The Feasibility and Effects in Full Staging Surgery of Endometrial Cancer by Combination of Transumbilical Single-port Laparoscopy and ERAS

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Research

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Abstract

Backgrounds

To study the safety, feasibility and aesthetics of transumbilical single port laparoscopic technology combined with accelerated rehabilitation surgery in stage I endometrial cancer staging surgery, and whether the laparoscopic surgery is a factor affecting the prognosis of endometrial cancer.

Methods

A total of 93 patients with type I endometrial cancer stage I were enrolled in this study, including 31 cases and 62 cases in the single port and multi-port laparoscopic groups, respectively. Both groups received ERAS technology to compare the intraoperative and postoperative conditions. Subsequently, the medical records of 62 patients who had undergone open surgery were collected, and the survival, recurrence and death of the single port laparoscopic group, the multi-port laparoscopic group and the open surgery group were compared through survival analysis.

Results

The time of surgery, intraoperative blood loss and fluid infusion volume in the single port group and the multi-port group were significantly less than those of the multi-port group ($P < 0.05$). The single-hole group was better than the open group in terms of rapid postoperative recovery, hospitalization days, incision abdominal incision cosmetic effect, physical function, physical pain, vitality, and mental health ($P < 0.05$). And there is no significant differences of mortality and recurrence among single port, multi-port and open surgery ($P > 0.05$). Laparoscopic surgery is not a risk factor affecting OS and DFS in patients with endometrial cancer.

Conclusions

Transumbilical single port laparoscopy combined with ERAS was safe and feasible for the treatment of stage I endometrial cancer with good cosmetic results and more advantages than multi-port laparoscopy.

Background

Endometrial Cancer (Endometrial Cancer EC) is the most common disease among female reproductive system malignancies in developed countries and ranks second in China. According to statistics from the National Cancer Center in 2019, the incidence of endometrial cancer in my country is 10.28 per 100,000, and the mortality rate is 1.9 per 100,000. In recent years, its incidence rate has shown a gradual increase trend, and the age of onset has a younger trend^[1].

The treatment of endometrial cancer is based on surgical treatment, and staged surgery is performed according to the patient's condition. The basic surgical procedures include extrafascial double-attachment surgery, pelvic lymph node dissection, and para-aortic lymph node dissection. The surgical

methods include conventional open surgery, vaginal surgery and laparoscopic surgery. With the advancement of laparoscopic technology and the continuous improvement of laparoscopic instruments, the advantages of laparoscopic surgery have become increasingly prominent. A large number of studies have shown that laparoscopic surgery for endometrial cancer has less intraoperative blood loss and faster postoperative recovery compared with open surgery. Therefore, laparoscopic surgery is favored by more and more physicians and patients, and has become one of the preferred methods for comprehensive staging of endometrial cancer^[2,3]. Single port laparoscopic surgery (laparo-endoscopic single-site surgery, LESS) is to use the natural scar of the human umbilical to perform surgery, NOTES is the most feasible technology yet^[4, 5]. Nowadays, transumbilical single port laparoscopy is generally accepted and widely used because of its low dependence on equipment and mature technology and easy mastery.

The concept of enhanced recovery after surgery (ERAS) was first proposed by Danish surgeon Professor Kehlet in 1997. ERAS refers to a series of perioperative optimization treatment measures based on evidence-based medicine to reduce surgical trauma and stress. Reduce postoperative pain, promote early eating and activities of patients, and accelerate postoperative recovery of patients^[6]. At present, ERAS has been widely used in gastrointestinal surgery, hepatobiliary surgery, urology, etc., and has been proven to promote gastrointestinal peristalsis, relieve pain and promote postoperative recovery of patients.

In order to study the safety and effects of transumbilical single port laparoscopic endometrial cancer full staging surgery combined with ERAS in the treatment of stage I endometrial cancer, the ERAS concept was applied to the perioperative period of single port laparoscopic endometrial cancer staging surgery to understand whether laparoscopic surgery is a risk factor affecting the prognosis of endometrial cancer.

