer. Methods: From June 2013 to August 2015, 171 eligible Chinese patients with rectal cancer underwent total mesorectal excisions (TME) in Xijing Hospital, 82 by robot-assisted and 89 by laparoscopic-assisted techniques. Patients completed QLQ-C30 and QLQCR38 questionnaires about validated Chinese versions of the European Organization for Research and Treatment of Cancer before surgery and in the 3rd, 6th and 12th month after surgery. At different time points, QoL scores of the two groups, robotic group and laparoscopic group, were compared. In those questionnaires, higher symptomatic scale scores indicated a higher degree of symptomatics. Higher functional scale scores indicated better function. Results: Many factors were compared in the two groups of patients, including sociodemographic data, types of surgery, tumor staging, and baseline average scores of QoL. Compared to the laparoscopic group, the robotic group had significantly better sexual functioning at 6 months [(15.5±5.8) vs (10.9±3.9), P = 0.035], more sexual enjoyment at 3 months [(40.2±7.5) vs (36.9±9.6), P = 0.024], and fewer male sexual problems at 3 months [(28.7±3.6) vs (32.8±6.9), P = 0.013]. Apart from male sexual enjoyment and sexual problems, compared to the laparoscopic group, although the robotic group showed better global QoL at 3 and 6 months, better physical roles and cognitive functions at 6 months, together with less problems of micturition at 3 to 6 months along with nausea/vomiting and appetite loss and financial difficulties at 6 months were indicated. There was no statistical significance in either functional or symptomatic scales between the two groups from 3 to 12 months after the operation. Furthermore, at one year after the operation, both functional and symptomatic scales between the two groups did not show significant differences. Conclusion: Robotic sphincter preserving resection is a promising alternative for treatment of patients with rectal cancer, offering better QoL and fewer male sexual problems compared with laparoscopic surgery in Chinese patients.

Keywords: Quality of life, rectal cancer, robotic surgery, laparoscopic technique, total mesorectal excision, surgery, sphincter-preserving surgery

Introduction

Rectal cancer is a tumor of major importance, representing 40 percent of colorectal cancers. During the last two decades, outcomes following curative surgery have improved substantially and 5-year survival rate after curatively intended resections is now 63% [1]. It is evident that consequences of rectal surgery have an important bearing on a patient quality of life. Advantages of any treatment, i.e. improved survival rate, should outweigh the negative impact on patient function and QoL in the remainder of his life [2]. Therefore QoL assessment has been regarded as an important outcome in addition to traditional endpoints such as survival, tumour recurrence, and complication rates [3]. Although differences in the definition exist [3], 'quality of life' may be regarded as representing an individual's ability to carry out daily activities, as well as satisfaction with personal performance, with a balance between disease control and adverse effects of treatment [4, 5]. Therefore, in addition to traditional study endpoints, such as postoperative recovery, morbidity and survival, and functional results, QoL has

recently become important outcome parameter defining surgical performance in clinical trials [6].

The last 2 decades have witnessed a progressive expansion of minimally invasive surgery in rectal cancer resections [7]. Despite initial skepticism, various randomized controlled trials have now demonstrated that robotic surgery shows both short-term and long-term advantages over conventional laparoscopic surgery in the treatment of rectal cancer. These include faster recovery, decreased morbidity, and reduced hospital length of stay with comparable oncological results and survival outcomes [8-11]. However, whether robotic surgery could achieve better functional outcomes and quality of life (QoL) remains unknown.

This prospective study aimed to compare QoL outcomes in Chinese patients after robotic surgery with conventional laparoscopic sphincter preserving surgery for rectal cancer. Health-related QoL after cancer surgery was assessed by standardized instruments, such as questionnaires developed by the European Organization for Research and Treatment of Cancer (EORTC). These contain multidimensional generic and disease-specific domains. EORTC QLQ-C30 and QLQ-CR38 are the most commonly used questionnaires in colorectal cancer trials [3, 4]. Changes in QoL over time were also longitudinally assessed and compared between the robotic surgery group and conventional laparoscopic sphincter preserving surgery group.

Materials and methods

Patients and methods

From June 2013 to August 2015, a total of 229 Chinese patients with rectal cancer underwent sphincter preserving TME surgeries in Xijing Hospital. Of these, 171 (74.67%) responded to the questionnaire-based study, 82 by robot-assisted and 89 by laparoscopic-assisted techniques. Patients were considered eligible for this study if the operation had a curative intention. Patients with intestinal perforation or obstruction, local resection, synchronous tumors, familial adenomatous polyposis, or hereditary nonpolyposis colorectal cancer were excluded, along with those with distant metastasis.

The two groups of patients treated during the same period were matched in 1:1 fashion for comparison. Matching criteria included age, body mass index (BMI), tumor distance from the anal verge, neoadjuvant chemoradiation therapy, and final pathologic tumor stage. This study was conducted with the approval of the Institutional Review Board.

