Observational Study

Long-term outcomes of surgery alone versus surgery following preoperative chemoradiotherapy for early T3 rectal cancer

A propensity score analysis

Seung Hyun Cho, MD, PhD[a], Gyu-Seog Choi, MD, PhD[b,*], Gab Chul Kim, MD, PhD[a], An Na Seo, MD, PhD[c], Hye Jung Kim, MD, PhD[a], Won Hwa Kim, MD, PhD[a], Kyung-Min Shin, MD[a], So Mi Lee, MD[a], Hunkyu Ryeom, MD, PhD[a], See Hyung Kim, MD, PhD[d]

Abstract

Recently, a few studies have raised the question of whether preoperative chemoradiotherapy (PCRT) is essential for all T3 rectal cancers. This case-matched study aimed to compare the long-term outcomes of surgery alone with those of PCRT + surgery for magnetic resonance imaging (MRI)-assessed T3ab (extramural depth of invasion ≤5 mm) and absent mesorectal fascia invasion (clear MRF) in mid/lower rectal cancer patients.

From January 2006 to November 2012, 203 patients who underwent curative surgery alone (n = 118) or PCRT + surgery (n = 85) were enrolled in this retrospective study. A 1:1 propensity score-matched analysis was performed to eliminate the inherent bias. Case-matching covariates included age, sex, body mass index, histologic grade, carcinoembryonic antigen, operation method, follow-up period, tumor height, and status of lymph node metastasis. The end-points were the 5-year local recurrence (LR) rate and disease-free-survival (DFS).

After propensity score matching, 140 patients in 70 pairs were included. Neither the 5-year LR rate nor the DFS was significantly different between the 2 groups (the 5-year LR rate, P = 0.93; the 5-year DFS, P = 0.94). The 5-year LR rate of the surgery alone was 2% (95% confidence interval [CI] 0.2%–10.9%) versus 2% (95% CI 0.2%–10.1%) in the PCRT + surgery group. The 5-year DFS of the surgery alone was 87% (95% CI 74.6%–93.7%) versus 88% (95% CI 77.8%–93.9%) in the PCRT + surgery group.

In patients with MRI-assessed T3ab and clear MRF mid/lower rectal cancer, the long-term outcomes of surgery alone were comparable with those of the PCRT + surgery. The suggested MRI-assessed T3ab and clear MRF can be used as a highly selective indication of surgery alone in mid/lower T3 rectal cancer. Additionally, in those patients, surgery alone can be tailored to the clinical situation.

Abbreviations: 5-FU = 5-fluorouracil, CI = confidence interval, CRM = circumferential resection margin, DFS = disease-free-survival, DRM = distal resection margin, EMVI = extramural venous invasion, LARC = locally advanced rectal cancer, LF = leucovorin and 5-fluorouracil, LN = lymph node, LR = local recurrence, LVI = lymphovascular invasion, MERCURY = Magnetic Resonance Imaging and Rectal Cancer European Equivalence, MRF = mesorectal fascia, NCCN = National Comprehensive Cancer Network, PCRT = preoperative chemoradiotherapy, PNI = perineural invasion, PRM = proximal resection margin, RCT = randomized controlled trial, RT = radiation therapy, TRG = tumor regression grade.

Keywords: chemoradiotherapy, MRI, prognosis, rectal cancer, rectum

1. Introduction

Preoperative chemoradiotherapy (PCRT) and subsequent surgery have been recommended for locally advanced rectal cancer (LARC) because of difficult surgical techniques and the anatomical position of the rectum in the narrow pelvic cavity. Although indications and methods for PCRT differ by country, the most widely accepted indication, which is the National Comprehensive Cancer Network (NCCN) guideline, is stage II or III rectal cancer.[1–5] However, this indication has become an issue in terms of the broad range of prognoses for T3 cancer.[6–13] Some of the latest studies have demonstrated that surgery alone achieved local recurrence (LR) rates ≤3% in highly selected T3 patients.[14,15] These findings have raised the question of whether PCRT is essential for all T3 cancers and whether the T3 subgroup can be treated by primarily surgery.

