

Fig. 3 Manovolumetric examination in comparison of the IESR group with the LARJ group. M, months after surgery.

satisfied at 12 months after surgery than before closure of the stoma.

Table 3 shows five parameters of Wexner's Continence Grading Score. One patient in the LARJ group had incontinence at 12 months after surgery, and the IESR group also had two patients. Six of eight patients had wearing pads at 6 months after surgery. All 3 ESR patients needed pads. However, they did not need wearing pads at 12 months after surgery. Only one ISR patient needed a pad at 12 months after surgery.

Neither anastomotic recurrence nor mortality was seen during the mean of 16.1 months of follow-up. One patient had para-aortic lymph node metastasis and died of lung metastasis. Another patient had pelvic recurrence and received abdominoperineal resection.

### Discussion

Sphincter-saving operations to avoid a permanent stoma have been adopted as an operative interven-

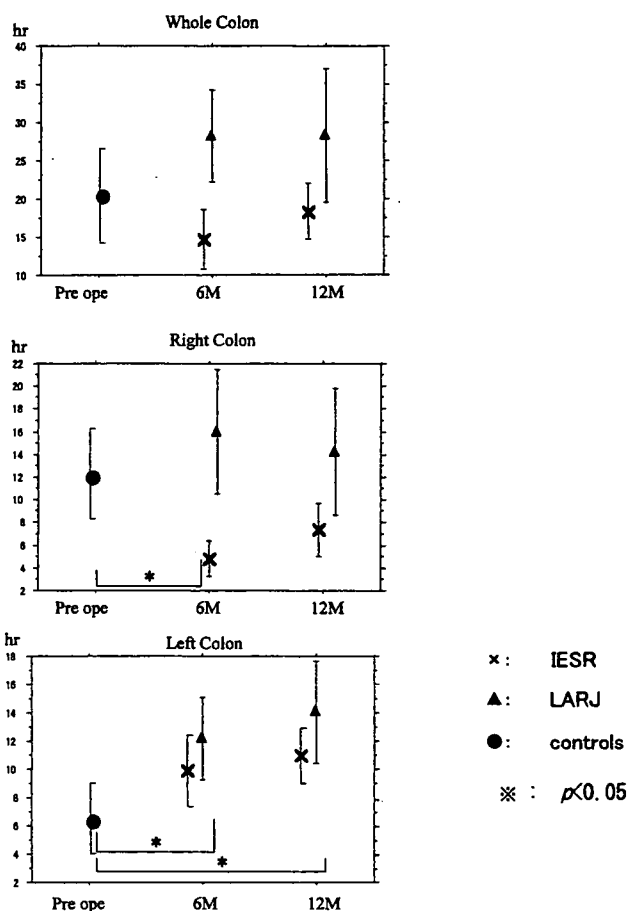


Fig. 4 Transit time study in comparison of the IESR group with the LARJ group. M, months after surgery.

tion for low rectal cancer since the 1940s.<sup>12,13</sup> Since safe methods for mechanical anastomosis and transanal anastomosis were established, the sphincter-saving operations securing good anal function have gained increased popularity. ISR, an operative modality resecting the internal anal sphincter muscle

Table 2 Functional score

	Score		
	0	1	2
Bowel frequency (times/day)	>6	3-6	≤3
Fecal incontinence (times/wk)	>2	≤2	Never
Urgency (ability to defer defecation)	<10 minutes	10-30 minutes	>30 minutes

Three parameters (bowel frequency, soiling, and urgency) were evaluated and scored 0 (poor), 1 (fair), or 2 (good) to obtain the functional score ranging from a total of 0 to 6.

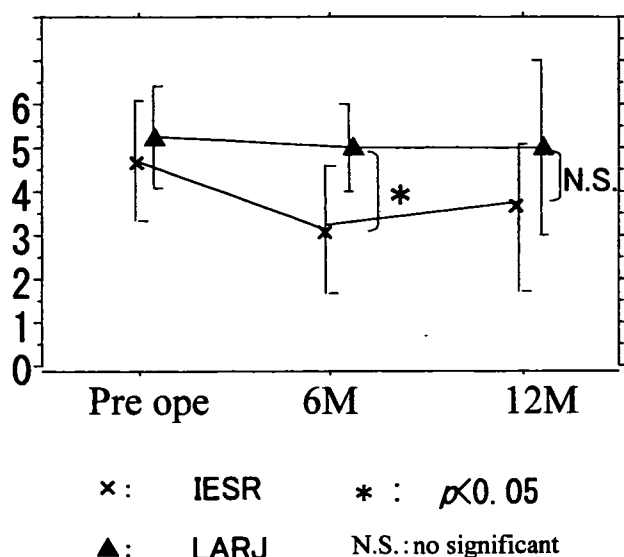


Fig. 5 Functional score in comparison of the IESR group with the LARJ group. M, months after surgery.

and preserving the anus, was reported to bring good anal bowel function and cure since 1994.<sup>5,14,15</sup> The new surgical strategy of preserving the anus with resection of the anal sphincter muscle seems to be replacing the standard sphincter-saving operation for the treatment of low rectal cancer or anal canal cancer extremely close to anus.

