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ORIGINAL ARTICLE

Retrospective Cohort Study

Total mesorectal excision for mid and low rectal cancer: Laparoscopic *vs* robotic surgery

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Abstract

AIM: To compare the short- and long-term outcomes of laparoscopic and robotic surgery for middle and low rectal cancer.

METHODS: This is a retrospective study on a prospectively collected database containing 111 patients who underwent minimally invasive rectal resection with total mesorectal excision (TME) with curative intent between January 2008 and December 2014 (robot, *n* = 53; laparoscopy, *n* = 58). The patients all had a diagnosis of middle and low rectal adenocarcinoma with stage Ⅰ-Ⅲ disease. The median follow-up period was 37.4 mo. Perioperative results, morbidity a pathological data were evaluated and compared. The 3-year overall survival and disease-free survival rates were calculated and compared.

RESULTS: Patients were comparable in terms of preoperative and demographic parameters. The median surgery time was 192 min for laparoscopic TME (L-TME) and 342 min for robotic TME (R-TME) ($P < 0.001$). There were no differences found in the rates of conversion to open surgery and morbidity. The

patients who underwent laparoscopic surgery stayed in the hospital two days longer than the robotic group patients (8 d for L-TME and 6 d for R-TME, $P < 0.001$). The pathologic evaluation showed a higher number of harvested lymph nodes in the robotic group (18 for R-TME, 11 for L-TME, $P < 0.001$) and a shorter distal resection margin for laparoscopic patients (1.5 cm for L-TME, 2.5 cm for R-TME, $P < 0.001$). The three-year overall survival and disease-free survival rates were similar between groups.

CONCLUSION: Both L-TME and R-TME achieved acceptable clinical and oncologic outcomes. The robotic technique showed some advantages in rectal surgery that should be validated by further studies.

Key words: Robotic surgery; Laparoscopic surgery; Rectal cancer; Total mesorectal excision; Minimally invasive surgery

Core tip: The aim of this retrospective study was to compare the short- and long-term outcomes of 111 patients who underwent minimally invasive rectal resection with total mesorectal excision (TME) with curative intent. The median surgery time was shorter for laparoscopic TME while there were no differences found in the rates of conversion to open surgery and morbidity. The pathologic evaluation showed a higher number of harvested lymph nodes in the robotic group and a shorter distal resection margin for laparoscopic patients but the three-year overall survival and disease-free survival rates were similar between groups.

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INTRODUCTION

Several randomized clinical trials have shown the long-term oncologic results of laparoscopic versus open surgery for colorectal cancer[1-3]. The recently published long-term results of the COLOR II trial state that laparoscopic surgery in patients with rectal cancer produces similar rates of locoregional recurrence, 3-year disease-free survival and 3-year overall survival as open surgery[4]. However, technical difficulties associated with laparoscopic resection and the extensive training required to perform the operation have limited its dissemination outside specialized centres[5-7]. A robot-assisted approach could potentially overcome some of the limitations of conventional laparoscopic rectal surgery. A robotic system enables the surgeon to control a three dimensional, high-definition, 10-fold magnification vision steady camera. It provides wrist motion for endoscopic instruments (7 degrees of freedom, 180 degrees of articulation and 540 degrees of rotation). The motion scaling feature reduces physiological tremors, provides superior dexterity, and increases ergonomic comfort[8]. Therefore, robotic systems can overcome several of the technical difficulties associated with traditional laparoscopic surgery and allow high-quality manoeuvres to be performed in narrow spaces such as the pelvic cavity. The additional third arm instrument is a fixed retractor used to improve vision and stability in restricted spaces. Robot-assisted operations have been used for years in other surgical specialties. However, it was not until 2002 that Weber *et al*[9] reported the first two cases of robot-assisted colectomies. Several meta-analyses have been published and they demonstrate the scientific community's interest in this surgery[10-14]. The most relevant data resulting from these studies was that robotic surgery had reduced conversion to open surgery compared to the laparoscopic group. Additionally, the short-term clinical and oncologic outcomes were not significantly different between groups. The recently published 5-year results demonstrate that there are similar rates for overall survival, disease-free survival, and local recurrence between robotic and laparoscopic surgical procedures[15]. There are currently two ongoing multicentre randomized controlled trials comparing robotic versus laparoscopic surgery for rectal cancer: the ROLARR[16] and COLRAR[17] trials.

