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RESEARCH ARTICLE

Approach of Colorectal Surgeons to Lower Rectal Adenocarcinomas: Results from the Turkish Society of Colon and Rectal Surgery Database

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ABSTRACT

Aim: This study aimed to analyze surgical preferences and outcomes among patients with lower rectal tumors in Türkiye using data from the national Colorectal Cancer Database of the Turkish Society of Colon and Rectal Surgery (TSCRS).

Method: A retrospective analysis was conducted on 158 patients with lower rectal tumors who underwent surgery between July 2018 and March 2022, with data prospectively collected from the TSCRS database. Variables included demographic characteristics, neoadjuvant therapy administration, surgical techniques, and postoperative outcomes.

Results: Among the 158 patients (mean age: 57.8 years; 58.2% men), 95.6% received neoadjuvant therapy. Approximately half the patients underwent open surgery, and the other half underwent minimally invasive surgery (MIS). The T-stage distribution differed significantly (p=0.009); early-stage cancers (stages I-II) were more frequently treated with MIS, whereas advanced stages (stages III-IV) were predominantly managed with open surgery. Conversion from laparoscopic to open surgery occurred in five patients (5.9%). Abdominoperineal resection was more common in patients who underwent open surgery. Hand-sewn anastomosis was performed more frequently in patients undergoing MIS. The operative time was longer for MIS than for open surgery (249±85 min vs. 169±52 min). The circumferential resection margin positivity rate was 3.2%, and tumor perforation occurred in 4.5% of cases.

Conclusion: The treatment of lower rectal cancer increasingly relies on a multidisciplinary approach integrating neoadjuvant therapies and diverse surgical techniques. Turkish surgeons adopt a tailored approach based on patient characteristics, leading to similar adoption rates for both surgical techniques. These findings highlight the dynamic and evolving nature of lower rectal cancer management, particularly in the context of neoadjuvant treatment strategies.

Keywords: Low anterior resection, lower rectal cancer, minimally invasive surgery, multidisciplinary approach, neoadjuvant therapy

Introduction

Colorectal cancer remains one of the most common malignancies worldwide, ranking third in prevalence both nationally and globally. It accounts for approximately 10% of all cancer diagnoses and is the second leading cause of cancer-related mortality worldwide.[1,2] Although it primarily affects individuals aged ≥50 years, there is a concerning rise in cases among younger populations.[3] Notably, about one-third of these diagnoses are classified as rectal cancer.[2]

The optimal management strategy for rectal adenocarcinoma depends on multiple factors, with paramount consideration given to tumor location within the rectum and disease extent. In cases where patients present with limited invasive cancer confined to a polyp without adverse features, polypectomy

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alone may be a sufficient treatment modality. Conversely, for individuals with locally advanced disease, such as fixed, bulky tumors, nodal involvement, or evidence of extramural venous invasion on staging magnetic resonance imaging, a neoadjuvant approach is recommended. Additionally, in selected patients who achieve a complete response to neoadjuvant therapy, the watch-and-wait strategy-postponement of surgery with close surveillance-may be an option.[4] However, surgery remains the cornerstone of curative treatment for rectal adenocarcinoma.[5]

In determining the appropriate surgical treatment for rectal cancer, several critical factors should be considered, including tumor distance from the anal verge or from the lower border of the tumor to the top of the anorectal ring (which guides sphincter preservation decisions), invasion into the lateral pelvic walls or adjacent intra-abdominal organs, tumor size, regional lymph node involvement, pelvic anatomy, preoperative anorectal sphincter function, and the patient's ability to tolerate transabdominal surgery.[6]

Given the diverse nature of rectal cancer and the multifaceted considerations involved in treatment decisions, treatment modalities may vary considerably. Substantial differences in clinical approaches to lower rectal tumors exist between institutions. Although international guidelines are generally adhered to, notable variations occur, particularly in low anterior resection/abdominoperineal resection (APR) rates, anastomosis techniques, and stoma rates. Ongoing research aims to further elucidate optimal management approaches. In Türkiye, data regarding surgeons' preferences for treating lower rectal tumors are currently lacking. This study aims to address this gap by analyzing national data on surgical preferences and clarifying the approaches employed by colorectal surgeons in managing lower rectal adenocarcinoma.