All patients were asked to participate in the QoL study. Patients were given QoL questionnaires and carcinoembryonic antigen testing in the week before treatment, on the day of discharge (early postoperative assessment), and at 3, 6, and 12 months after surgery. A reminder was sent after two weeks if no reply was received.

Clinical parameters including patient age, gender, TNM classification, operation type, and short-term clinical outcomes were recorded prospectively. For this study, patients were followed for one year with respect to recurrence/metastatic disease and death. Survival was measured in days from the time of surgery to death.

Quality of life assessment

This study used a cancer specific instrument (the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire QLQ-C30) [12] and a colorectal specific QoL questionnaire (the EORTC Colorectal Quality of Life Questionnaire QLQ-CR38) [13]. The clinical validity and reliability of both QLQ-C30 and QLQ-CR38 of the Chinese versions have been confirmed [14-16]. QLQ-C30 is a generic questionnaire for assessment of QoL in cancer patients [12]. QLQ-C30 contains 30 questions and it is subdivided into five functional levels (physical, role, emotional, cognitive, and social), nine symptomatic scales (fatigue, nausea and vomiting, pain, dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties), and one global quality of life scale. Scores are summed and transformed into a score ranging from 0 to 100. High scores for the functional scale represent a high level of function, while high scores for the global health status and quality of life represent high quality of life. On the other hand, high scores for a symptomatic scale or item represent a high level of symptomology and problems. QLQ-CR38 is a specific questionnaire module spe-

Table 1. Sociodemographic and clinicopathologic data of patients n (%)

	Robotic group	Laparoscopic group	*P* value
Number of patients	82	89	/
Age (yr, mean ± SD)	64.3±9.5	67.8±7.9	0.825[1]
Sex (male/female)	55/27	59/30	0.522[2]
Body mass index (Kg/m^2, mean ± SD)	26.3±4.2	25.8±3.7	0.343[1]
Number of patients with comorbidities	33 (40.2)	47 (52.8)	0.196[2]
Tumor location in rectum(upper/middle/lower)	21/42/19	25/48/16	0.698[2]
Types of surgery (AR/LAR with TME)	21/61	23/66	0.556[2]
Number of patients with temporary ileostomy	25 (30.5)	31 (34.5)	0.392[2]
Number of patients with complications	14 (17.1)	25 (28.1)	0.117[2]
Subclinical anastomotic leak	/	2	
Anastomotic bleeding	2	3	
Lung infection	3	/	
Wound infection	4	7	
Urinary tract infection	/	3	
Urinary retention	2	5	
Ileus	0	/	
Others	/	3	
Reoperation	0	0	
AJCC staging(I/II/III)	3/40/39	5/44/35	0.511[2]
Adjuvant chemotherapy	13 (15.8)	18 (20.2)	0.338[2]
Adjuvant radiotherapy	39 (47.6)	35 (39.3)	0.293[2]

1. Student's *t*-test; 2. X^2 test. AR: Anterior resection; LAR: Low anterior resection; TME: Total mesorectal excision; AJCC: American Joint Committee on Cancer.

cifically designed for assessment of QoL in patients with colorectal cancer [13]. QLQ-CR38 consists of 38 questions: 19 questions are completed by all patients while the remaining 19 questions are divided into groups of questions relevant for subsamples of patients only (i.e., male or female, patients with or without a stoma). It is subdivided into four functional scales (body image, sexual functioning, sexual enjoyment, and future perspective), eight symptomatic scales (micturition problems, gastrointestinal tract symptomatics, chemotherapy side effects, defecation problems, stoma-related problems, male and female sexual problems, and weight loss). Scoring is equal to that for the QLQ-C30.

All questionnaires were administered by a single research assistant and completed by patients before surgery and at the 3rd, 6th and 12th month after surgery (during clinic visits). Every effort was made to avoid missing data during questionnaire administration. According to questionnaire manuals, missing values were dealt with as follows: if at least half of the items on a scale were completed, the scale score was divided by the number of items present. If less than half of the items were completed, the scale was considered as missing [2].

Measures and statistical analysis

All statistical analyses were performed using SPSS for Windows (version 12.0; SPSS, Chicago, IL, USA). Patient clinical and demographic characteristics were compared using Student's *t*-test for continuous variables and X^2 test (or Fisher's exact test when appropriate) for categorical variables. QoL scores are presented as mean ± SD. Changes in QoL over time (before surgery and at 3, 6, and 12 months after surgery) were analyzed with the Friedman test, comparing follow-up scores to baseline scores. A post-hoc Wilcoxon signed-rank test for paired data was used to compare pairs of QoL scores. Mann-Whitney U test was used to analyze differences in QoL scores between the robotic and laparoscopic groups at each time points. For results, a *P* value of less than 0.05 is considered statistically significant, whereas a difference in mean QoL scores of more than 10 points is regarded as clinically significant [17].