The aim of this study was to compare the feasibility and short-term and long-term outcomes of robotic surgery for middle and low rectal cancer with the results of conventional laparoscopic surgery in two different centres with high volume of colorectal minimally invasive surgery.

MATERIALS AND METHODS

Study population and patient selection

This is a retrospective study on a prospectively collected database containing 111 patients who underwent minimally invasive rectal resection with total mesorectal excision (TME) for curative intent. The patients all had a diagnosis of middle and low rectal adenocarcinoma (tumour located within 12 cm from the anal verge). The enrolled patients were from two Italian institutions; the Unit of General and Oncologic Surgery, Santo Stefano Hospital, Prato and the Unit of Minimally Invasive Surgery, Division of General and Laparoscopic Surgery, European Institute of Oncology, University of Milan. The Institutional Review Boards of both hospitals approved the study.

Patients considered for minimally invasive surgery were enrolled between January 1, 2008 and December

31, 2014. The exclusion criteria included emergency cases, patients with clinical T4 or metastatic disease, and those with contraindication for prolonged pneumoperitoneum. All surgeries were performed by the expert surgeons MS (Santo Stefano Hospital, Prato) and PPB (European Institute of Oncology, University of Milan). Both surgeons have performed more than 100 laparoscopic colorectal resections. The robotic resections were executed by a single surgeon (PPB).

Data collection and evaluation parameters

The preoperative data included the following: general patient characteristics, American Society of Anaesthesiologists (ASA) score, body mass index (BMI), previous neoadjuvant treatment, distance of the lesion from the anal verge, and tumour biomarkers.

The intraoperative data consisted of the following: surgical time including the docking of the robot, adjunct procedures, intraoperative complications, blood loss, ileostomy, and conversions to laparotomy.

The postoperative results included first bowel movement, hospital length of stay, postoperative surgical and non-surgical complications, and need for revision surgery. The postoperative complications were defined as adverse events that occurred within 30 d after surgery. All of the complications were diagnosed and categorized according to patient's symptoms with the aid of laboratory and radiological evaluation to confirm clinical suspicions. The diagnosis of anastomotic leakage was based on clinical suspicion and required contrast radiography (radiograph or computed tomographic scan) or surgery to confirm the diagnosis. The signs of clinical leakage included abdominal pain or fever, discharge of pus or bowel contents through the indwelling drain, and local or generalized peritonitis. The total numbers of postoperative complications were counted for all cases related to morbidity. The postoperative surgical complications were also stratified by the Clavien-Dindo classification[18].

The tumour-node-metastasis (TNM) stage, resection margins, numbers of harvested lymph nodes, lymphovascular invasion, and circumferential resection margin (CRM) were evaluated for analysis of the pathologic outcomes. The involved CRM was defined when the tumour was located 1 mm or less from the CRM[19]. The pathologic analyses conducted after 2010 used the criteria of the American Joint Committee on Cancer seventh edition[20]. TNM stages evaluated before 2010[21] have been reviewed according to the newest edition.

All patients undergoing surgery were registered in our database and received close follow-up. We calculated the 3-year overall survival and disease-free survival rates. A local recurrence was defined as the relapse of the tumour at the primary site confirmed by radiological or histological evidence. Simultaneous local and systemic recurrences were counted as a local recurrence. A distant metastasis was considered a metastatic lesion diagnosed in other organs beyond the primary site.

Clinical management

The preoperative patient work-up included a colonoscopy with biopsy, standard blood testing, thoracic-abdominal computed tomography (CT), transrectal ultrasonography (US), and pelvic magnetic resonance imaging (MRI) if necessary. For locally advanced disease (clinical stage T3 N0 or any T N+) that was confirmed by MRI and/or US we considered neoadjuvant CRT. After neoadjuvant therapy, the patients received a thoracic-abdominal CT for restaging. A radical surgical treatment was proposed in all cases, including the patients with a pathological complete response[22]. Surgery was performed 8 wk after the completion of RT, when tumour regression was maximal[23].