Recently, a few studies have tried to define a favorable T3 cancer for the potential indication of surgery alone. A few researchers have suggested that as a clear circumferential resection margin (CRM), N0/N1 or T3N0 according to the

concordance of the histopathologic findings.[11,15] However, given that MRI is currently playing an important role in determining therapeutic planning, MRI-based indication of surgery alone in T3 rectal cancer will be better at defining T3 cancers that may respond to surgery alone.[6] Our hypothesis is that a combination of MRI-assessed T3ab with extramural depth of invasion ≤5 mm and absent mesorectal fascia invasion (clear MRF) can be used as a highly selective indication of surgery alone in mid/lower T3 rectal cancer.[16] To the best of our knowledge, there was no available research comparing oncologic outcomes between the 2 treatment arms based on this hypothesis. Therefore, the purpose of our study was to compare the long-term outcomes of surgery alone with those of surgery following PCRT (PCRT + surgery) for MRI-assessed T3ab and clear MRF in mid/lower rectal cancer patients.

2. Methods

This retrospective, single-institution study was approved by the local institutional review board, which waived informed consent.

2.1. Study Cohort

We searched our institutional database to identify patients who underwent rectal MRI between January 2006 and November 2012. A total of 1168 consecutive patients were found in the picture archiving and communication system database. We included 213 patients who satisfied the following criteria: had undergone pretherapeutic rectal MRI for adenocarcinoma staging; had tumors in the mid/lower rectum (≤10 cm from the anal verge); had staged MRI-assessed T3ab and clear MRF (in lower third cancer, a tumor >1 mm away from the levator ani muscle or no invasion into the intersphincteric plane was considered a clear MRF);[17] and had undergone curative surgery alone or PCRT + surgery at our institution. Among these patients, 10 patients were excluded for the following reasons: undergone transanal local excision (n = 3); diagnosed with synchronous or metachronous cancers (n = 3); determined to have stage IV cancer at initial staging (n = 3); and diagnosed with familial adenomatous polyposis (n = 1). Finally, 203 patients who met the eligibility criteria were enrolled as the study cohort (Fig. 1).
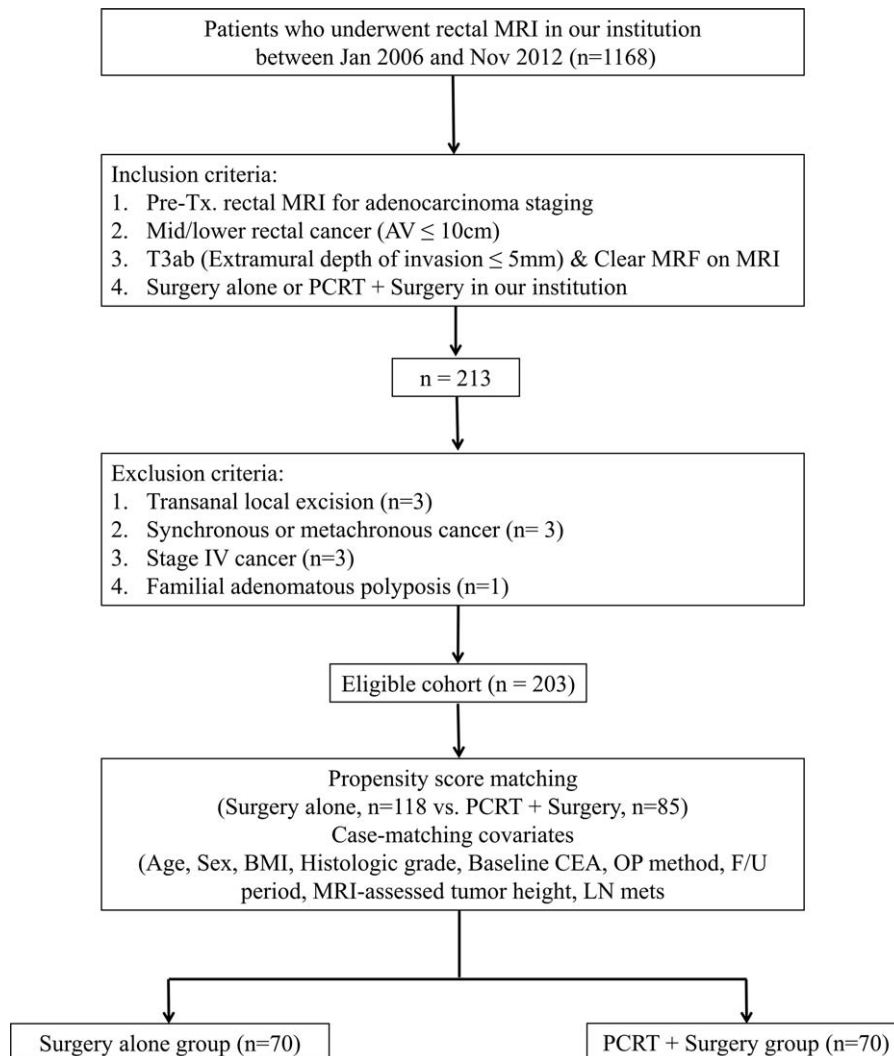
Figure 1. Flow diagram of the study cohort enrollment. AV = anal verge, BMI = body mass index, CEA = carcinoembryonic antigen, F/U = follow-up, LN = lymph node, MRF = mesorectal fascia, OP = operation, PCRT = preoperative chemoradiotherapy, Tx = treatment.