Materials And Methods

clinical data

clinical candidates

A prospective randomized controlled study of 93 patients with type I endometrial cancer in the Department of Gynecology of Guangxi Medical University Affiliated Cancer Hospital from February 2017 to December 2019 were selected as candidates. Single port laparoscopic group and multi-port laparoscopic group, of which 31 cases and 62 cases in single port laparoscopic group and multi-port laparoscopic group were respectively. ERAS technology was used in the perioperative period of the two groups of patients, and the intraoperative and postoperative patients were compared. The medical records of 62 patients with type I endometrial cancer stage I who underwent open surgery from April 2011 to June 2018 were collected. Survival analysis was performed to compare the survival, mortality and recurrence among single port, multi-port laparoscopic and the open group.

Criteria

Inclusion criteria

☐Diagnosed as pathological type I endometrial cancer and verified as stage I by surgery; ☐The size of uterus was smaller than 3 months pregnancy; ☐No history of multiple abdominal surgery and repeated episodes of chronic pelvic inflammatory diseases; ☐No serious medical and surgical complications symptoms; ☐ No contraindications to surgery, anesthesia and artificial pneumoperitoneum. ☐ The patients were in good conditions with an ECOG score of 0-1.

exclusion criteria

☐Ages>75 years old with high risk of induction of anesthesia; ☐Patients with severe medical and surgical basic diseases, coagulation dysfunction or receiving therapeutic anticoagulants; ☐Active period of acute infection; ☐A history of secondary abdominal surgery; ☐Patients with suspected multiple tumor metastases; ☐Obese patients (BMI>35kg/m²); ☐Received radiotherapy or chemotherapy in the past; ☐Type ☐ endometrial cancer; ☐Other medical or psychological diseases that cannot cooperate to complete this research.

Grouping methods

This study was grouped by surgical method, and SMD (standardized difference) was used to verify the matching effect. The patients in the single port laparoscopic group and the multi-port laparoscopic group were matched and grouped according to 1:2. Different surgical methods were used as the dependent variables. Age, body mass index, menopause, gravity and parity, neoadjuvant chemotherapy, tumor tissue grade, surgical methods of hysterectomy, pelvic lymph node dissection, and para-aortic lymph node dissection were used as covariates. After matched grouping, there were 31 cases in the single port laparoscopic group and 62 cases in the multi-port laparoscopic group. In order to reduce the bias caused by different covariates, the SMD of each variable was calculated, such as SMD<0.2, indicating that the equilibrium distribution of covariates among the groups. All cases were supervised by the ethics committee of Guangxi Medical University Affiliated Cancer Hospital.

Administration in perioperative period

The candidates were administrated in accordance with the ERAS concept. ☐ All patients underwent preoperative examinations. And the gynecologists, anesthesiologists and nurses communicated with the patients before the operation about treatment methods and relieved their anxiety. ☐ No fasting food and liquid before the operation, 800ml orally took maltodextrin fructose drinks at 24:00 am last night before the surgery, and 400ml orally took maltodextrin fructose drinks at 6:00am in the surgery morning. ☐Preoperative skin preparation and preoperative antibiotics were used to clean contaminated incisions (class II incisions) and preventive use of antibiotics (conventional use of cefazolin sodium pentahydrate 2g combined with ornidazole 0.5g) with intravenous infusion 30min to 1h before skin incision. If the surgery time was more than 3 hours or exceeded twice the half-life of antibiotics or the intraoperative blood loss exceeded 1500ml, the administration should be repeated. ☐ Intravenous short-acting

anesthetics were applied during the surgery. Keeping a warm environment, raising the temperature of operating room and using a thermal insulation blanket to keep the body temperature at about 36.5 degrees, the incision was infiltrated and anesthetized with local anesthetics after surgery. Besides, the amount of fluid input was control to prevent excessive fluid. ¶ Returning to liquid diet as soon as possible after the surgery. The gastrointestinal function assessment performed by the physician in charge at least three times a day and adjusted diet according to the assessment. Routine analgesia and antiemetic treatment were given after the surgery, and early out-of-bed activity was encouraged. According to the patient's postoperative recovery, the drainage tube and catheter should be removed as soon as possible. ¶The basic discharge standards included being engaged in a semi-liquid diet,, wounds healing well without signs of infection, pain relieving merely by oral painkillers and moving freely.

Surgery methods

All candidates received extrafascial hysterectomy, adnexectomy and pelvic and paraaortic lymphadenectomy.