Total mesorectal excision was the standard procedure for middle and low rectal cancer. The surgical techniques were performed as described in previous reports[24,25]. The tumour height and the absence of direct tumour invasion into the levator ani muscle or sphincter muscle were the primary considerations for sphincter-preserving procedures. Both institutions applied similar fast-track protocols and similar discharge criteria for the perioperative management of colorectal surgical patients[26]. Neoadjuvant and adjuvant therapies were administered according to the Italian National Institute of Health recommendations and the most current NCCN guideline for rectal cancer[27]. The discharged patients received a physical examination and tumour marker analysis at 1 mo, 3 mo, and then every 3 mo for the first 3 years. The patients were then evaluated every 6 mo until 5 years after surgery. Each patient was evaluated by colonoscopy at 1 year and 3 years after surgery and then every 5 years. We obtained chest and abdominopelvic computed tomography scans every 6 mo for the first 3 years. We then obtained scans every 12 mo until 5 years after surgery to detect local recurrence or systemic metastasis during the follow-up period.

Statistical analysis

The differences in clinically important baseline characteristics, intraoperative outcomes, short-term (30-d) postoperative outcomes and long-term (3-year) outcomes were compared between the laparoscopic and robotic cohorts. A univariate analysis was performed using the Mann-Whitney *U* test for continuous variables. The χ^2 test was used for categorical variables. A *P* values < 0.05 was considered statistically significance for all analyses and all tests were two-sided. The univariate results are reported as median (interquartile range) or frequency (percent).

Table 1 Patient characteristics *n* (%)

	L-TME (*n* = 58)	R-TME (*n* = 53)	*P* value
Age[1] (yr)	66 (33-80)	66 (42-84)	0.597
Sex			0.031
Male	42 (72.4)	27 (50.9)	
Female	16 (27.6)	26 (49.1)	
BMI[1] (kg/m^2)	24.6 (19-37)	24.6 (18-31)	0.512
ASA score			0.082
1	7 (12.1)	11 (20.8)	
2	31 (53.4)	33 (62.3)	
3	20 (34.5)	9 (16.9)	
Neoadjuvant therapy	25 (43.1)	26 (49.1)	0.571
Tumour location from anal verge[1] (cm)	8 (3-12)	8 (4-12)	0.607
CEA[1]	1.55 (0.6-51.6)	1.65 (0.5-11.1)	0.803
CA 19.9[1]	7.85 (0.8-241)	7.5 (2-905)	0.896

[1]Median (range). L-TME: Laparoscopic total mesorectal excision; R-TME: Robotic total mesorectal excision; BMI: Body mass index; ASA: American Society of Anesthesiologists.

The patient overall survival and disease free survival were calculated using the Kaplan-Meier method and were compared with the log-rank test. All data were analysed on an intention-to-treat basis. The data were tabulated using a Microsoft© Excel spreadsheet (Excel for Windows©; Microsoft Corporation, Redmond, WA, United States) and were processed with SPSS© 16.0 for Windows (SPSS, Chicago, IL, United States).

The overall survival for both groups was calculated as the interval from surgery to death and disease free survival was calculated as the interval from surgery to the first diagnosis of recurrence. Due to the current lack of a uniform consensus regarding the definition of conversion to laparotomic surgery, we defined a converted rectal resection as any interruption of the minimally invasive approach (laparoscopic or robotic) and subsequent use of a conventional abdominal incision for completion of the operation.

RESULTS

Patient characteristics

There were 58 laparoscopic rectal resections with TME (L-TME) and 53 robotic rectal resections with TME (R-TME).

There were no significant differences between groups for age and Body Mass Index. There were more males in the laparoscopic group ($P = 0.031$). The ASA score showed no significant differences between the laparoscopic and robotic patients and a score of 2 was the most common value in both groups. The groups were similar with respect to tumour location, preoperative presence of tumour markers, and rate of patients who underwent preoperative CRT (Table 1).