2.2. Treatment

All surgeries were performed or supervised by 3 experienced colorectal surgeons in the Division of Colorectal Cancer Center, Kyungpook National University Hospital. PCRT consisted of radiation therapy (RT) (4500–5000 cGy/25 fractions) concurrent with the "Mayo Regimen" chemotherapy.[18] Surgery with curative intent was performed 6 to 8 weeks (mean day, 60.4 ± 9.9 days; range 38–80 days) after the completion of PCRT. In our institution, during the late period of the study, PCRT was a routine treatment strategy for LARC; however, in some patients, our institution preferred primary surgery alone for early stage T3 cancer. Selective PCRT was provided for advanced or lower rectal cancer that was lymph node-positive (LN+). In histopathologic stage II or III patients who underwent surgery alone, adjuvant chemotherapy was selectively given with oral 5-fluorouracil (5-FU) and LF (leucovorin and 5-FU), respectively. According to the "Mayo Regimen," LF-based adjuvant chemotherapy was also provided in patients who underwent PCRT + surgery. Since 2011, a multidisciplinary team approach has been established in our institution.

2.3. Outcome Variables

Histopathologic outcomes were recorded, which included the longitudinal tumor size, length of proximal resection margin (PRM), distal resection margin (DRM), the presence or absence of CRM invasion, lymphovascular invasion (LVI), perineural invasion (PNI), number of retrieved LN, LN stage, and the tumor stage according to the American Joint Committee on Cancer 7th edition.[19] All histopathologic outcomes were evaluated according to the guideline of the College of American Pathologists. The histopathologic tumor regression grade (TRG) was also recorded on the basis of that by Dworak et al.[20] The histopathologic TRG was graded as follows: grade 0 indicates the presence of viable tumor without any regressed change; grade 1, the presence of dominant tumor with apparent fibrosis and/or vasculopathy; grade 2, the presence of dominant fibrosis with scattered tumor cells; grade 3, the presence of only scattered tumor cells in the space of fibrosis with/without acellular mucin; and grade 4, the absence of viable cancer cells.[21,22] Perioperative outcomes were also collected and included skin-to-skin operation time, estimated blood loss during surgery, duration of hospital stay, status of temporary protective ileostomy, and postoperative morbidity.

After recovering from surgery, the patients were clinically observed in an outpatient clinic every 3 months for the first 2 years and every 6 months for the subsequent 3 years. Follow-up abdomen and chest CTs were obtained every 6 or 12 months. The main endpoint of this study was the 5-year LR rate, which was defined as tumor recurrence within the pelvic cavity. The secondary endpoint was the 5-year disease-free-survival (DFS). DFS was defined as the time from curative surgery to distant metastasis or LR. LR and DFS were confirmed by a combination of clinical, radiologic, histopathologic, and surgical findings.