Results

From June 2013 to August 2015, a total of 229 Chinese patients with rectal cancer underwent sphincter preserving TME surgeries in Xijing Hospital. Of these, 171 (74.67%) responded to the questionnaire-based study, 82 by robot-assisted and 89 by laparoscopic assisted technique. Patient characteristics are displayed in **Table 1**. There was no statistical significance

Table 2. Comparison of EORTC QLQ-C30 scores between the robotic and laparoscopic groups at different time points

	Baseline			3 months			6 months			12 months		
	Rob	Lap	*P*	Rob	Lap	*P*	Rob	Lap	*P*	Rob	Lap	*P*
Functional Scales												
Global QOL	75.2±3.5	73.8±5.0	0.537	70.8±5.5	66.2±4.7	0.525	72.5±4.2	70.9±5.1	0.620	74.6±4.3	71.3±3.9	0.534
Physical	93.8±5.0	94.3±4.9	0.731	89.4±4.1	85.9±4.3	0.655	90.2±5.3	87.6±6.8	0.323	91.5±4.8	88.7±5.9	0.726
Role	88.5±4.4	87.6±4.0	0.659	80.9±3.2	76.7±5.8	0.538	86.5±5.4	81.9±5.6	0.466	86.9±4.8	82.4±3.1	0.549
Emotional	75.5±6.1	72.3±5.0	0.325	80.8±5.4	74.5±7.3	0.365	81.3±4.2	76.4±5.5	0.624	80.9±7.4	81.1±3.4	0.921
Cognitive	74.8±4.5	72.9±5.3	0.655	71.5±5.1	68.4±5.0	0.394	78.0±6.4	75.2±4.1	0.480	76.6±4.0	64.3±2.9	0.131
Social	86.2±4.3	84.5±4.7	0.556	83.5±7.0	78.6±6.0	0.412	85.4±4.9	80.1±5.3	0.815	84.1±4.5	81.3±4.2	0.373
Symptomatic Scales/items												
Fatigue	16.2±4.2	15.8±3.1	0.329	16.9±6.3	19.1±4.4	0.565	15.0±5.7	17.7±7.2	0.483	12.8±6.6	15.9±5.8	0.230
Nausea/vomiting	0 (0)	0 (0)	/	2.5±0.7	3.3±1.1	0.253	0 (0)	0 (0)	/	0 (0)	0 (0)	/
Pain	16.2±3.9	15.1±3.6	0.622	20.7±4.2	22.5±5.1	0.633	18.0±5.3	21.4±6.9	0.284	16.8±7.2	15.0±5.3	0.825
Dyspnea	4.5±1.3	4.3±2.0	0.213	6.9±5.7	7.8±3.4	0.894	6.7±3.8	5.5±1.3	0.632	4.5±5.3	4.9±6.1	0.989
Insomnia	38.5±4.3	34.7±4.2	0.539	36.4±5.9	35.5±6.5	0.908	32.7±3.8	33.2±7.5	0.787	31.5±6.1	27.8±7.0	0.741
Appetite loss	7.2±3.6	7.8±2.3	0.211	7.9±5.1	7.1±4.5	0.413	7.0±4.3	6.9±3.7	0.632	7.5±5.6	7.0±4.0	0.526
Constipation	19.5±2.8	21.3±3.5	0.237	12.0±1.9	12.5±4.2	0.479	17.9±5.1	18.1±5.9	0.773	19.8±7.1	20.9±6.6	0.887
Diarrhea	19.2±3.7	18.8±3.6	0.322	25.3±6.0	24.5±2.9	0.382	17.8±5.4	16.1±6.4	0.681	16.5±5.0	16.9±3.8	0.610
Financial difficulties	14.7±3.9	14.2±3.1	0.354	31.5±6.2	23.8±4.9	0.528	26.8±3.8	22.1±5.0	0.649	16.4±6.7	14.3±9.8	0.688

Quality of life (QOL) scores are presented as mean (standard error of mean). Scores ranged from 0 to 100. A higher score on a functional scale indicates better functioning, whereas a higher score on a symptomatic scale indicates higher degree of symptoms. Scores in the robotic and laparoscopic groups were compared by the Mann-Whitney U-test. EORTC: European Organization for Research and Treatment of Cancer.

between the two groups in terms of sociodemographic data, types of surgery, tumor staging, and proportion of patients that received adjuvant therapy. The two groups had similar overall short-term morbidity rates, with 17.1% in robotic surgery group vs 28.1% in laparoscopic surgery group ($P = 0.117$, X^2 test, **Table 1**). Septic complications (including chest infection, wound infection, and urinary tract infection) and transient urinary retention were significantly lower in the robotic surgery group. No patient in this study required reoperation for postoperative complications. As shown in **Table 2**, average QoL scores for either of the functional or symptomatic scales at baseline between the two groups were also very similar and showed no significant differences.