Materials and Method

Patient Selection

This study was approved by the Ankara University Medical School Institutional Review Board (approval number: i03-285-24, dated: 25.04.2024). Data were obtained from the national Colorectal Cancer Database (CCD) of the Turkish Society of Colon and Rectal Surgery (TSCRS). The TSCRS-CCD was established in 2018, with 18 centers providing data. To participate in this database, centers must perform at least 50 colorectal cancer surgeries annually and conduct multidisciplinary tumor board meetings for tumor-related surgeries. The preoperative, operative, and short-term (30-day) postoperative data of patients who underwent curative colon or rectal resection for colorectal cancer are prospectively recorded in this database.

In the TSCRS-CCD, data entry is performed by responsible colorectal surgeons from each contributing center, and the entered data are subsequently verified by the CCD working study group.

This study included patients with lower rectal adenocarcinomas who underwent surgery between July 2018 and March 2022. Patients aged ≥18 years were included, whereas those with tumors located >5 cm from the anal verge or diagnosed with squamous cell carcinoma were excluded.

Variables Examined

The surgical preferences of the surgeons, along with patient demographic data and pathological outcomes, were analyzed. The demographic data included age, gender, preferred neoadjuvant therapy, operation type, and surgical technique. The patients were categorized into two groups based on the surgical techniques used: open surgery and minimally invasive surgery (MIS; laparoscopic or robotic). These groups were compared and analyzed in terms of age, gender, body mass index, American Society of Anesthesiologists score, clinical stage, T staging, neoadjuvant therapy, tumor distance to the anal verge, operation type, intraoperative blood loss, circumferential resection margin (CRM), mesorectal plane completeness, history of prior abdominal surgery, anastomosis type, presence of stoma, and operative time.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. The Fisher's exact test or chi-square test was used to assess the significance of categorical variables, whereas the t-test or Mann-Whitney U test was used for continuous variables. Statistical analyses were conducted using SPSS version 21.0. A p-value <0.05 was considered statistically significant.

Results

A retrospective analysis was conducted on data from 158 patients (36.9%) with lower rectal cancer, selected from a total of 428 patients with rectal cancer registered in the database. The mean age was 57.8±12.6 years, and 92 patients (58.2%) were men.

Among the total cohort, 151 patients (95.6%) received neoadjuvant treatment. Approximately 40% of the patients underwent APR, whereas the remaining patients underwent surgeries concluded with anastomosis. Abdominoperineal resection was more commonly performed in patients undergoing open surgery. Regarding the surgical technique, approximately half the patients underwent open surgery, whereas the remaining half underwent MIS (Table 1).

When comparing the results of open surgery and MIS, a statistically significant difference was observed in the T-stages. Specifically, among patients in stages I-II, 30 patients (41.1%) underwent open surgery, whereas 56 patients (65.9%)

underwent MIS (p=0.009). In stages III-IV, the distribution shifted toward open surgery, with 43 patients (58.9%) undergoing open surgery and 29 patients (34.1%) undergoing MIS. The number of T0 patients was 16 in the open surgery group and 20 in the MIS group. Except for one patient (open surgery), all cases demonstrated a pathological complete response (Table 2).

Table 1. Characteristics of the patients (n=158)

Variables	Value
Age (years)	57.8±12.6
Men, n (%)	92 (58.2%)
Neoadjuvant therapy, n (%)	
CRT	139 (88%)
CT	5 (3.2%)
RT	7 (4.4%)
None	7 (4.4%)
Operation type, n (%)	
LAR	93 (58.9%)
APR	63 (39.9%)
Total proctocolectomy	2 (1.2%)
Operation technique, n (%)	
Open	73 (46,2%)
Laparoscopic	77 (48,7%)
Robotic	8 (5.1%)

CRT: Chemoradiotherapy, CT: Chemotherapy, RT: Radiotherapy, LAR: Low anterior resection, APR: Abdominoperineal resection

In five patients (5.9%), laparoscopic surgery was converted to an open procedure. No conversions to open surgery occurred during robotic procedures. Positive circumferential resection margins were observed in five patients (3.2%), whereas tumor perforation occurred in seven patients (4.5%) during surgery (Table 3).