2.4. Statistical Analysis

Statistical analyses were performed using statistical software packages (SPSS, version 22, SPSS, Chicago, IL; MedCalc, version 16.2.0, MedCalc Software bvba, Ostend, Belgium). All continuous variables are expressed as the mean ± standard deviation. Given small number of study cohort, all percentages were rounded to integers. To compare categorical variables between the 2 groups, which were treated differently with surgery alone or PCRT + surgery, we used a χ^2 or a Fisher exact test as appropriate. In the case of continuous variables, an independent t test or Mann-Whitney U test was performed. To eliminate the inherent bias in study cohort, a 1:1 propensity score-matched analysis was used. Propensity scores were calculated by using a logistic regression model with the dependent variable defined as the odds of undergoing a surgery alone and the independent variables as age, sex, body mass index, histologic grade, carcinoembryonic antigen, operation method, follow-up period, MRI-assessed tumor height, and presence or absence of MRI-assessed LN metastasis. The Kaplan-Meier method with a log-rank test was used to compare the survival difference between the groups. A P value <0.05 indicated a statistically significant difference.

3. Results

3.1. Demographics of the study cohort

Of the 203 patients enrolled, 140 patients in 70 pairs were finally assigned to each differently treated group, either surgery alone versus PCRT + surgery, after propensity score-matching (Table 1). No covariates exhibited a large imbalance such that a standardized mean difference was >0.25 between the 2 groups. The mean follow-up period of the 140 matched patients was 45.7 ± 19.8 months. Fifteen (11%) patients developed postoperative distant metastases and/or LR. Of these, 13 (9%) patients had distant metastases alone, and 1 (1%) had LR alone. One (1%) patient had both distant metastases and LR. The recurrent sites are summarized in Table 2. The overall 5-year LR rates and DFS were 2% (95% confidence interval [CI] 0.4%–6.1%) and 88% (95% CI% 80.6–92.5%), respectively.

3.2. Comparison of histopathologic and perioperative outcomes

Histopathologic and perioperative outcomes are summarized in Tables 3 and 4, respectively. In the PCRT + surgery group, histopathologic TRG 0 was observed in 1 (1%) patient, TRG 1 in 13 (19%) patients, TRG 2 in 19 (27%) patients, TRG 3 in 25 (36%) patients, and TRG 4 in 12 (17%) patients. The longitudinal tumor size, mean length of PRM, PNI status, median number of retrieved LNs, and the tumor stage were significantly different between the 2 groups. Owing to the therapeutic effect of the PCRT, the histopathologic outcomes in terms of those variables were better in the PCRT + surgery group than in the surgery-alone group. Specifically, the PNI rate was lower in the PCRT + surgery group than in the surgery-alone group (17% vs. 4%, $P = 0.03$). The final histopathologic tumor stage was also significantly lower in the PCRT + surgery group ($P = 0.009$). However, other histopathologic outcomes, including the mean length of the DRM, CRM, LVI, and LN stage, were not significantly different between the groups.

In terms of the perioperative outcomes, the mean operation time and protective ileostomy rate were significantly different between the 2 groups. The mean operation time was significantly shorter in the surgery-alone group than in the PCRT + surgery group (178.8 ± 69.8 vs. 206.1 ± 76.9 minutes; $P = 0.03$). The protective ileostomy rate was also lower in the surgery-alone group (11% vs. 47%; $P < 0.001$). However, other perioperative outcomes, including estimated blood loss, mean duration of hospital stay, and postoperative morbidity rate, did not reach

Table 1

Baseline characteristics of the study cohort.

Characteristic	Unmatched cohort (n=203)			Matched cohort (n=140)		
	Surgery alone (n=118)	PCRT+surgery (n=85)	P	Surgery alone (n=70)	PCRT+surgery (n=70)	P
Age, y			0.05			0.87
<65	53 (45)	50 (59)		36 (51)	37 (53)	
≥65	65 (55)	35 (41)		34 (49)	33 (47)	
Sex			0.50			0.60
Male	68 (58)	53 (62)		46 (66)	43 (61)	
Female	50 (42)	32 (38)		24 (34)	27 (39)	
BMI, kg/m^2			0.45			>0.99
<25	77 (65)	51 (60)		43 (61)	43 (61)	
≥25	41 (35)	34 (40)		27 (39)	27 (39)	
Histologic grade			0.09			>0.99
Well	4 (3)	9 (11)		4 (6)	3 (4)	
Moderate	113 (96)	76 (89)		66 (94)	67 (96)	
Poor	1 (1)	0 (0)				
CEA, ng/mL			0.04			>0.99
<5	100 (85)	62 (73)		55 (79)	55 (79)	
≥5	18 (15)	23 (27)		15 (21)	15 (21)	
Operation			0.08			>0.99
SSO	117 (99)	80 (94)		69 (99)	70 (100)	
APR	1 (1)	5 (6)		1 (1)	0 (0)	
F/U period, mo	52 (36–60)	47 (36–56)	0.21	49 (35–60)	44 (37–56)	0.54
mrTumor height, cm			<0.001			0.23
≤5	28 (24)	47 (55)		26 (37)	33 (47)	
>5	90 (76)	38 (45)		44 (63)	37 (53)	
mrLN mets			0.27			0.87
Absent	73 (62)	46 (54)		37 (53)	38 (54)	
Present	45 (38)	39 (46)		33 (47)	32 (46)	