Perioperative clinical outcomes

The median surgical time was 342 min (range 249-536 min) in the R-TME group, which includes time spent for the docking of the robot. The median surgical time was 192 min (range 90-335 min) in the L-TME group ($P < 0.001$). A transanal mechanical end to end anastomosis was performed in all the robotic procedures and in 54 laparoscopic patients. There was a manual coloanal anastomosis executed in the remaining four L-TME cases. There were eight adjunct procedures in the laparoscopic group that included the following: one prolonged lysis of visceral adhesions, one cholecystectomy, two urologic procedures, one left adrenalectomy, two liver biopsies, and one resection of jejunal gastro intestinal stromal tumour. There were the following five adjunct procedures performed in the robotic surgery group: two hysterectomy and salpingo-oopherectomy, two cholecystectomies and one urologic procedure. There were no intraoperative complications in either group. There were no significant differences for intraoperative bleeding or diverting ileostomy. There was one conversion to laparotomy in the laparoscopic due to the presence of extensive visceral adhesions and there were two conversions in the robotic group ($P = 0.605$). The cause of conversion to laparotomy in both robotic procedures was the need to resect the anastomotic colon after the intraoperative identification of ischemia. The other robotic case was converted to conventional laparoscopy for the same reason. The day of first bowel movement, perioperative morbidity, and rate of revision surgery were similar between groups. However, patients who underwent laparoscopic surgery stayed at the hospital two days longer than the robotic group patients (8 d for L-TME and 6 d for R-TME, $P < 0.001$). There were no 30-d mortalities (Table 2).

Postoperative pathologic assessment

The tumour stage distribution and lymphovascular invasion did not differ between groups. The factors indicating the mesorectal excision quality such as invasion of distal resection margin (DRM) and positivity of CRM were not significantly different. The CRM was less than 1 mm in one laparoscopic patient ($P = 0.523$) and the DRM was involved in one laparoscopic and one robotic patient ($P = 0.729$). The median number of harvested nodes was 11 (range 3-27) in the laparoscopic group and 18 (range 4-49) in the robotic group ($P < 0.001$). The median length of DRM was 1.5 cm (range 0.5-5 cm) for the L-TME and 2.5 cm (range 0.5-10 cm) cm for the R-TME ($P < 0.001$). A pathological complete response after neoadjuvant therapy was observed in 6 (10.3%) laparoscopic patients and in 5 (9.4%) robotic cases ($P = 0.381$). Our results are comparable with data reported in a recent meta-analysis[22] (Table 3).

Oncologic long-term outcomes

The median follow-up period for all cases was 37.4 mo (range 2-85 mo). There were no patients lost to follow-up. There was no significant difference in the administration of adjuvant chemotherapy between

Table 2 Perioperative outcomes *n* (%)

	L-TME (*n* = 58)	R-TME (*n* = 53)	*P* value
Operative time[1] (min)	192 (90-335)	342 (249-536)	< 0.001
Anastomosis			0.120
Mechanical transanal	54 (93.1)	53 (100)	
Manual coloanal	4 (6.9)	0	
Adjunctive procedure	8 (13.8)	5 (9.4)	0.562
Diverting ileostomy	43 (74.1)	41 (77.4)	0.825
Intraoperative blood loss[2] (mL)	47.4 (0-400)	60.8 (0-400)	0.510
Conversion to laparotomy	1 (1.7)	2 (3.8)	0.605
Hospital stay[1] (d)	8 (5-53)	6 (3-17)	< 0.001
First bowel movement[1] (postoperative day)	1 (1-6)	1 (1-6)	0.904
Total morbidity	26 (44.8)	17 (32.1)	0.122
Surgical morbidity			
Anastomotic leak	8 (13.8)	3 (5.7)	0.208
Peritoneal haemorrhage	2 (3.4)	1 (1.9)	0.534
Stomal stricture	3 (5.2)	1 (1.9)	0.620
Wound infection	2 (3.4)	0	0.496
Ileus	4 (6.8)	3 (5.7)	0.551
Abdominal pain[3]	2 (3.4)	3 (5.7)	0.457
Other surgical complications	5 (8.6)	3 (5.7)	0.410
Non surgical morbidity	11 (19.0)	6 (11.4)	0.302
Reoperation	8 (13.8)	3 (5.7)	0.208
Clavien-Dindo Classification			0.297
0	32 (55.2)	36 (67.9)	
1	9 (15.5)	5 (9.4)	
2	7 (12.1)	8 (15.1)	
3a	2 (3.4)	1 (1.9)	
3b	4 (6.8)	3 (5.7)	
4a	2 (3.4)	0	
4b	2 (3.4)	0	

[1]Median (range); [2]Mean (range); [3]Without other causes. L-TME: Laparoscopic total mesorectal excision; R-TME: Robotic total mesorectal excision.