We retrospectively studied surgical specimens of 213 patients who underwent abdominoperineal resection for rectal cancer. According to our histological examination, we found that internal or external sphincter muscle resection could be a curative therapy for preserving the anus for low rectal cancer or anal canal cancer.<sup>16</sup>

In this prospective study, we compared IESR and standard low anterior resection concerning early postoperative anal and bowel function. It is well known that MRP and HPZ reflect internal anal sphincter muscle function, whereas MSP reflects external anal sphincter muscle function.<sup>17</sup> MRP, HPZ,

and MSP were significantly lower after IESR than those after LARJ. MTV indicating neorectal capacity<sup>17</sup> decreased 12 months after surgery in the IESR group compared with that of the LARJ group, although there was no significant difference between the two groups. This suggests that IESR caused sphincteric insufficiency, leading to precocious detachment of the rectal balloon and making it difficult to evaluate function of the pouch, in contrast with normal sphincter muscle function after LARJ.

Furst *et al*<sup>18</sup> noted that a short pouch of 5 cm in length was useful in decreasing defecation frequency and preventing fecal urgency caused by abolished peristaltic waves. In our study, intestinal peristalsis was measured at the oral side anastomotic portion, but the pouch was found to be devoid of peristaltic waves. Rullier *et al*<sup>14</sup> obtained better bowel function after ISR with construction of pouch than after ISR with straight anastomosis. In their ISR patients, the functional score showed a trend toward improvement despite anorectal function remaining unchanged during the course of time. Construction of a pouch may contribute to the inconsistency between physiological findings and clinical symptoms.

The postoperative transit time in the left colon determined by Arhan *et al*<sup>8</sup> was significantly increased in both groups over preoperative values of the preoperative control group. This is explained by the decrease of blood flow in the left colon after severing of the inferior mesenteric artery and by the decrease of motility of the left colon after dissection of the parasympathetic nerve. The delayed transit in the left colon seems to be a benefit for bowel function for IESR. The lack of peristaltic waves caused by construction of pouch may also contribute to maintaining good bowel function for IESR. It was reported that ISR was accompanied by frequent defecation, fecal urgency, and fecal incontinence, which tended to improve with time, and that neither major incontinence nor serious bowel dysfunction occurred to require reconstruction of the colostomy.<sup>14</sup> The incidence of minor incontinence after recon-

Table 3 Continence grading score in comparing the IESR group with the LARJ group

Type of incontinence	LARJ (n = 8)			IESR (n = 8)		
	Preoperative	6 months	12 months	Preoperative	6 months	12 months
Solid	0/8	1/8	1/8	0/8	1/8	0/8
Liquid	0/8	1/8	1/8	0/8	2/8	2/8
Gas	0/8	3/8	1/8	0/8	5/8	3/8
Wears pad	0/8	2/8	1/8	1/8	6/8	1/8
Life style alternation	0/8	1/8	2/8	0/8	6/8	2/8

struction of the low anterior resection (LAR) with a colonic J-pouch was estimated to range from 11% to 60%.<sup>19-26</sup> We observed night soiling in two of eight IESR patients at 12 months after surgery. Daily remnant sphincter muscle training with biofeedback may be one of the helpful treatment for improving physiologic, clinical anal function. Post-LAR symptoms including frequent defecation, fecal incontinence, fecal urgency, and constipation were attributable to decreased anal sphincteric function and decreased capacity for feces.<sup>27</sup> Some investigators reported the usefulness of a colonic J-pouch against these complications.<sup>23-26</sup> Constructing a pouch that would delay the postoperative transit time in the left colon was found to be effective, at least for a year after IESR, in reducing frequent defecation, fecal urgency, fecal incontinence, and other adverse events observed in the early postoperative phases. However, a disadvantage was indicated with reconstruction of a colonic J-pouch; some patients complained of difficulty of defecation for a long time after surgery.<sup>19,21,22</sup> According to observation, the transit time in the left colon was prolonged after operation for rectal cancer, and this constituted one of causes of defecation trouble,<sup>28</sup> so we prepared a 6-cm short pouch, and none of our patients complained of difficulty of defecation. However, the patients in the IESR group may be suffered from the risk of developing difficulty of defecation in the future. It is well known that patients with permanent stoma suffer from mental stress, depression, and limited social function more frequently than those with a preserved anus.<sup>29-31</sup> Renner *et al*<sup>15</sup> compared quality of life (QOL) of patients receiving transanal anastomosis including ISR and those with stoma and concluded, on the basis of physical signs and objective evaluation, that the former had poorer QOL. They recommended that every patient to be subjected to transanal anastomosis should be fully informed of postoperative adverse events. In our study, all IESR patients felt satisfied after closure of ileostomy.