Values in parentheses are percentages. APR = abdominoperineal resection, BMI = body mass index, CEA = carcinoembryonic antigen, F/U = follow-up, LN = lymph node, mets = metastasis, mr = MRI-assessed, PCRT = preoperative chemoradiotherapy, SSO = sphincter saving operation.

statistical significance. In terms of the postoperative morbidity rate, 13 patients (19%) in the surgery-alone group and 11 patients (16%) in the PCRT+surgery group had postoperative complications. In both groups, the main complication was anastomosis leakage.

3.3. Comparison of oncologic outcomes

The oncologic outcomes are provided in Table 5, and the Kaplan-Meier survival curves are illustrated in Figure 2. In the unmatched study cohort (n=203), neither the 5-year LR rate nor the DFS was significantly different between the groups (the 5-year LR rate, P=0.40; the 5-year DFS, P=0.23). The 5-year LR rate of the

Table 2

Recurrent sites in the matched study cohort.

Recurrence pattern	Surgery alone (n=7)	PCRT+surgery (n=8)	P
Distant metastasis	13 (100)	8 (100)	0.45
Lung	5 (38)	4 (50)	
Liver	3 (23)	2 (25)	
Bone	3 (23)	0 (0)	
Mesentery	1 (8)	0 (0)	
Paraaortic LN	1 (8)	2 (25)	
Local recurrence	1 (100)	1 (100)	>0.99
Internal iliac LN	1 (100)	1 (100)	

Values in parentheses are percentages. Of the 15 patients with recurrence, recurrences at 1, 2, 3, and 5 sites occurred in 11, 2, 1, and 1 patient, respectively. LN = lymph node, PCRT = preoperative chemoradiotherapy.

Table 3

Histopathologic outcomes in the matched study cohort.

Characteristic	Surgery alone (n=70)	PCRT+surgery (n=70)	P
Tumor size, cm[*]	4.4±1.6	2.3±1.4	<0.001
PRM, cm[*]	15.6±7.7	18.6±7.1	0.03
DRM, cm[*]	1.9±1.3	1.9±1.5	0.99
CRM (n)			>0.99
Clear	69 (99)	68 (97)	
Involved	1 (1)	2 (3)	
LVI (n)			0.37
Negative	62 (89)	66 (94)	
Positive	8 (11)	4 (6)	
PNI (n)			0.03
Negative	58 (83)	67 (96)	
Positive	12 (17)	3 (4)	
Retrieved LN[†]	17 (11–25)	11 (7–15)	<0.001
LN stage			0.08
N0	49 (70)	60 (86)	
N1	18 (26)	9 (13)	
N2	3 (4)	1 (1)	
Stage[‡]			0.009
I	14 (20)	26 (37)	
II	35 (50)	22 (31)	
III	21 (30)	10 (14)	

Values in parentheses are percentages. CRM = circumferential resection margin, DRM = distal resection margin, LN = lymph node, LVI = lymphovascular invasion, PNI = perineural invasion, PRM = proximal resection margin

[*] Values are expressed as the mean ± standard deviation.

[†] Values are expressed as the median (interquartile range).

[‡] Twelve patients who underwent CRT+surgery had complete remission.

Table 4

Perioperative outcomes in the matched study cohort.