The hand-sewn anastomosis rate was 7.9% in patients who underwent open surgery, increasing to 40.4% in those who underwent MIS. Additionally, the mean operative time was 169±52 minutes for open surgery and 249±85 minutes for MIS. There was no statistically significant difference between the two groups in the number of harvested lymph nodes, rates of distal surgical margin positivity, or postoperative complication rates (Table 3).

Discussion

The treatment of rectal cancer requires a multidisciplinary approach. Although surgery remains the cornerstone of treatment, neoadjuvant therapy, particularly for distal rectal tumors and locally advanced disease, has become an essential component of rectal cancer management. Despite the availability of various surgical techniques, none have been demonstrated to be superior in terms of oncological outcomes, and all continue to be widely used. In Türkiye, as in the rest of the world, rectal cancer treatment is guided by decisions made by multidisciplinary tumor councils. Our study reflects that surgeons adopt a tailored approach for each patient, aligning with this multidisciplinary strategy.

Table 2. Demographics outcomes comparing minimally invasive vs. open surgery for lower rectal cancer (n=158)

Variables	Open	Minimally invasive	p-value
Age (years)	58.3±11.9	57.5±13.3	0.691
Gender (M/F)	38/35	54/31	0.15
BMI (kg/m^2)	26.1±4.9	26.9±4.6	0.331
ASA score, n (%)			
1-2	62 (84.9%)	74 (87.1%)	0.819
3-4	11 (15.1%)	11 12.9%)	
Clinical stage, n (%)			
1	5 (7.1%)	10 (16.4%)	0.194
2	12 (17.1%)	14 (23%)	
3	44 (62.9%)	33 (54.1%)	
4	9 (12.9%)	4 (6.6%)	
Pathological T-stage, n (%)			
0-1-2*	30 (41.1%)	56 (65.9%)	**0.009**
3-4	43 (58.9%)	29 (34.1%)	
Neoadjuvant therapy, n (%)	72 (98.6%)	79 (92.9%)	0.124
Distance to anal verge (cm)	3.4±1.5	3.4±1.2	0.947

*The number of T0 patients is 16 in the open surgery group and 20 in the minimally invasive surgery group. BMI: Body mass index, ASA: American Society of Anesthesiologists

Minimally invasive surgery has made substantial advancements, particularly in the last quarter century, and has increasingly become the preferred option over open surgery in colorectal procedures. Its safety, feasibility, and oncologic equivalence have been established, with well-documented clinical benefits over open approaches.[7] Moreover, MIS is considered superior to the open approach because of the various postoperative outcomes, including reduced surgical site infections, shorter hospital stays, and less blood loss. It is also associated with enhanced short-term non-oncologic outcomes compared with open surgery for rectal cancer.[8-11] However, no significant difference has been observed in short-term and long-term oncologic outcomes.[10,11] Minimally invasive surgery is a safe and effective option for patients with colorectal cancer, providing similar oncologic outcomes in both the short and long term when compared with the open approach.[12]

Although our study did not include long-term oncological outcomes, there were no differences between the groups in

Table 3. Peri-operative outcomes comparing minimally invasive vs. open surgery for lower rectal cancer (n=158)