EORTC QLQ-C30

Compared with baseline scores, global QoL scores of patients in the laparoscopic group showed no statistically significant decreases at evaluated time points ($P = 0.082$, Friedman test), but a significant increase from 3 to 6 months ($P = 0.033$, Wilcoxon signed-rank test) (**Figure 1A**). For the robotic group, patients reported a little decrease at evaluated time points compared with baseline scores ($P = 0.095$, Friedman test), which gradually increased from 3 to 6 months ($P = 0.065$, Wilcoxon signed rank test) and finally returned to baseline until 12 months postoperatively (**Figure 1A**). Physical function in the two groups showed a decrease from 3 to 12 months postoperatively ($P < 0.001$), but patients in laparoscopic group expressed more bad function (**Figure 1B**). Furthermore, it was found that role functioning and social functioning both showed no significant decreases from 3 to 6 months (**Figure 1C** and **1F**), but emotional functioning remained the same as at baseline for the two groups (**Figure 1D**). Patients in the laparoscopic group expressed fluctuated cognitive functioning with time ($P = 0.049$, Friedman test), but those in robotic groups showed very similar cognitive functioning with baseline (**Figure 1E**).

Symptomatic scores concerning fatigue, nausea/vomiting, pain, dyspnea, insomnia, appetite loss, constipation, and diarrhea did not show any differences in the robotic group and laparoscopic group (**Figure 2A-H**). Considering the higher cost of the robotic group, it can be understood why more financial difficulties were found in the robotic group at 3 months postoperatively. This returned to baseline levels by 12 months for both two groups (**Figure 2I**).

Compared to the laparoscopic group, the robotic group had significantly better global QoL at 3 and 6 months, better physical, role, and cogni-

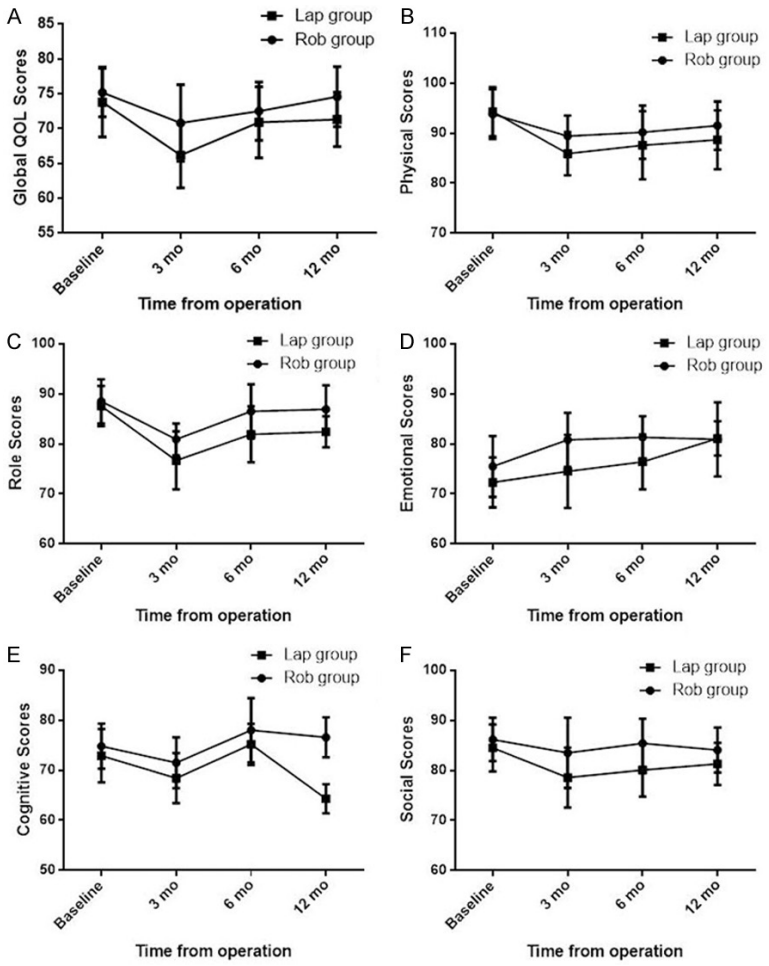

Figure 1. Longitudinal assessment of changes in quality of life scores over time for various functional scales in EORTC QLQ-C30. A: Global health status/quality of life (QoL); B: Physical functioning; C: Role functioning; D: Emotional functioning; E: Cognitive functioning; F: Social functioning. A higher score indicates better functioning. Error bars indicate the standard error of the mean. The Friedman test was used to identify overall significant differences between QoL scores at the four different time points for each variable. QoL: Quality of life.

tive functioning at 6 months, together with less nausea/vomiting, appetite loss, and financial difficulties at 6 months (**Table 2**). No significant differences were observed in any of the EORTC QLQ-C30 functional or symptomatic scales between the two groups at 12 months after the operation.

EORTC QLQ-CR38

For the robotic group, body image did not have any changes from baseline. In the laparoscopic group, it was significantly worse compared to baseline after the operation and gradually back to normal by 12 months (P = 0.019, Friedman test) (**Figure 3A**). Sexual function remained the same as baseline for both groups (**Figure 3B**). Although total scores decreased 3 months after surgical resection in both groups without intergroup differences (**Table 3**), scores at 6 months after surgery were significantly higher in the robotic group than the laparoscopic group [(15.5±5.8) vs (10.8±3.9), P = 0.035, Mann-Whitney U test]. At 12 months after surgery, the mean score was still higher in the robotic group, but differences were not significant [(16.7±7.0) vs (14.3±6.1), P = 0.62, Mann-Whitney U test]. Changes between baseline and each follow-up point are shown in **Figure 3B**. As shown, it was found that interval decreases in overall scores (baseline to follow-up) were significantly less in the robotic group than in the laparoscopic group at 6 months, but similar for both groups at 12 months.