Characteristic	Surgery alone (n = 70)	PCRT + surgery (n = 70)	P
Operation time, min	178.8 ± 69.8	206.1 ± 76.9	0.03
Estimated blood loss, mL	164.7 ± 142.6	183.4 ± 133.4	0.42
Surgical procedure			0.04
Low anterior resection	59 (84)	48 (69)	
ISR with CAA	10 (14)	22 (31)	
Abdominoperineal resection	1 (1)	0 (0)	
Duration of hospital stay, days	12.7 ± 6.0	11.6 ± 8.5	0.39
Protective ileostomy	8 (11)	33 (47)	<0.001
Postoperative morbidity	13 (19)	11 (16)	0.68
Anastomosis leakage	6 (9)	3 (4)	
Intraabdominal abscess	2 (3)	1 (1)	
Surgical wound infection	1 (1)	2 (3)	
Anastomosis stricture	1 (1)	1 (1)	
Other medical complication	3 (4)	4 (6)	

Values in parentheses are percentages. CAA = coloanal anastomosis, ISR = intersphincteric resection.

surgery-alone group was 1% (95% CI 0.1%–6.3%) versus 3% (95% CI 0.6%–9.7%) in the PCRT + surgery group. The 5-year DFS of the surgery-alone group was 92% (95% CI 84.5%–95.9%) versus 88% (95% CI 78.0%–93.1%) in the PCRT + surgery group.

In the matched study cohort (n = 140), neither the 5-year LR rate nor the DFS was significantly different between 2 groups (the 5-year LR rate, P = 0.93; the 5-year DFS, P = 0.94). The 5-year LR rate of the surgery-alone group was 2% (95% CI 0.2%–10.9%) versus 2% (95% CI 0.2%–10.1%) in the PCRT + surgery group. The 5-year DFS of the surgery alone group was 87% (95% CI 74.6%–93.7%) versus 88% (95% CI 77.8%–93.9%) in the PCRT + surgery group.

3.4. Subgroup analysis for LN stage

The correlation between MRI and pathology-based LN staging was provided in supplement Table 1, http://links.lww.com/MD/B604. The 5-year LR rate and DFS according to histopathologic LN status were summarized in Table 6. In patients with histopathologic LN−, neither the 5-year LR rate nor the DFS was significantly different between the surgery alone (n = 49) or the PCRT + surgery (n = 60) groups (the 5-year LR rate, P = 0.81; the 5-year DFS, P = 0.52). Furthermore, in patients with histopathologic LN+, neither the 5-year LR rate nor the DFS was significantly different between the surgery-alone (n = 21) or the PCRT + surgery (n = 10) groups (the 5-year LR rate, P > 0.99; the 5-year DFS, P = 0.18).

In both groups, the surgery-alone versus the PCRT + surgery group, the 5-year LR rate was not significantly different between histopathologic LN+ and LN− patients (the surgery-alone group, P = 0.49; the PCRT + surgery group, P = 0.68). In the surgery-alone group, the 5-year LR rate of LN− patients (n = 49) was 2% (95% CI 0.1%–15.8%) versus 0% in LN+ patients (n = 21). In the PCRT + surgery group, the 5-year LR rate of LN− patients (n = 60) was 2% (95% CI 0.1%–11.8%) versus 0% in LN+ patients (n = 10).

4. Discussion

We hypothesized that a combination of MRI-assessed T3ab and clear MRF could be used as a highly selective indication of surgery alone in mid/lower T3 rectal cancer. This suggestion is similar to that of the Magnetic Resonance Imaging and Rectal Cancer European Equivalence (MERCURY) group.[14] The MERCURY group suggested that T3ab, clear MRF, and absent extramural venous invasion (EMVI) could be used as a potential indication of surgery alone in T3 rectal cancer. In the present study, we did not include EMVI status. This is because the prevalence rate of EMVI in patients with T3ab and clear MRF is very low at approximately only 5% in our experience and because in those patients, most EMVI is detected in only small venules perforating the normal outer rectal wall. Sohn et al[23] reported that MRI-detected EMVI involving a large vessel (≥3 mm) was a strong risk factor for a poor prognosis, whereas EMVI involving a small vessel was not. Talbot et al[24] also demonstrated that patients with pathology-detected EMVI on thick-walled vessels had a poorer prognosis than EMVI on thin-walled vessels. Although the prognostic value of MRI-detected EMVI on small perforating venules has not been well established, our suggestion based on the above-mentioned studies deserves careful consideration. In our hypothesis, the LN and Pelvic LN status was also excluded as a potential indication of surgery alone in T3 rectal cancer. Given that the current NCCN guideline recommends PCRT for all patients with LN metastasis, interpretation of this should be very cautious.[1] This is because there is a possibility that the LN status might not affect the LR in cases of qualified surgery.[25] A randomized controlled trial (RCT) by Quirke et al[26] showed that there was no difference in the LR rate between LN+ and LN− patients (6% vs. 5%). The result from the subgroup analysis of our study was also similar. In both groups, the 5-year LR rate was not significantly different between histopathologic LN+ and LN− patients. Moreover, MRI has a relatively lower diagnostic accuracy for the prediction of LN metastasis.[27,28] Our study demonstrated that the diagnostic accuracy of MRI for the prediction of LN metastasis