Evaluation

Intraoperation evaluation

Intraoperation conditions

¶ Surgery time; ¶ intraoperative blood loss; ¶ intraoperative fluid infusion;¶ intraoperative blood transfusion rate;¶ decrease in hemoglobin after the operation;¶ number of lymph nodes resection.

Intraoperation complications

¶ Obturator nerve injury; ¶injury to nearby organs during surgery, including intestine, bladder, and ureter during surgery; ¶vascular damage needing repair.

Postoperative evaluation

Rapid rehabilitation evaluation

¶ Postoperative hospitalization days; ¶ postoperative urinary catheter indwelling time; ¶ recovery of gastrointestinal function; ¶ abdominal drainage tube indwelling time; ¶ postoperative incision pain scores were all based on the international standard Visual Analog Scale (Visual Analog Scale, VAS). The degree of pain is represented by 11 numbers from 0 to 10, 0 means no pain, and 10 represents the most painful. The patients choose one of the 11 numbers from 0-10 to represent the degree of pain according to her own pain level and records it (table1).

Table1.Visual analog scale	
scores	Pain levels
0	No pain
1-3	A slight pain and can be tolerate
4-6	The pain affects sleep and should be treated
7-10	Severe or unbearable pain

Postoperative complications

⊠ Postoperative incisional hernia;⊠ Incision infection; ⊠ Intestinal obstruction;⊠ Pelvic infection;⊠ Thrombus;⊠ Urinary tract infection;⊠ Lymphatic leakage.

Cosmetic effects

Three months after the surgery, the patients were followed up by telephone for their satisfaction with the cosmetic result of the abdominal wall wound. The score corresponds to satisfaction (table 2).

Table2. Satisfaction scale				
Very unsatisfied	Unsatisfied	Medium	Satisfied	Very satisfied
1	2	3	4	5

Quality of Life

The quality of life was assessed using the Health Survey Brief Table (SF-36), which included physiological functions, physiological functions, physical diseases, general health conditions, energy, social functions, emotional functions, mental health, etc., each with a full score of 100 points, The higher the score, the better the quality of life.

Survival analysis

Mortality, recurrence rate, overall survival (OS: the time interval from the beginning of treatment to death or the end of follow-up) and disease-free survival (DFS: the beginning of treatment to recurrence of the disease or the patient due to progression) time of death).

Follow up

All patients were followed up in outpatient clinics and telephone with every 3 months in the first and second years after surgery. The main follow-up contents included gynecological physical examination, abdominal and pelvic imaging examination, and related laboratory examinations of tumor biomarkers to decide whether to perform chest, abdomen, and pelvic CT further. From the third year, the follow-up would

be conducted every six months. And from the fourth year on, the follow-up would be conducted once a year.

Statistical analysis

SPSS22.0 statistical software was used for statistical analysis. If the measurement data obeys the normal distribution or approximately accorded with normal distribution, the mean $\pm$ standard deviation was used to describe the data and the independent sample t test was used for the comparison between groups. While the measurement data was consistent with the skewness distribution, the median (interquartile) number interval to describe the data, and the Wilcoxon test was used for comparison between groups. Categorical data was described by percentages, and comparison between groups is by chi-square test or Fisher's test. The p value less than 0.05 was considered to be significant. SMD (standardized difference) was used to verify the balance of general data that $SMD < 0.2$ indicating the ideal matching effect. And the smaller the SMD, the better the balance between groups.

Survival analysis was performed by R 3.6.1 software (<https://www.r-project.org/>). The Kaplan-Meier method was used to compare OS between groups. The Cox proportional hazard regression model was used to analyze the relationship between surgical methods and OS and PFS, and the hazard ratio (HR) and its corresponding 95% confidence interval (CI) were calculated. The p value less than 0.05 was considered to be significant.

Results

Clinical characteristics

All clinical characteristics of single port and multiple-port laparoscopy groups were balance and comparable (table 3).