Previous reports have shown that robotic surgery patients get more sexual enjoyment and less sexual problems than laparoscopic surgery patients [18]. Considering that Chinese women are very subtle and did not want to respond to the sexual function survey, this study only analyzed male patients for further QoL-related sexual activities assessments. Male patients in the robotic group showed relatively more sexual enjoyment and less sexual problems than those in laparoscopic group, from 3 to 6 months postoperatively (**Table 4**), consistent with a previously report. There were no significant changes from baseline of future perspective scores for both groups, **Figure 3C**, but future perspective scores became worse compared to baseline over time for robotic (P = 0.079, Friedman test) and laparoscopic (P = 0.063, Friedman test) groups.

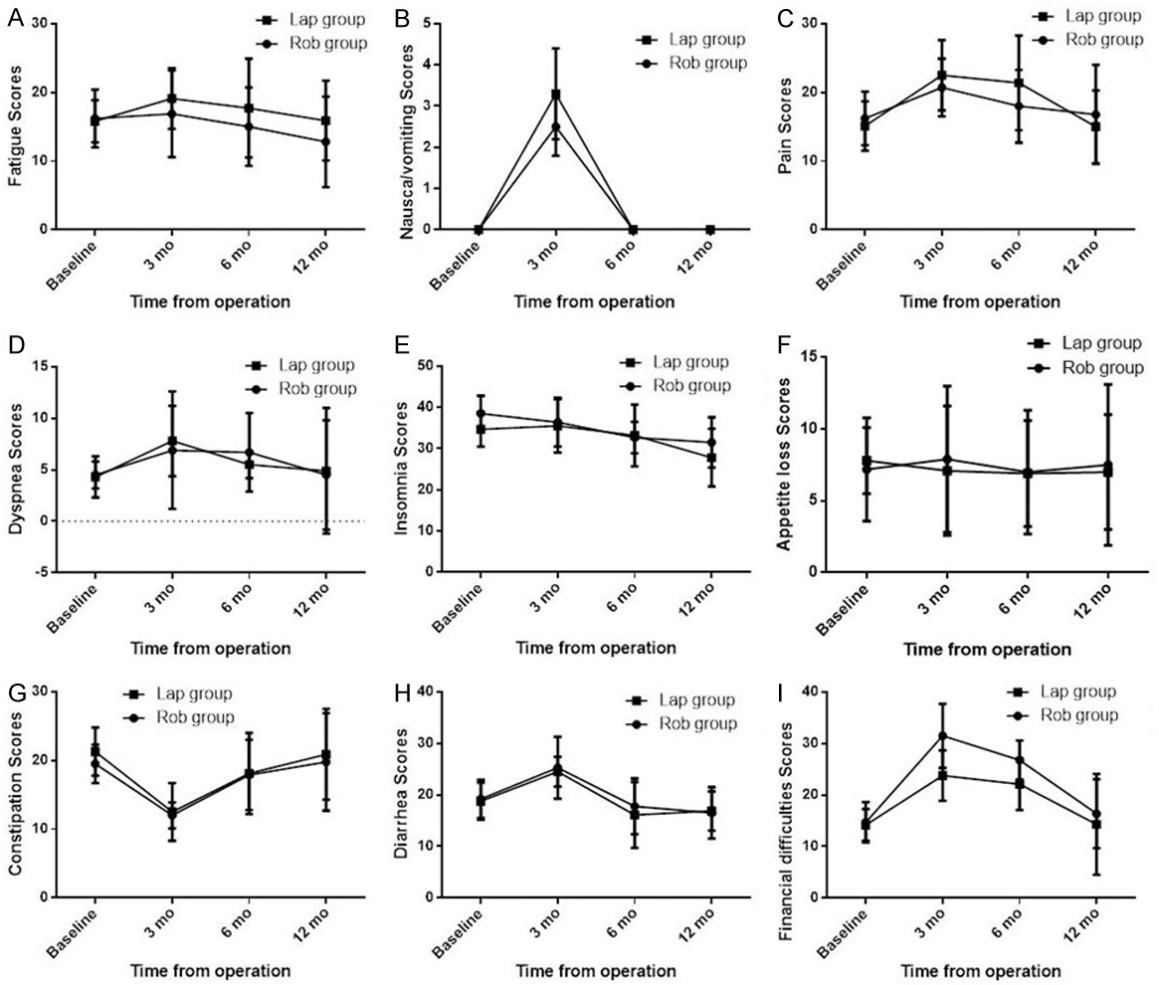

Figure 2. Longitudinal assessment of changes in quality of life scores over time for various symptomatic scales/items in EORTC QLQ-C30. A: Fatigue; B: Nausea/vomiting; C: Pain; D: Dyspnea; E: Insomnia; F: Appetite loss; G: Constipation; H: Diarrhea; I: Financial difficulties. A higher score indicates a higher degree of symptoms. Error bars indicate the standard error of the mean. The Friedman test was used to identify overall significant differences between QoL scores at the four different time points for each variable. QoL: Quality of life.