Table 3 Pathologic evaluation *n* (%)

	L-TME (*n* = 58)	R-TME (*n* = 53)	*P* value
TNM stage			0.716
Stage Ⅰ	28 (48.3)	22 (41.5)	
Stage Ⅱ	11 (19.0)	8 (15.1)	
Stage Ⅲ	13 (22.4)	18 (34.0)	
Pathological complete response	6 (10.3)	5 (9.4)	0.381
Total harvested lymph nodes[1]	11 (3-27)	18 (4-49)	< 0.001
DRM[1] (cm)	1.5 (0.5-5)	2.5 (0.5-10)	< 0.001
DRM			0.729
Involved	1 (1.7)	1 (1.9)	
Non involved	57 (98.3)	52 (98.1)	
CRM			0.523
Involved	1 (1.7)	0	
Non involved	57 (98.3)	53 (100)	
Lymphovascular invasion	10 (17.2)	5 (9.4)	0.087

[1]Median (range). L-TME: Laparoscopic total mesorectal excision; R-TME: Robotic total mesorectal excision; DRM: Distal resection margin; CRM: Circumferential resection margin.

Table 4 Long-term outcomes *n* (%)

	L-TME (*n* = 58)	R-TME (*n* = 53)	*P* value
Adjuvant chemotherapy	25 (43.1)	27 (50.9)	0.700
Distant recurrence	5 (8.6)	9 (17.0)	0.265
Local recurrence	3 (5.2)	1 (1.9)	0.618
Overall mortalit	6 (10.3)	5 (9.4)	0.564
Mortality for rectal cancer	4 (6.9)	4 (7.5)	0.491
3-yr overall survival (%)	90.0	90.2	0.956
3-yr disease-free survival (%)	83.4	79.2	0.268

L-TME: Laparoscopic total mesorectal excision; R-TME: Robotic total mesorectal excision.

groups. There were local recurrences observed in three laparoscopic patients (5.2%) and one robotic case (1.9%, *P* = 0.618). There were distant metastasis in nine R-TME cases (17%) and five L-TME cases (8.6%, *P* = 0.265). The overall patient mortality rate was 10.3% (6 patients) for the laparoscopic group and 9.4% (5 patients) for the robotic group (*P* = 0.564). There were four patient deaths in each group due to the primary diagnosis of rectal cancer. The remaining deaths occurred for other reasons (Table 4).

The 3-year overall survival rate (Figure 1A) was 90.2% in R-TME group and 90.0% in L-TME group (*P* = 0.956). The 3-year disease-free survival rate (Figure 1B) was 79.2% in R-TME and 83.4% in L-TME (*P* = 0.268). There was no mortality or tumour recurrence in patients achieving a pathological complete response after neoadjuvant therapy in either group.

DISCUSSION

In this study, the robotic and laparoscopic patients were comparable with respect to intraoperative, short-term, and long-term results.

Robotic resections required a longer median surgical time, as reported in other series[28]. However, the similar rates of diverting ileostomy reflect the confidence of the robotic surgeon.

Although there were no differences in postoperative morbidity, the length of hospital stay was longer in the laparoscopic group for unclear reasons. This result is consistent with data from a pilot randomized trial comparing laparoscopic and robotic TME[29].

Our evaluation of CRM positivity and DRM involvement parameters accessed the quality of mesorectal excision and showed no significant differences between robotic and laparoscopic procedures. These results are oncologically acceptable and comparable to other reports[30-32]. The evidence of a longer median DRM in the robotic group (2.5 cm for R-TME; 1.5 cm for L-TME; *P* < 0.001) may be the result of technical advantages of the robotic approach because it allows the surgeon to perform high-quality manoeuvres in narrow spaces such as the pelvic cavity. Despite this consideration, a median DRM of 1.5 cm in the laparoscopic group was adequate and did not compromise the oncological outcome[33-35].