Table 3 Comparison of general clinical data between the two groups					
	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	t/χ ²	P	SMD
age	50.94±7.60	54.18±7.49	-1.959	0.053	
Age ranges			0.134	0.714	0.129
>53	14 (45.2%)	32 (51.6%)			
<51	17 (54.8%)	30 (48.4%)			
menopause			0.447	0.504	0.196
Yes	16 (51.6%)	38 (61.3%)			
no	15 (48.4%)	24 (38.7%)			
Gravidity			0.459	0.498	0.201
0-1	21 (67.7%)	36 (58.1%)			
>3	10 (32.3%)	26 (41.9%)			

Intraoperation

The single port group was compared with the multiple-port group in terms of operation time, intraoperative blood loss, intraoperative fluid infusion, and intraoperative blood transfusion rate. The differences were statistically significant ($P \leq 0.05$). However, the change of hemoglobin in the single port group before and after the surgery, the number of pelvic and para-aortic lymph nodes resection, intraoperative complications were no significantly different. See Table 4.

Table 4 Comparison of surgical procedures between two groups

	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	t/X ² /Z	P
Surgery time min	283.00 (251.00-322.00)	180.00 (149.25-235.00)	1676.500	<0.001
Blood loss ml	100.00 (50.00-200.00)	90.00 (50.00-150.00)	1199.000	0.044
Change of hemoglobin g/l	13.00 (7.50-17.50)	17.00 (10.00-21.75)	746.500	0.080
infusion volume ml	2400.00 (1975.00-2800.00)	1900.00 (1700.00-2562.50)	1272.500	0.011
Transfusion rate %	0%	1.61%	16.25	0.000
Number of pelvic lymph nodes	13.39±7.36	14.05±7.64	2.778	0.0656
Number of para-aortic nodes	3.00 (0.50, 5.50)	4.00 (2.00, 7.00)	774.500	0.125
Intraoperative complications	2 6.45%	3 4.84%	1.35	0.770

Post operation

ERAS

The postoperative conditions of single port laparoscopic group were significantly better than the multi-port laparoscopic group. The time of water and food intake, flatus, urinary catheter and abdominal drainage tube indwelling, hospital stay were significantly shorter in single port laparoscopic group. And pain score for 24 hours after surgery group was lower in single port laparoscopic group (Table 5).

Table5 Comparison of postoperative recovery in two groups

	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	t	p
Water intake time [hour]	5.94±1.46	15.69±3.28	15.74	<0.001
Fluid food intake time [hour]	7.45±1.57	16.92±3.15	15.76	<0.001
exhaust time (day)	2.03±1.44	2.33±0.84	1.66	<0.001
Out of bed activity [day]	1.68±0.79	3.00±0.80	7.55	<0.001
Catheter indwelling time (day)	1.84±1.73	2.87±1.86	64.78	<0.000
drainage tube indwelling time (day)	4.00±2.28	4.89±3.36	6.118	0.0028
Hospital days (day)	8.29±3.12	8.86±2.92	25.01	<0.0001
Pain level scores after surgery 24h	1.32±0.91	3.24±1.44	77.22	0.000

Complications

There was 1 case of pelvic infection in the single port laparoscopic group. While there were 4 cases suffering complications in the multi-port laparoscopic group, including 2 cases of intestinal obstruction, 1 case of lymphatic leakage, and 1 case of urinary tract infection. But there was no significant difference between two groups in terms of the incidence of postoperative complications.

Cosmetic effect of incision

Transumbilical single port laparoscopic surgery took advantage of the skin folds of the umbilical to conceal the incision to the greatest extent. The appearance of the umbilical restored to the preoperative state in 3 months after the surgery, as shown in Figure 1 and Figure 2. Patients in the single port group were more satisfied with the cosmetic effect of the postoperative incision (Table 6).

Table 6 : comparison of postoperative cosmetic effects between tow groups

groups	cases	Very unsatisfied	unsatisfied	medium	satisfied	Very satisfied	$\bar{x} \pm S$
Single port laparoscopic group	31	0	0	9	32	100	4.55±0.68
Multit- port laparoscopic group	62	0	10	72	92	50	3.61±0.86
t	-						38.24
P	-						0.000

Postoperative life quality

The physical function, physical pain and vitality of the single port laparoscopic group were significantly better than that of the multi-port laparoscopic group. But there was no significant difference in physical roles, general health status, social function, emotional roles, and mental health between the two groups, see Table 7.