Regarding micturition problems, the mean baseline score did not differ between the robotic group and laparoscopic group. After surgery, the robotic group showed quicker improvements from 3 to 6 months (P = 0.027, Wilcoxon signed-rank test) than the laparoscopic group from 6 to 12 months (P = 0.039, Wilcoxon signed-rank test). There were no intergroup differences during any follow-up period (**Figure 4A**). Both groups expressed chemotherapy side effects at 3 months postoperatively, but those side effects slowly returned to baseline levels by 12 months for patients receiving chemotherapy in both groups (**Figure 4B**). Compared with baseline, this study did not find any significant increase of gastrointestinal tract symptoms in the two groups (**Figure 4C**), but the stoma in both group patients with defecation problems showed a significant decrease at 3 to 6 months after operation (P = 0.006, robotic group; P = 0.009, laparoscopic group, Wilcoxon signed-rank test) (**Figure 4D**). With the extension of time, both groups showed significant improvement in weight loss (**Figure 4E**).

Apart from male sexual enjoyment and sexual problems, the robotic group did not express better statistical differences of the EORTC QLQ-CR38 functional or symptomatic scales than the laparoscopic group.

Discussion

Since the World Health Organization has defined health as “not only the absence of infir-

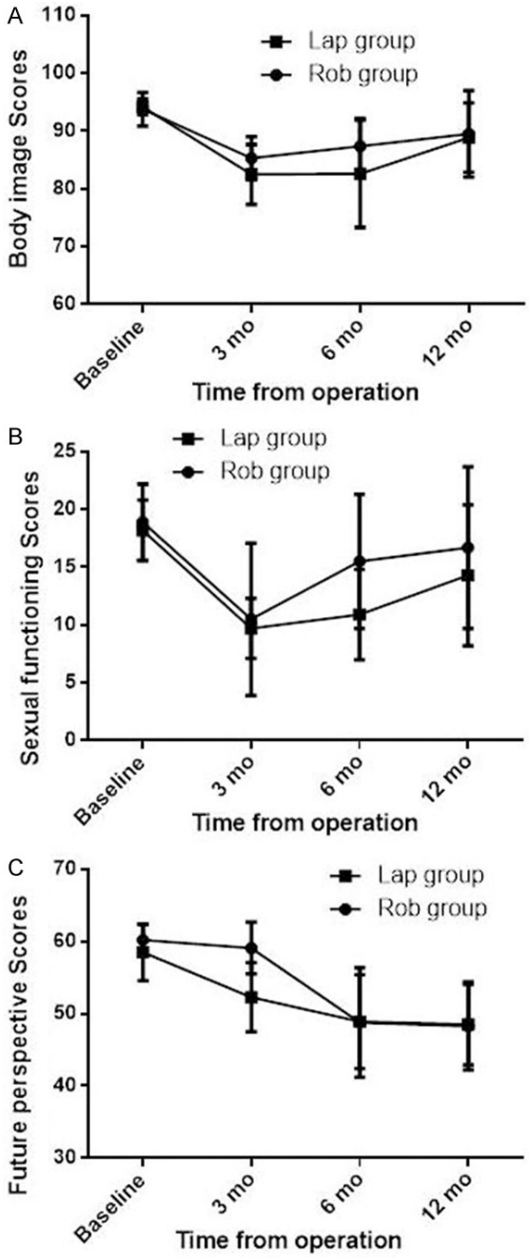

Figure 3. Longitudinal assessment of changes in quality of life scores over time for various functional scales in EORTC QLQ-CR38. A: Body image; B: Sexual functioning; C: Future perspective. A higher score indicates better functioning. Error bars indicate the standard error of the mean. The Friedman test was used to identify overall significant differences between QoL scores at the four different time points for each variable. QoL: Quality of life.

mity and disease but also a state of physical, mental, and social wellbeing" [19], it has not been sufficient enough to define outcomes of therapy only in terms of survival and complication rates. After potentially curative surgery for rectal cancer, patients may suffer from a range of problems affecting physical, social, and psychological aspects of their life. Physical problems are related mainly to sexual [20-24], urinary [25-28], and bowel [28-32] function. Men suffer from impotence and ejaculatory difficulties, while women suffer mainly from dyspareunia. Urinary problems include incontinence, retention, and dysuria. The present study compared QoL outcomes in Chinese patients after curative robotic with laparoscopic sphincter-preserving resections for rectal cancer. It was found that, compared with the laparoscopic group, patients in the robotic group showed better preservation of QoL after the operation in the first year. Sexual function remained impaired and was worse in patients undergoing laparoscopic surgery than in those undergoing robotic surgery. However, better physical function and fewer micturition and gastrointestinal problems in the robotic group only showed short term benefits. Problems in the laparoscopic group returned to preoperative levels or even improved one year postoperatively.