Variables	Open (n=73)	Minimally invasive (n=85)	p-value
APR, n (%)	35 (47.9%)	28 (32.9%)	0.152
Intraoperative bleeding (mL)	125±78	145±132	0.252
CRM (+)	3 (4.1%)	2 (2.4%)	0.663
Intraoperative tumor perforation	5 (6.9%)	2 (2.4%)	0.248
Mesorectal plane, n (%)			
Complete or nearly complete	47 (100%)	58 (93.5%)	0.132
Incomplete	0	4 (6.5%)	
Lymph node count	14.52±11.23	15.86±8.73	0.41
Metastatic lymph node count	2.4±5.47	1.2±3.68	0.12
Distal surgical margin positivity, n (%)*	5 (13.1%)	6 (10.5%)	0.75
Previous abdominal surgery, n (%)			
Yes	48 (65.8%)	63 (85.9%)	**0.004**
No	25 (34.2%)	12 (14.1%)	
Anastomosis, n (%)			
Hand-sewn	3 (7.9%)	23 (40.4%)	**0.001**
Stapled	32 (84.2%)	33 (57.9%)	
Stoma (excluding APR), n (%)	39 (100%)	49 (84.5%)	**0.01**
Operation time (min.)	169±52	248±85	**<0.001**
Postoperative complications, n (%)			
Superficial SSI	10 (13.6%)	5 (5.9%)	0.182
Deep SSI	8 (10.9%)	5 (5.9%)	0.398
Intra-abdominal abscess	1 (1.4%)	8 (9.4%)	0.033
Evisceration	2 (2.7%)	2 (2.4%)	1.0
Prolonged ileus	7 (9.6%)	7 (8.2%)	1.0
Anastomotic leak	5 (6.8%)	1 (1.2%)	0.114
Urinary complications	6 (8.2%)	6 (7.1%)	1.0
Bleeding	1 (1.4%)	1 (1.2%)	1.0
Obstruction	2 (2.7%)	0	0.241
Non-surgical**	2 (2.7%)	4 (4.7%)	0.681
Timing of surgery after neoadjuvant treatment (weeks)	10±3.5	10.5±6	0.576

*Excluding APR. Open (n=38), minimally invasive (n=57). **Open surgery: 1 atelectasis, 1 encephalopathy. Minimally invasive surgery: 1 myocardial infarction, 1 pulmonary edema, 1 pleural effusion, and 1 acute kidney injury. APR: Abdominoperineal resection, CRM: Circumferential resection margins, SSI: Surgical site infection., min.: Minute

terms of pathological evaluation, including specimen quality, lymph node yield, and resection margins. This suggests that the role of MIS in rectal surgery is well established and no longer open to debate.

Unfortunately, this study included only a limited number of patients undergoing robotic surgery. Current literature suggests that robotic surgery offers the advantages of laparoscopic surgery and may even be superior in certain aspects. According to the results of the REAL study, which compared robotic and laparoscopic surgery in rectal cancer, robotic surgery resulted in better oncological quality of resection, less surgical trauma, and improved postoperative recovery.[13] Additionally, robotic surgery provided several advantages over laparoscopic surgery, including substantially lower conversion rates to open surgery, shorter hospital stays, decreased risk of urinary retention, and improved survival rates to hospital discharge or 30-day overall survival rates.[14]

However, a meta-analysis showed that robotic surgery yields results similar to, rather than better than, laparoscopic surgery in terms of hospital stay, blood loss, time to first flatus, conversion rates to open surgery, number of removed lymph nodes, complication rates, and CRM positivity rates. Another meta-analysis comparing open, laparoscopic, and robotic surgery for rectal cancer found no differences in oncologic outcomes or recovery parameters among the three techniques. However, robotic surgery demonstrated improved distal resection margin distance.[15] Despite these similarities, robotic surgery was associated with longer operative times and higher costs.[16]

Overall, robotic surgery has been shown to offer comparable or better clinical outcomes compared with both laparoscopic and open surgery.[17] In our study, none of the patients undergoing robotic surgery exhibited CRM positivity, intraoperative tumor perforation, or distal surgical margin positivity. Moreover, no statistically significant differences were observed between the groups in terms of postoperative complications. These results are likely attributable to the small sample size, which may have limited the statistical power of the study. However, operative times were significantly longer in patients undergoing robotic surgery.

The criteria for selecting patients for neoadjuvant treatment in rectal cancer are well established. Traditionally, long-course chemoradiotherapy (CRT) followed by consolidation therapy has been recommended for lower rectal tumors. The majority of patients in this study were treated with long-term CRT in accordance with the guidelines at the time of surgery, but a small number received only short-term radiotherapy (RT). Although studies have shown that RT and CRT yield similar results in reducing the risk of local recurrence, evidence suggests that adding chemotherapy to the treatment regimen may be more beneficial for patients requiring downstaging before surgery, particularly in cases where tumors have invaded the mesorectal fascia.[18-21] In this study, clinics administered consolidation chemotherapy after RT or CRT in accordance with their own protocols. However, the latest National Comprehensive Cancer Network guideline recommends total neoadjuvant therapy (TNT) for locally advanced rectal cancer.[22]