Table 7 Comparison of life quality between two groups

life quality	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	t	p
Body function	92.42±4.45	90.08±3.68	2.69	0.008
Body roles	83.06±23.62	81.85±15.79	0.29	0.77
Pain	95.56±6.08	87.50±11.09	3.77	0.000
General condition	82.97±7.75	81.44±6.06	0.99	0.32
vitality	85.32±5.47	82.34±6.25	2.26	0.02
social function	82.66±10.04	81.45±18.21	0.34	0.73
emotional roles	91.40±22.72	87.10±22.87	0.86	0.39
mental health	83.87±7.48	80.97±6.94	1.85	0.07

The influence of prognosis among different surgery methods

Based on the above prospective randomized controlled study (31 cases in the single port laparoscopic group and 62 cases in the multi-port laparoscopic group), combining with 62 cases of open surgeries for type I endometrial cancer stage I from April 2011 to June 2018, a comparative survival analysis was performed.

clinical data

Comparing the general information of the patients, there was no significant difference in age, pregnancy, menopause, BMI, pelvic lymph node dissection, and para-aortic lymph node dissection among the three groups ($P>0.05$); while the three groups of patients had significant differences in stages and differentiation ($P<0.05$). The three groups of patients had a good balance in terms of age, pregnancy and childbirth, and para-aortic lymph node dissection, with $SMD<0.2$; but the balance of variables such as BMI, FIGO staging, and tumor differentiation slightly worse with $SMD>0.2$. So, the multivariate COX regression models analysis were conducted to control the influence of confounding factors (Table 8).

Table8.Comparison of general features among three groups of patients					
	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	Open surgery(n=62)	P	SMD
age	50.94±7.60	54.18±7.49	53.19±6.09	0.111	
Age ranges				0.551	0.130
>53	14 (45.2%)	32 (51.6%)	26 (41.9%)		
≤6	17 (54.8%)	30 (48.4%)	36 (58.1%)		
Menopause				0.623	0.131
Yes	16 (51.6%)	38 (61.3%)	34 (54.8%)		
No	15 (48.4%)	24 (38.7%)	28 (45.2%)		
gravidity				0.470	0.134
≤2	21 (67.7%)	36 (58.1%)	42 (67.7%)		
>3	10 (32.3%)	26 (41.9%)	20 (32.3%)		
Parity				0.593	0.152
≤1	25 (80.6%)	44 (71.0%)	45 (72.6%)		
>2	6 (19.4%)	18 (29.0%)	17 (27.4%)		
BMI	23.87±4.02	24.51±3.07	23.31±3.86	0.179	0.223
FIGO stages				0.013	0.363
IA	24 (77.4%)	54 (87.1%)	40 (64.5%)		
IB	7 (22.6%)	8 (12.9%)	22 (35.5%)		
Hemoglobin before treatment	114.68±15.33	122.81±14.74	113.31±23.42	0.008	
Pelvic lymph nodes resection				0.114	0.244
Yes	29 (93.5%)	54 (87.1%)	60 (96.8%)		
No	2 (6.5%)	8 (12.9%)	2 (3.2%)		
Para- aortic lymph nodes resection				0.583	0.120
Yes	23 (74.2%)	42 (67.7%)	47 (75.8%)		
No	8 (25.8%)	20 (32.3%)	15 (24.2%)		

Differentiation grades				0.020	0.390
Low grade	29 (93.5%)	54 (87.1%)	45 (72.6%)		
High grade	2 (6.5%)	8 (12.9%)	17 (27.4%)		
Number of Pelvic lymph nodes resection	13.84±6.99	14.05±7.64	17.23±6.51	0.022	0.352
Number of lymph nodes resection	3.00 (1.00, 6.00)	4.00 (2.00, 7.00)	3.00 (2.00, 5.75)	0.256	0.325
Postoperative adjunctive therapy				0.815	0.105
No	22 (71.0%)	42 (67.7%)	40 (64.5%)		
Yes	9 (29.0%)	20 (32.3%)	22 (35.5%)		
Complications				0.729	0.121
Yes	4 (12.9%)	7 (11.3%)	10 (16.1%)		
No	27 (87.1%)	55 (88.7%)	52 (83.9%)		

follow-up

The median follow-up time in the single port laparoscopic group was 13 months, and 1 case died and 2 cases recurred. While the median follow-up time in the multi-port laparoscopic group was 20 months, 2 cases died, and 2 cases recurred. And the median follow-up time in the open surgery group was 66 months a total of 7 cases died and 4 cases recurred. The mortality and recurrence rate among three groups was no significantly different (Table 9).