Although few studies have investigated QoL after robotic surgery for rectal cancer, several recent reports have shown that male rectal cancer patients with robotic surgery experienced earlier restoration of erectile function and bladder function than those in the laparoscopic group. Luca et al. [33] reported robotic TME surgery allows for preservation of urinary and sexual function. Until now, present researchers have not found any reports of QoL after robotic sphincter-preserving resections for rectal cancer. Results showed that QoL scores of most of the functional and symptomatic scales in robotic surgery expressed relatively stable results at different time points after operation. However, those in laparoscopic group showed dramatic deterioration at 3 to 6 months, but gradually returned back to baseline at one year postoperatively.

Functional changes after rectal cancer surgery have traditionally resulted in a 10-40% incidence of urinary dysfunction and 40-60 % incidence of sexual dysfunction [34, 35]. Introduction of TME has reduced incidence to 0-12% for urinary dysfunction and 10-35% for sexual dysfunction [36-38] Normal bladder and sexual function is controlled by sympathetic input from the superior hypogastric plexus and parasympathetic input from the pelvic splanch-

Table 3. Comparison of EORTC QLQ-CR38 scores between the robotic and laparoscopic groups at different time points

	Baseline			3 months			6 months			12 months		
	Rob	Lap	*P*	Rob	Lap	*P*	Rob	Lap	*P*	Rob	Lap	*P*
Functional Scales												
Body image	93.8±2.9	94.2±1.3	0.949	85.3±3.7	82.5±5.2	0.785	87.4±4.8	82.6±9.3	0.453	89.5±7.5	88.9±6.0	0.938
Sexual functioning	18.9±3.3	18.2±2.6	0.938	10.5±6.6	9.7±2.6	0.889	15.5±5.8	10.9±3.9	0.035	16.7±7.0	14.3±6.1	0.620
Micturition problems	38.8±3.5	37.9±2.3	0.825	46.1±6.2	48.9±5.4	0.774	43.5±8.7	45.6±6.1	0.657	38.9±4.0	38.5±5.7	0.991
Future perspective	60.2±2.2	58.5±3.9	0.435	59.1±3.6	52.3±4.8	0.512	48.8±7.6	48.9±6.5	0.990	48.3±6.1	48.5±5.6	0.987
Symptomatic scales/items												
Chemotherapy side effect[1]	18.9±2.5	16.8±3.4	0.688	41.5±5.1	42.5±7.3	0.855	20.6±4.9	21.4±2.2	0.891	9.9±3.3	10.6±4.9	0.878
Gastrointestinal tract symptomatics	20.5±2.7	21.3±3.6	0.812	16.2±3.5	17.6±4.9	0.811	16.8±4.1	16.4±3.0	0.976	18.7±5.6	19.2±6.0	0.983
Defection problems[2]	21.6±4.9	22.6±3.7	0.881	23.9±4.3	24.8±6.7	0.746	12.7±2.8	12.9±5.1	0.992	13.1±3.2	13.6±4.6	0.994
Weight loss	28.5±3.4	26.8±2.1	0.532	9.8±5.5	10.2±4.7	0.899	7.2±2.1	8.9±3.9	0.753	6.8±3.8	6.4±5.0	0.995

1. Only for patients who received chemotherapy. 2. Only for patients without temporary loop ileostomy. Quality of life (QOL) scores are presented as the mean (standard error of mean). Scores ranged from 0 to 100. A higher score on a functional scale indicates better functioning, whereas a higher score on a symptomatic scale indicates a higher degree of symptoms. Scores in the robotic and laparoscopic groups were compared by the Mann-Whitney U-test. EORTC: European Organization for Research and Treatment of Cancer.

Table 4. Sexual enjoyment and sexual problems among men that had been sexually active: robotic vs laparoscopic group

	Baseline			3 months			6 months			12 months		
	Rob	Lap	P	Rob	Lap	*P*	Rob	Lap	*P*	Rob	Lap	*P*
Number of men who have been sexually active	22	20	/	14	8	/	16	13	/	19	15	/
Sexual enjoyment (functional scale)	40.7±5.4	41.2±7.3	0.238	40.2±7.5	36.9±9.6	0.024	44.5±6.3	45.1±5.8	0.077	45.1±10.7	43.8±10.0	0.120
Male sexual problems (symptomatic scale)	14.3±7.9	16.5±6.2	0.361	28.7±3.6	32.8±6.9	0.013	25.2±2.1	25.7±4.2	0.386	20.6±4.2	23.9±5.6	0.430

Quality of life scores are presented as the mean (standard error of mean). Scores ranged from 0 to 100. A higher score on a functional scale indicates better functioning, whereas a higher score on a symptomatic scale indicates a higher degree of symptoms. Scores in the two groups were compared by the Mann-Whitney U-test.