As demonstrated by cornerstone studies comparing open and laparoscopic rectal surgeries, APR rates vary, ranging from 7.3% to 23% in open surgery and 7.6% to 29% in laparoscopic surgery.[23-25] In the Robotic Versus Laparoscopic Resection for Rectal Cancer study, which compared robotic and other surgical techniques, the APR rate was 21.9% among 237 robotic cases and 19.2% among 234 laparoscopic cases.[26] In our study, the APR rate was 32.9% in the minimally invasive group and 50% in the open surgery group, likely due to patient selection bias, as patients at higher T-stages were more frequently selected for open surgery.

In this study, the hand-sewn anastomosis rate in open surgery was 7.9%, increasing to 40.4% in MIS. Although no comparable data are currently available in the literature, the increased frequency of manual anastomosis in MIS may be attributed to the enhanced visibility, allowing surgeons to achieve lower levels in the rectum, potentially exceeding the suitable levels for stapled anastomosis. As a result, hand-sewn anastomosis may have been preferred at a higher rate in these patients.

Study Limitations

The strengths of our study include its multicentric nature and the distinction of being the first study in Türkiye utilizing the TSCRS database. However, several limitations should be considered. The study did not include all clinics in Türkiye; only those actively engaged in colorectal cancer care were part of the research. Additionally, the lack of long-term follow-up meant that oncological outcomes could not be assessed. Furthermore, factors such as patients' neoadjuvant treatment regimens and the impact of comorbidities on surgical technique selection are not available in the database, which represents a limitation. Another limitation is that postoperative complications were not classified according to the Clavien-Dindo classification, and an important limitation of this dataset is the absence of data for patients with rectal cancer undergoing non-operative management.

Moreover, the TSCRS database does not include specific treatment details, such as intersphincteric resection, extralevator abdominoperineal excision, the use of stomas, toxicity profiles, and TNT regimens. As these data were unavailable, they could not be included in the study. The absence of such information limits the ability to comprehensively evaluate the full spectrum of treatment approaches and their outcomes.

Furthermore, patients received tailored treatments based on evaluations by multidisciplinary tumor councils at their respective clinics. Although such personalized treatments likely yielded better patient outcomes, they also introduced a selection bias into the study. Lastly, due to the limited number of patients who underwent robotic surgery, these cases could not be analyzed separately and were grouped together with laparoscopic surgeries under the MIS group.

CONCLUSION

In conclusion, the treatment of rectal cancer, particularly for distal and locally advanced tumors, increasingly relies on a multidisciplinary approach that integrates neoadjuvant therapies and diverse surgical techniques. Neither approach has demonstrated superiority over the other in terms of short-term oncological outcomes. Additionally, because Turkish surgeons prefer a tailored approach based on each patient's specific needs, the preference rates for open and minimally invasive surgeries appear to be similar. Despite the absence of long-term oncological data, current findings affirm the efficacy of minimally invasive approaches, which offer well-established advantages documented in the literature. Neoadjuvant treatment strategies continue to evolve, reflecting the dynamic nature of rectal cancer management.

Ethics

Ethics Committee Approval: This study was approved by the Ankara University Medical School Institutional Review Board (approval number: i03-285-24, dated: 25.04.2024).

Informed Consent: This study was conducted using data from TSCRS Database, which consists of de-identified patient information. Therefore, obtaining individual informed consent was not required.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: M.A.K., E.A., Concept: M.A.K., E.A., Design: M.A.K., E.A., Data Collection or Processing: M.A.K., E.A., Analysis or Interpretation: K.S., Literature Search: K.S., Writing: K.S., M.A.K.