The total number of harvested lymph nodes was higher for the robotic group and this finding contrasts previously reported data[10-13,36]. The lower median

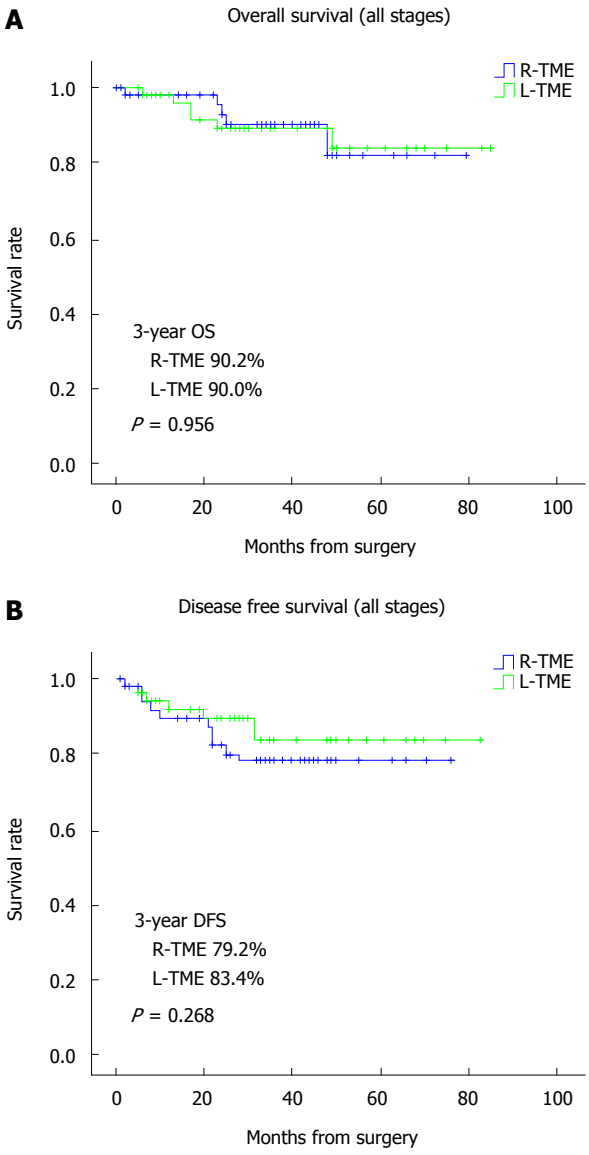

Figure 1 The 3-year overall (A) and disease-free (B) survival rate between robotic and laparoscopic total mesorectal excision surgical procedures. DTS: Disease-free survival; OS: Overall survival; L-TME: Laparoscopic total mesorectal excision; R-TME: Robotic total mesorectal excision.

number of resected lymph nodes for L-TME did not translate into higher rates of recurrence or mortality. This finding demonstrates the lymphadenectomy was accurate in both the laparoscopic and robotic procedures.

The 3-year survival rates of this study did not differ significantly between groups and is comparable with previously reported 3-year and 5-year outcomes[14,37-39].