Table 9. comparison of mortality and recurrence rate of patients in three groups				
	Single port laparoscopic group (n=31)	Multi-port laparoscopic group (n=62)	Open surgery(n=62)	P
Death	1 (3.2%)	2 (3.2%)	7 (11.3%)	0.165
recurrence	2 (6.5%)	2 (3.2%)	4 (6.5%)	0.713

Comparison of OS and DFS

The 1-year OS of patients in single port, multiple-port laparoscopic groups, and open surgery group were 96.8%, 98.4%, and 91.5%, respectively. There was no significant difference among the groups (P=0.941), as shown in Figure 3A. The 1-year DFS of patients in single port, multiple-port laparoscopic groups, and

open surgery group were 93.5%, 94.7%, and 91.7%, respectively, and there was no significant difference among the groups ($P=0.759$), as shown in Figure 3B.

The relationship of surgery methods and prognosis

The univariate Cox regression (Model 1) analysis showed that there was no statistically significant difference in death risk and recurrence risk among single port, multiple-port laparoscopic groups and open surgery group ($P>0.05$). Furthermore, age, menopause, gravidity, parity, BMI, FIGO staging, hemoglobin before treatment, abdominal para-aortic lymph nodes, highest tumor grade, number of pelvic lymph nodes removed, number of abdominal para-aortic lymph nodes resection, postoperative complications and other factors were controlled (Model 2), compared with multi-port laparoscopic and open surgery, the risk of death and recurrence of multi-port laparoscopic group was still not significant ($P>0.05$), indicating that the surgical method was no related to OS and DFS, see Table 10.

Table10 relationship between surgical methods in OS and DFS				
	OS		DFS	
	HR (95% CI)	P	HR (95% CI)	P
Model 1				
Single port laparoscopic group	1.00		1.00	
Multi-port laparoscopic group	0.70 (0.06-8.03)	0.772	0.52 (0.08-3.22)	0.484
Open surgery	0.90 (0.09-9.22)	0.932	0.57 (0.10-3.34)	0.530
Model 2				
Single port laparoscopic group	1.00		1.00	
Multi-port laparoscopic group	0.51 (0.03-7.48)	0.621	0.38 (0.05-2.76)	0.339
Open surgery	0.68 (0.05-8.45)	0.762	0.41 (0.06-3.04)	0.384

Discussion

Safety, feasibility and cometic effect

Single port laparoscopic technology is a new emerging technology. The surgery is completed through a single incision. It has the advantages of small wounds, less damage, and concealed scars. It is also called no-scar surgery. Single port laparoscopic surgery is used in many fields of gynecology, ranging from benign lesions to malignant tumors. Single port laparoscopic surgery for endometrial cancer began in 2009. Fader et al. ^[7] first reported a comprehensive staging operation for endometrial cancer under LESS. It is believed that single port laparoscopic surgery is safe and feasible in the treatment of gynecological malignant tumors

This study selected 93 patients with type I endometrial cancer stage I for a prospective randomized controlled study to compare the clinical effects of single port laparoscopy and multiple-port laparoscopy. The results showed that compared with the multiple-port laparoscopic group, the differences of medium transfusion volume and intraoperative blood transfusion rate were significantly different in single port laparoscopic group ($P < 0.05$). Although the intraoperative blood loss of the single port laparoscopic group was slightly more than that of multiple-port laparoscopic group (100ml vs 90ml) ($P = 0.044$), the intraoperative blood transfusion rate was lower than that of the multiple-port laparoscopic group (0% vs 1.61%) ($P = 0.000$). It resulted that the change of hemoglobin before and after the surgery was not significantly different between single port and multi-port laparoscopic groups ($P > 0.05$). Meanwhile, the intraoperative and postoperative complications did not increase in single port laparoscopic group, which was consistent with the research conducted by Chambers^[8], verifying the safety and feasibility of single port laparoscopy technology in full staging surgery of endometrial carcinoma. However, the surgery time of the single port laparoscopic group (283min) was significantly longer than that of the multi-port laparoscopic group (180min) ($P = 0.001$), so the intraoperative fluid infusion volume (2400ml) of the single port laparoscopic group was significantly more than that of the multi-port laparoscopic group (1900ml) ($P = 0.011$). This might be due to the lack of experiences. Although our team had carried out multi-port laparoscopic gynecological malignant tumor surgery for many years, it was in the year of 2018 that the single port laparoscopic endometrial cancer staging surgery was carried out. In 2017, Barnes et al.^[9] retrospectively analyzed 110 cases of single port laparoscopic endometrial cancer comprehensive staging surgeries, and compared the last 30 cases with the first 20 cases in the study cohort. The results indicated that after the first 20 surgeries, the surgeries time, intraoperative blood loss and complication rate decreased significantly. Moreover, the limitations of the equipment that the unique "chopsticks effect" of single port laparoscopy contributed to longer surgery time at some extent^[10,11]. Generally, the application of conventional laparoscopic surgical instruments was difficult in single port laparoscopy, which leads to prolonged surgery time. If we made improvements to the equipment, the lens could be replaced with a smaller one, and the instrument could be replaced with a long or short instruments, which were able to reduce the difficulty of the surgery and shorten the surgery time.