Table 5

Local recurrence and disease-free survival in the study cohort.

	Unmatched cohort (n = 203)			Matched cohort (n = 140)		
	Surgery alone (n = 118)	PCRT + surgery (n = 85)	P	Surgery alone (n = 70)	PCRT + surgery (n = 70)	P
Local recurrence (%)						
3 y	1 (0.1–6.3)	3 (0.6–9.7)	0.40	2 (0.2 10.9)	2 (0.2–10.1)	0.93
5 y	1 (0.1–6.3)	3 (0.6–9.7)	0.40	2 (0.2–10.9)	2 (0.2–10.1)	0.93
Disease-free-survival (%)						
3 y	94 (87.8–97.4)	88 (78.0–93.1)	0.09	92 (80.9–96.4)	88 (77.8–93.9)	0.49
5 y	92 (84.5–95.9)	88 (78.0–93.1)	0.23	87 (74.6–93.7)	88 (77.8–93.9)	0.94

Values in parentheses are the 95% confidence interval. PCRT = preoperative chemoradiotherapy.
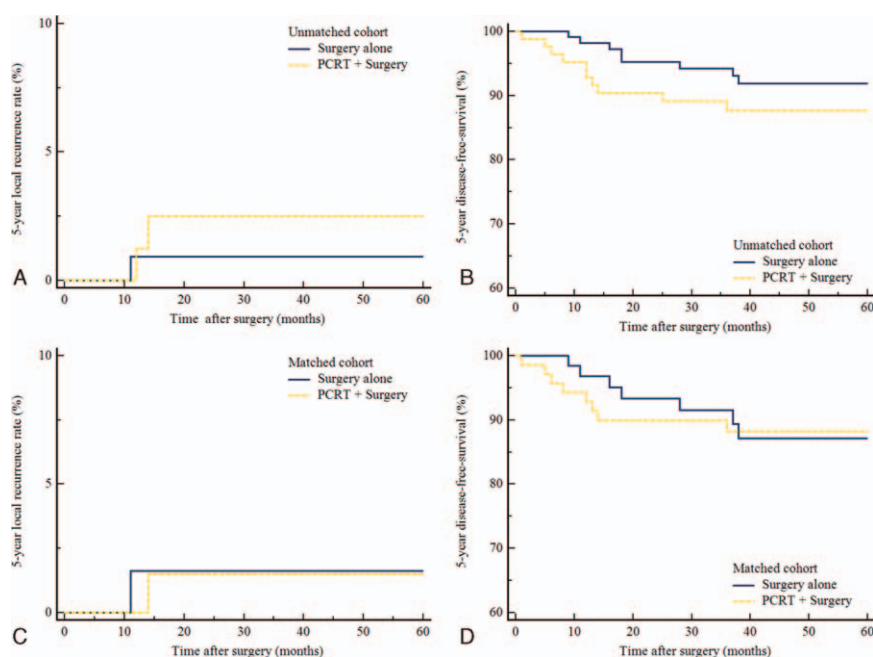
Figure 2. Kaplan–Meier survival curves of the 5-year LR rate and DFS in the unmatched and matched study cohort. (A, B) unmatched cohort (n = 203). Neither the 5-year LR rate nor the DFS was significantly different between the 2 groups (the 5-year LR rate, P = 0.40; the 5-year DFS, P = 0.23). (C, D) matched cohort (n = 140). Neither the 5-year LR rate nor the DFS was significantly different between the groups (the 5-year LR rate, P = 0.93; the 5-year DFS, P = 0.94). DFS = disease-free survival, LR = local recurrence, PCRT = preoperative chemoradiotherapy.

was also approximately 60% in the surgery alone group. Accordingly, the paradigm shifts of current treatment planning based on MRI-predicted LN may be necessary.