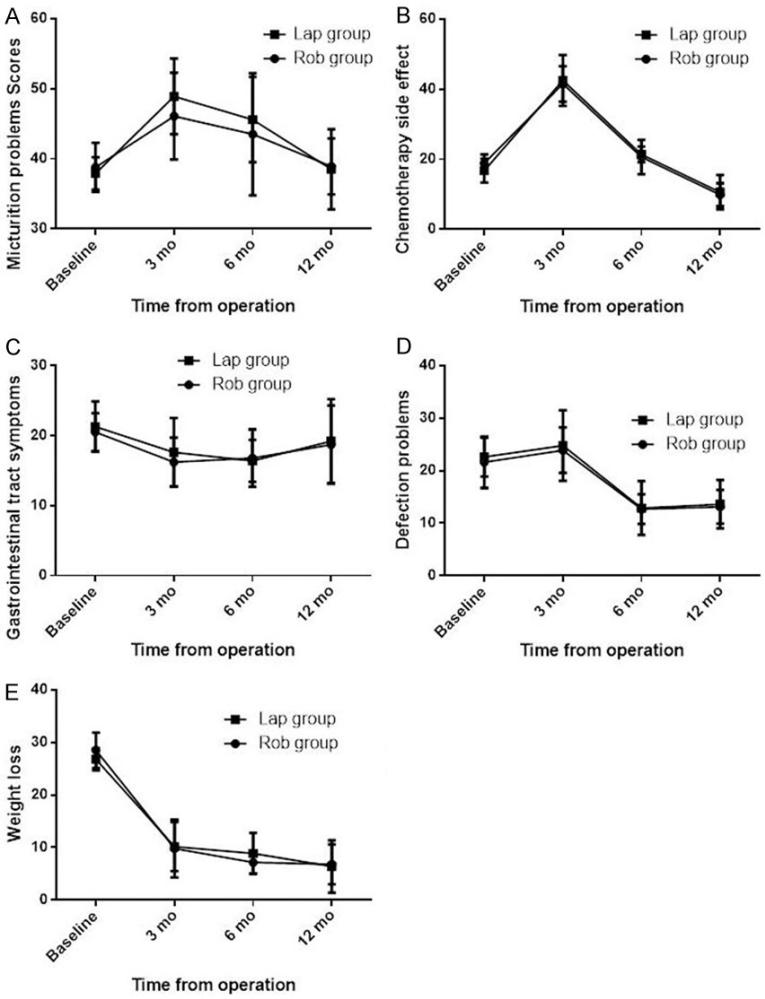

Figure 4. Longitudinal assessment of changes in quality of life scores over time for various symptomatic scales/items in EORTC QLQ-CR38. A: Micturition problems; B: Chemotherapy side effect; C: Gastrointestinal tract symptoms; D: Defection problems; E: Weight loss. A higher score indicates a higher degree of symptoms. Error bars indicate the standard error of the mean. The Friedman test was used to identify overall significant differences between QoL scores at the four different time points for each variable. QoL: Quality of life.

nic nerves. These nerves are susceptible to injury during mesorectal resection. In simple terms, injury to the sympathetic supply results in bladder instability and ejaculatory difficulties, whereas injury to the parasympathetic supply results in poor detrusor contraction and erectile dysfunction. Robotic surgery may provide better visualization of the pelvic structures, especially the multiple pelvic fascial layers and autonomic nerves, thereby facilitating adequate and fine dissection. The present study found that, compared to the robotic group, male sexual enjoyment and male sexual problems remained worse in the laparoscopic group at 12 months after the operation. Kim et al. [39] reported early improvement in bladder and erectile function after robotic surgery rectal cancer resections, compared to that after laparoscopic surgery. In another study from D'Annibale et al. [40], erectile function was completely recovered at 1 year after surgery in the robotic surgery group but not in the laparoscopic surgery group. These reports and the present results show favorable functional recovery after robotic surgery. This may be attributed to the technical advantages of robotic surgery over laparoscopic surgery. Although surgical robots offer specific technologic advantages, including wristed instrumentation, three dimensional visualization, filtration of hand tremors, an ergonomic surgical console, a surgeon-controlled camera, and three working arms [41, 42], risk of autonomic nerve injury is still substantial if the rectal dissection is performed by an inexperienced surgeon.

In conclusion, the present research demonstrated that robotic sphincter-preserving resection for rectal cancer was associated with better preservation of quality of life and fewer male sexual problems compared with laparoscopic surgery in Chinese patients. Considering that this research was a retrospective study and risk of selection bias was inevitable, further large-scale, multicenter, and randomized trials are necessary in the future.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Guosheng Wu, State Key Laboratory of Cancer Biology and Xijing Hospital of Digestive Diseases, The Fourth Military Medical University, 17 Changle Western Road, Xi'an

710032, China. Tel: 86-29-82554199; Fax: 86-29-82554199; E-mail: xjyywcwk@163.com; Xiaohua Li, State Key Laboratory of Cancer Biology and Xijing Hospital of Digestive Diseases, The Fourth Military Medical University, Xi'an, China. E-mail: xjyylixiaohua@163.com

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