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References

1. Wild CP, Weiderpass E, Stewart BW. World Cancer Report. International Agency for Research on Cancer, Lyon, France 2020.
2. Turkish Statistical Institute (TurkStat), General Directorate of Public Health, June 2023.
3. Mauri G, Sartore-Bianchi A, Russo AG, Marsoni S, Bardelli A, Siena S. Early-onset colorectal cancer in young individuals. Mol Oncol. 2019;13:109-131.
4. Vailati BB, São Julião GP, Habr-Gama A, Perez RO. Non-operative management of rectal cancer: The watch and wait strategy. Surg Oncol Clin N Am. 2022;31:171-182.
5. McCourt M, Armitage J, Monson JR. Rectal cancer. Academic Surgical Unit, Castle Hill Hospital, Cottingham, East Yorkshire, UK. Surgeon. 2009;7:162.
6. Monson JR, Weiser MR, Buie WD, Chang GJ, Rafferty JF, Buie WD, Rafferty J; Standards Practice Task Force of the American Society of Colon and Rectal Surgeons. Practice parameters for the management of rectal cancer (revised). Dis Colon Rectum. 2013;56:535-550.
7. Keller DS, Ibarra S, Haas EM. Minimally invasive colorectal surgery: status and technical specifications. Minerva Chir. 2015;70:373-380.
8. Shin JK, Kim HC, Lee WY, Yun SH, Cho YB, Huh JW, Park YA. Minimally invasive versus open intersphincteric resection of low rectal cancer regardless of neoadjuvant chemoradiotherapy: long-term oncologic outcomes. Sci Rep. 2021;11:11001.
9. Quero G, Rosa F, Ricci R, Fiorillo C, Giustiniani MC, Cina C, Menghi R, Doglietto GB, Alfieri S. Open versus minimally invasive surgery for rectal cancer: a single-center cohort study on 237 consecutive patients. Updates Surg. 2019;71:493-504.
10. Schietroma M, Romano L, Apostol AI, Vada S, Necozione S, Carlei F, Giuliani A. Mid- and low-rectal cancer: laparoscopic vs. open treatment-short- and long-term results. Meta-analysis of randomized controlled trials. Int J Colorectal Dis. 2022;37:71-99.
11. Fukuoka E, Matsuda T, Hasegawa H, Yamashita K, Arimoto A, Takiguchi G, Yamamoto M, Kanaji S, Oshikiri T, Nakamura T, Suzuki S, Kakeji Y. Laparoscopic vs. open surgery for colorectal cancer patients with high American Society of Anesthesiologists classes. Asian J Endosc Surg. 2020;13:336-342.
12. Sueda T, Tei M, Mori S, Nishida K, Yoshikawa Y, Nomura M, Matsumura T, Koga C, Miyagaki H, Tsujie M, Akamaru Y. Oncological outcomes following minimally invasive surgery for pathological N2M0 colorectal cancer: A propensity score-matched analysis. Asian J Endosc Surg. 2022;15:781-793.
13. Feng Q, Yuan W, Li T, Tang B, Jia B, Zhou Y, Zhang W, Zhao R, Zhang C, Cheng L, Zhang X, Liang F, He G, Wei Y, Xu J; REAL Study Group. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. Lancet Gastroenterol Hepatol. 2022;7:991-1004.