In our study, the histopathologic outcomes, such as the PNI status and the tumor stage, were better in the PCRT + surgery group than in surgery-alone group. This was attributed to the therapeutic effect of the PCRT. However, the mean length of the DRM, CRM, and LVI status, which has relatively more important implications in terms of the LR, was not significantly different. Specifically, it is notable that the proportion of patients with a positive CRM, which is the strongest risk factor for LR, was not different between the groups.[17] In terms of the perioperative outcomes, surgery alone might be equivalent to or better than PCRT + surgery. In our study, the mean operation time in the surgery-alone group was approximately 30 minutes shorter than in the PCRT + surgery group. Additionally, the temporary protective ileostomy rate was also approximately 35% lower in surgery-alone than in PCRT + surgery group. Even given the cost-effectiveness and the adverse effects of irradiation as delayed wound healing, small bowel obstruction, diarrhea, anastomosis stricture, among others, surgery alone might be better than PCRT + surgery in patients with MRI-assessed T3ab and clear MRF mid/lower rectal cancer.[29]

In the present study, we demonstrated that in patients with MRI-assessed T3ab and clear MRF mid/lower rectal cancer, the long-term outcomes of surgery alone were comparable with PCRT + surgery. Surgery alone achieved a 5-year LR rate of approximately 2% and a 5-year DFS of 90%. The oncologic outcomes of those patients were similar to those of stage I patients.[30] Given this result, surgery alone in mid/lower rectal cancer patients with MRI-assessed T3ab and clear MRF can be acceptable in terms of oncologic outcomes. Previous studies also support this. Merkel et al[8] reported that the 5-year survival rate of pT3ab cancer that was treated by radical surgery alone was similar to pT2 cancer regardless of LN status. Strassburg et al[31] suggested that the assessment of MRF status based on preoperative MRI could be used as an individualized indication of PCRT. Baek et al[32] demonstrated that the oncologic outcome of T3 rectal cancer without PCRT could be acceptable in terms of LR. Although our study is not a RCT, it can be suggested that surgery alone is feasible in MRI-defined favorable T3 mid/lower rectal cancer patients with T3ab and clear MRF. A further RCT is necessary to confirm these findings.

Our study had several limitations. First, the study cohort was small, and the design was a case-matched retrospective analysis. Additional case-matching covariates could not be applied

Table 6

5-Year local recurrence and disease-free survival of matched cohort according to histopathologic LN status.

	Histopathologic LN−			Histopathologic LN+		
	Surgery alone (n = 49)	PCRT + surgery (n = 60)	P	Surgery alone (n = 21)	PCRT + surgery (n = 10)	P
5-y LR rate (%)	2 (0.1–15.8)	2 (0.1–11.9)	0.81	0	0	>0.99
5-y DFS rate (%)	89 (73.4–95.9)	86 (74.3–92.9)	0.52	83 (54.9–94.0)	100	0.18

Values in parentheses are the 95% confidence interval. DFS = disease-free-survival, LN = lymph node, LR = local recurrence, PCRT = preoperative chemoradiotherapy.

because of small numbers in the study cohort. Although adjuvant therapy may have an effect on the prognosis, the present study did not consider it as a case-matching covariate.[33] It would be noteworthy if a RCT with large study cohort was conducted. Furthermore, we did not calculate the sample size to enhance the statistical power. Third, although we tried to eliminate the inherent bias using the propensity score-matched analysis, a few more patients with lower rectal cancer were assigned to the PCRT+surgery group. The possibility cannot be completely excluded that this influenced the study result.

In conclusion, although it had several limitations, our study demonstrated that, in patients with MRI-assessed T3ab and clear MRF mid/lower rectal cancer, the long-term outcomes of surgery alone were comparable with those of PCRT+surgery. The suggested MRI-assessed T3ab and clear MRF can be used as a highly selective indication of surgery alone in mid/lower T3 rectal cancer. Additionally, in those patients, surgery alone can be tailored to the clinical situation. Further validation studies with prospective design are required.

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