In addition, the number of lymph node dissection is an important indicator to evaluate the effect of surgery, and the surgery of endometrial cancer includes pelvic lymph node dissection±para-aortic lymph node dissection. The effect of different surgical methods can be evaluated by counting the number of lymph nodes. There was no statistically significant difference between the pelvic lymph nodes (13.39 ± 7.36 vs 14.05 ± 7.64) and para-aortic lymph nodes ($3.00 (0.50, 5.50)$ vs $4.00 (2.00, 7.00)$) dissected in the single port laparoscopic group and the porous group ($P > 0.05$), suggesting that single-port laparoscopic surgery can also achieve the effect of multi-port laparoscopic surgery in cleaning lymph nodes.

In 2012, Fagotti et al.^[12] retrospectively analyzed 100 patients with endometrial cancer undergoing single port laparoscopic surgery. The mean of pelvic lymph node dissections was 16 (1-33), which was similar to the results of this study. Although there is no significant difference in the dissection of the lymph

nodes adjacent to the abdominal aorta, the number of lymph nodes was relatively less. These were likely caused by the position of the para-aortic lymph nodes was higher, and the laparoscopic exposure was not enough, especially for some obese patients, resulting more difficult to clean the para-aortic lymph nodes. Besides, proficiency in surgical technique exerted a certain influence. With the improvement of surgical skills and the proficiency in the application of single-port instruments, the number of lymph nodes dissected by single-port laparoscopic surgery in the abdominal aortic lymph node dissection will increase, which is similar to the domestic case report of Sun Dawei^[13].

In terms of cosmetic effects, the transumbilical single port laparoscope uses a 1.5-3cm incision in the natural recess of the umbilical channel as the surgical approach. The postoperative incision was sutured with absorbable sutures, and the umbilical skin folds could be maximized. Compared with the multiple-port laparoscopic group, the patient satisfaction is significantly improved.

Application of ERAS in single port laparoscopic endometrial staging surgery

Although there are no obvious requirements for minimally invasive surgical incisions in the rapid rehabilitation (ERAS) surgical concept, transumbilical single port laparoscopic surgery (LESS) has only one incision on the abdominal wall with a smaller incision than that of multi-port laparoscopic surgery. If combined with perioperative ERAS, patients should benefit more. Although there is few research on LESS combined with ERAS at home and abroad, the development of colorectal and other surgery has become mature.

In 2012, Ge Haiying et al.^[14] published a case analysis of 5 patients with rectal cancer combining ERAS with single port laparoscopy. The 5 patients had little postoperative pain, the postoperative hospital stay was 6 days, and there were no surgery complications. No recurrence or metastasis was found during the 12-month follow-up. In 2016, Chapman et al.^[15] used a retrospective case-control study to take laparoscopic or robot-assisted gynecological tumor surgery patients who received ERAS perioperative management and care as the research subjects. The analysis found that who received minimally invasive surgery (laparoscopic or laparoscopic surgery or robot-assisted surgery) for gynecological cancer patients recover faster. The implementation of the ERAS route during the perioperative period can shorten the recovery time and reduce overall hospitalization costs, immune function damage, and damage to inflammatory factors^[16].