14. Safiejko K, Tarkowski R, Koselak M, Juchimiuk M, Tarasik A, Pruc M, Smereka J, Szarpak L. Robotic-assisted vs. standard laparoscopic surgery for rectal cancer resection: a systematic review and meta-analysis of 19,731 patients. Cancers (Basel). 2021;14:180.
15. Seow W, Dudi-Venkata NN, Bedrikovetski S, Kroon HM, Sammour T. Outcomes of open vs. laparoscopic vs. robotic vs. transanal total mesorectal excision (TME) for rectal cancer: a network meta-analysis. Tech Coloproctol. 2023;27:345-360.
16. Yang L, Fang C, Bi T, Han J, Zhang R, Zhou S. Efficacy of robot-assisted vs. laparoscopy surgery in the treatment of colorectal cancer: A systematic review and meta-analysis. Clin Res Hepatol Gastroenterol. 2023;47:102176.
17. Ontario Health. Robotic-assisted surgery for rectal cancer: an expedited summary of the clinical evidence. Ont Health Technol Assess Ser. 2024;24:1-45.
18. Bujko K, Nowacki MP, Nasierowska-Guttmejer A, Michalski W, Bebenek M, Kryj M. Long-term results of a randomized trial comparing preoperative short-course radiotherapy with preoperative conventionally fractionated chemoradiation for rectal cancer. Br J Surg. 2006;93:1215-1223.
19. Ngan SY, Burmeister B, Fisher RJ, Solomon M, Goldstein D, Joseph D, Ackland SP, Schache D, McClure B, McLachlan SA, McKendrick J, Leong T, Hartopeanu C, Zalcberg J, Mackay J. Randomized trial of short-course radiotherapy versus long-course chemoradiation comparing rates of local recurrence in patients with T3 rectal cancer: Trans-Tasman Radiation Oncology Group trial 01.04. J Clin Oncol. 2012;30:3827-3833.
20. Braendengen M, Tveit KM, Berglund A, Birkemeyer E, Frykholm G, Påhlman L, Wiig JN, Byström P, Bujko K, Glimelius B. Randomized phase III study comparing preoperative radiotherapy with chemoradiotherapy in non-resectable rectal cancer. J Clin Oncol. 2008;26:3687-3694.
21. Smith HG, Nilsson PJ, Shogan BD, Harji D, Gambacorta MA, Romano A, Brandl A, Qvortrup C. Neoadjuvant treatment of colorectal cancer: comprehensive review. BJS Open. 2024;8:zrae038.
22. Benson AB, Venook AP, Al-Hawary MM, Azad N, Chen YJ, Ciombor KK, Cohen S, Cooper HS, Deming D, Garrido-Laguna I, Grem JL, Gunn A, Hecht JR, Hoffe S, Hubbard J, Hunt S, Jeck W, Johung KL, Kirilcuk N, Krishnamurthi S, Maratt JK, Messersmith WA, Meyerhardt J, Miller ED, Mulcahy MF, Nurkin S, Overman MJ, Parikh A, Patel H, Pedersen K, Saltz L, Schneider C, Shibata D, Skibber JM, Sofocleous CT, Stotsky-Himelfarb E, Tavakkoli A, Willett CG, Gregory K, Gurski L. Rectal cancer, version 2.2022, NCCN clinical practice guidelines in oncology. J Natl Compr Canc Netw. 2022;20:1139-1167.
23. Law CK, Brewer K, Brown C, Wilson K, Bailey L, Hague W, Simes JR, Stevenson A, Solomon M, Morton RL; Australasian Gastro-Intestinal Trials Group (AGITG) ALaCaRT investigators. Return to work following laparoscopic-assisted resection or open resection for rectal cancer: Findings from AlaCaRT-Australasian Laparoscopic Cancer of the Rectum Trial. Cancer Med. 2021;10:552-562.
24. Fleshman J, Branda ME, Sargent DJ, Boller AM, George VV, Abbas MA, Peters WR Jr, Maun DC, Chang GJ, Herline A, Fichera A, Mutch MG, Wexner SD, Whiteford MH, Marks J, Birnbaum E, Margolin DA, Larson DW, Marcello PW, Posner MC, Read TE, Monson JRT, Wren SM, Pisters PWT, Nelson H. Disease-free survival and local recurrence for laparoscopic resection compared with open resection of stage II to III rectal cancer: Follow-up results of the ACOSOG Z6051 randomized controlled trial. Ann Surg. 2019;269:589-595.
25. van der Pas MH, Haglind E, Cuesta MA, Fürst A, Lacy AM, Hop WC, Bonjer HJ; Colorectal cancer Laparoscopic or Open Resection II (COLOR II) Study Group. Laparoscopic versus open surgery for rectal cancer (COLOR II): short-term outcomes of a randomised, phase 3 trial. Lancet Oncol. 2013;14:210-218.
26. Jayne D, Pigazzi A, Marshall H, Croft J, Corrigan N, Copeland J, Quirke P, West N, Rautio T, Thomassen N, Tilney H, Gudgeon M, Bianchi PP, Edlin R, Hulme C, Brown J. Effect of robotic-assisted vs conventional laparoscopic surgery on risk of conversion to open laparotomy among patients undergoing resection for rectal cancer: The ROLARR Randomized Clinical Trial. JAMA. 2017;318:1569-1580.