The advantages of laparoscopic TME compared to the open approach have been examined in several studies[40-43]. The procedure has been described as oncologically safe and is associated with the standard benefits of minimally invasive techniques. Recent trials have reported long-term oncologic outcomes of laparoscopic TME and have shown survival rates similar to those obtained with open surgery[31,44-47]. The 3-year analysis of the CLASICC trial suggested there are improved outcomes for early stage rectal cancer excised laparoscopically compared with open surgery[48]. Despite these advantages, laparoscopic surgery for middle and low rectal cancers can be very challenging due to technical difficulties. Thus, the MRC CLASICC trial revealed high conversion rates, CRM involvement, and an increased incidence of urinary and sexual dysfunctions[49]. Although higher CRM infiltration did not result in increased local recurrence rates, the concerns regarding laparoscopic rectal cancer surgery led to decreased use in United Kingdom/ United States for rectal cancer[50,51]. The rate of conversion to open surgery is critical in minimally invasive rectal cancer surgery because the converted patients had higher complication rates than non- converted cases[45]. Additionally, one series reported the conversion patients had the worst oncological outcomes[52]. The COREAN trial revealed outcomes of the laparoscopic approach were comparable to open resection in middle and low rectal cancer after neoadjuvant therapy[53]. However, the low conversion rate of 1.5% and the excellent oncological outcomes achieved by a high volume skilled surgeon in low BMI patients may not be reproducible. All of the procedures in this trial have been performed by seven highly skilled laparoscopic specialists (each one performed more than 200 laparoscopic rectal resections). This suggests that excellent results in laparoscopic rectal cancer surgery can be achieved in expert surgeons. A recent study assessing the learning period for laparoscopic TME stated that 90 operations were required to achieve adequate oncological safety. However, fewer surgeries were needed to achieve operative safety[35].

Robot-assisted surgery may overcome several technical limitations of conventional laparoscopy such as a stable and high-definition 3D image, finer dissection with articulated tools, and better ergonomics for the surgeon. Several meta-analyses comparing robotic and laparoscopic TME[10-14] showed there was a lower percentage of conversion for robotic surgery. However, intraoperative reports indicate there are no significant differences in short-term and oncologic outcomes between the two approaches.

We did not evaluate the costs and preservation of genitourinary function in this study. One of the main concerns regarding robotic technology is the expense and maintenance of the equipment. Baek showed there are increased costs in robotic rectal resection compared to the standard laparoscopic procedure[54]. Conversely, recent studies have demonstrated a superiority of robotic rectal resection in recovery of urinary voiding and sexual function[55,56] due to improved visualization of the autonomic plexii in the pelvis. We are waiting for the results of the ROLARR and COLRAR trials to better define the optimal surgical approach in patients with advanced middle and low rectal cancer.

There are several aspects of our study that me-

rit discussion. First, the patients were assigned to robotic surgery or laparoscopy in an uncontrolled and nonrandomized manner, which is a limitation. However, to reduce the margin of error the data were obtained independently by two authors. Additionally, the retrospective nature of this study is a limitation. However, both surgical centres followed similar perioperative and oncological protocols. Therefore, clinical differences were reduced. Furthermore, this study was limited by its small sample size.

In conclusion, our observations suggest that L-TME and R-TME can be safely performed at high volume centres for rectal cancer. Both procedures achieve acceptable clinical and oncologic outcomes. Moreover, the robotic technique shows some advantages in rectal surgery that should be validated by further studies.

COMMENTS

Background

The short- and long-term outcomes of laparoscopic total mesorectal excision (L-TME) were found to be acceptable in previous reports. However, the benefits of the robotic approach for treatment of rectal cancer (R-TME) have not been clearly described.

Research frontiers

There were no differences found in the rates of conversion to open surgery and morbidity. The patients who underwent laparoscopic surgery stayed in the hospital two days longer than the robotic group patients (8 d or L-TME and 6 d for R-TME, $P < 0.001$). The pathologic evaluation showed a higher number of harvested lymph nodes in the robotic group (18 for R-TME; 11 for L-TME; $P < 0.001$) and a shorter distal resection margin for laparoscopic patients (1.5 cm for L-TME; 2.5 cm for R-TME; $P < 0.001$). The three-year overall survival and disease-free survival rates were similar between groups.

Innovations and breakthroughs

Both procedures achieved acceptable clinical and oncologic outcomes. Moreover, the robotic technique showed some advantages in rectal surgery that should be validated by further studies.

Applications

Author's observations suggested that L-TME and R-TME can be safely performed at high volume centres for rectal cancer.

Peer-review

This is a retrospective comparative study of a prospectively collected data of 111 patients who underwent minimally invasive TME (53 patients robotic assisted *vs* 58 patients laparoscopic assisted TME). The authors concluded that both techniques achieved acceptable similar clinical and oncologic outcomes. The manuscript is well written in clear English, and the authors addressed the study limitation such as the small study sample size, selection bias, and the retrospective nature of the study.

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