According to the previous studies, LESS combined with ERAS can shorten the postoperative recovery time of patients. For the patients with gynecological malignant tumors, rapid postoperative recovery is conducive to early implementation of postoperative adjuvant treatment. In the comprehensive staging surgery of endometrial cancer, domestic and foreign literature believed that traditional endoscopic technology combined with ERAS was safer and more effective^[17,18]. But there were few studies related to LESS combined with ERAS. In this study, the results suggested that single port laparoscopic combined with ERAS group patients recovered better than that of multi-port laparoscopic combined with ERAS group. In general, single port laparoscopy combined with ERAS can not only promote the recovery of

patients after surgery, shorten the hospital stay, but also relieve wound pain. Also, this study conducted a survey of the quality of life of SF-36 in patients 3 months after surgery. The scores of each index of the two groups of patients were above 80 points, indicating that the quality of life after laparoscopy combined with ERAS was ideal for both single port and multi-port laparoscopic groups. The scores of physical function, physical pain, and vitality of the single port laparoscopic group are higher than those of the multi-port laparoscopic group, indicating that the single port combined with ERAS has more advantages in the quality of life of patients after surgery.

The influence of surgical methods on the prognosis of endometrial cancer

There are many factors that affect the prognosis of endometrial cancer, but whether the choice of surgical methods will affect the prognosis has always been a hotspot. Janda et al. ^[19] conducted a study on 760 patients with stage I endometrioid carcinoma, 407 cases of laparoscopic staging surgery, 353 cases of open surgery, and the results showed that compared with open surgery, there was no difference in disease-free survival period and overall survival. Stefano et al. ^[20] conducted a retrospective analysis of 1012 endometrial cancer patients in 6 medical centers in Italy and found that in patients with stage I endometrioid cancer, the total number of patients in the laparoscopic surgery group and the open surgery group had no difference in overall survival and disease-free survival. It is considered that laparoscopic surgery is safe and feasible in stage I endometrial cancer surgery.

This study was based on a prospective randomized controlled study (31 cases in the single port laparoscopic group and 62 cases in the porous group), combined with 62 patients with type I endometrial cancer stage I who had undergone open surgery for survival analysis. The 1-year overall survival of patients with single port, multi-port laparoscopic groups and open surgery group were 96.8%, 98.4%, and 91.5%, respectively, but there was no significant difference among the groups, so were the disease-free survival and overall survival. Subsequent univariate and multivariate COX regression analysis showed that the surgical method was not associated with DFS and OS, indicating that the surgical method was not an independent risk factor affecting the prognosis of endometrial cancer, and laparoscopic surgery would not increase the risk of prognosis, which was consistent with those reported in the literature.

In summary, single port laparoscopic surgery for stage I endometrial cancer staging is safe and feasible, and the cosmetic effect is satisfactory. ERAS technology combined with single-port laparoscopic endometrial cancer staging surgery has obvious advantages in the perioperative period. At the same time, it was confirmed that the single port laparoscopic technique did not affect the prognosis of endometrial cancer. However, this study was a single-center study, and the sample size was small, and the follow-up time was not long enough, which might have a certain impact on the results. In the future, multi-center prospective studies should be carried out to make the observation time can be extended to make the results more convincing.

Abbreviations

EC Endometrial cancer

ERAS enhanced recovery after surgery

FIGO The International Federation of Gynecology and Obstetrics

CI confidence interval

HR Hazard ratio

NOS Newcastle-Ottawa Scale Newcastle-Ottawa

OS overall survival

DFS disease-free survival

BMI Body Mass Index

Declarations

Ethics approval and consent to participate

This retrospective study protocol was approved by the Ethics Committee of Guangxi Medical University affiliated Cancer Hospital. Of note, the requirement to obtain informed consent was waived because of the retrospective nature of this study, and all sensitive information, including the identification of patients, medical institutions, and medical practitioners, was made anonymous.

Consent for publication

I understand that the information will be published without my/my child or ward's/my relative's name attached, but that full anonymity cannot be guaranteed.

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

The authors declare that they have no competing interests.

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Authors' contributions

Li Li acted as the guarantor of this study and conceived the idea. Zhifu Cai and Mengjie Chen collected the data and wrote this paper. He Wang performed statistical analysis and performed manuscript editing. All authors have read and approved the manuscript.

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Figures

Figure 1

postoperative abdominal incision(left)

Figure 2

abdominal incision (3 months after surgery)

Figure 3

survival curves A. comparison of OS among three groups B. comparison of DFS among three groups