Even patients who underwent partial resection of the superficial-deep external sphincter muscles had relatively good bowel function at the time of this report. The maximum extent of sphincteric resection that preserves good bowel function is still unknown. Because sphincter function alone determined by anorectal function test is not predictive for bowel function after closure of stoma, additional predictable measures should be established. As to the oncologic results, long-term follow-up is required. Local recurrence including anastomotic site is one of the impor-

tant problems. However, we have not anastomotic recurrences.

In conclusion, a new procedure of transanal rectal resection with internal and external sphincterectomy showed usefulness in preserving bowel function and avoiding permanent stoma. Further research and long-term observation will be necessary to clarify the extent of resection of the external sphincter muscle that would secure good anal function and to evaluate the therapeutic effect of this surgical modality.

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## Isolated tumor cell in lateral lymph node has no influences on the prognosis of rectal cancer patients

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### Abstract

**Background and aims** The aim of this study was to determine the incidence of isolated tumor cells (ITC) and micrometastasis in lateral lymph nodes of patients with rectal cancer and its possible correlation with prognosis.

**Materials and methods** One hundred seventy-seven rectal cancer patients who underwent curative resection with lateral lymph node dissection were enrolled. Dissected lymph nodes were examined using hematoxylin–eosin staining (HE) and immunohistochemistry (IHC) with anti-keratin antibody (AE1/AE3). States of lymph node metastasis were divisible into three groups: detectable with HE (HE+), detectable with only IHC (HE–/IHC+), and undetectable even with IHC (IHC–). Almost all the HE–/IHC+ group was classified as ITC consisting of a few tumor cells according to the UICC criteria (ITC+). Survival rates were compared among HE+, ITC+, and IHC–.

**Results** ITC+ were detected in 24.1% of patients with HE-negative lateral lymph nodes. No significant difference in overall 5-year survival was observed between ITC+ and IHC– patients (76.1 and 82.9%, respectively,  $p=0.25$ ). Multivariate analysis showed that perirectal HE+ lymph

nodes, but not ITC+ lateral lymph nodes, was an independent prognostic factor.

**Conclusions** ITC in lateral lymph nodes does not contribute to the prognosis of rectal cancer in patients who undergo extended lateral lymph node dissection, unlike HE+ lateral lymph node metastasis.

**Keywords** Rectal cancer · Lateral lymph node metastasis · Isolated tumor cell · Immunohistochemistry · Lateral lymph node dissection

### Introduction

Malignant tumors originating from pelvic urogenital organs such as the uterus and prostate often metastasize to pelvic lymph nodes. The prognostic value and therapeutic significance of pelvic lymph node metastasis in such cancers at certain stages have been determined [1–3]. In rectal cancer, however, pelvic lymph nodes were considered sites of distant metastasis in the studies by Bacon and Sauer [4] and Deddish and Stearns [5] in the 1950s. As a result, total mesorectal excision (TME), in combination with radiotherapy and chemotherapy, had been advocated to improve the therapeutic outcome of rectal cancer [6–11]. In contrast, in Japan, lateral lymph node dissection, which evolved from pelvic node dissection, has developed as an extended requisite procedure for advanced rectal cancer [12–14]. For this reason, pre- or postoperative radiotherapy has not become an established procedure in such cases.

Over the past decade, lymph node micrometastasis from colorectal cancer has been reported as a prognostic factor [15–17], although other studies have claimed the contrary [18–20]. To date, however, only one small-scale study (66 patients) has investigated micrometastasis in lateral lymph

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nodes of patients with rectal cancer in Japan [21]. Recently, the UICC have adopted criteria for micrometastasis as isolated tumor cells (ITC) and “micrometastasis” [22–25], but little is known about the correlation between ITC and the prognosis of colorectal cancer. In this paper, we describe a larger scale immunohistochemical study of lymph node micrometastasis in 177 rectal cancer patients who underwent lateral lymph node dissection, aimed at evaluating the incidence and prognostic value of ITC in lateral lymph nodes.

## Materials and methods

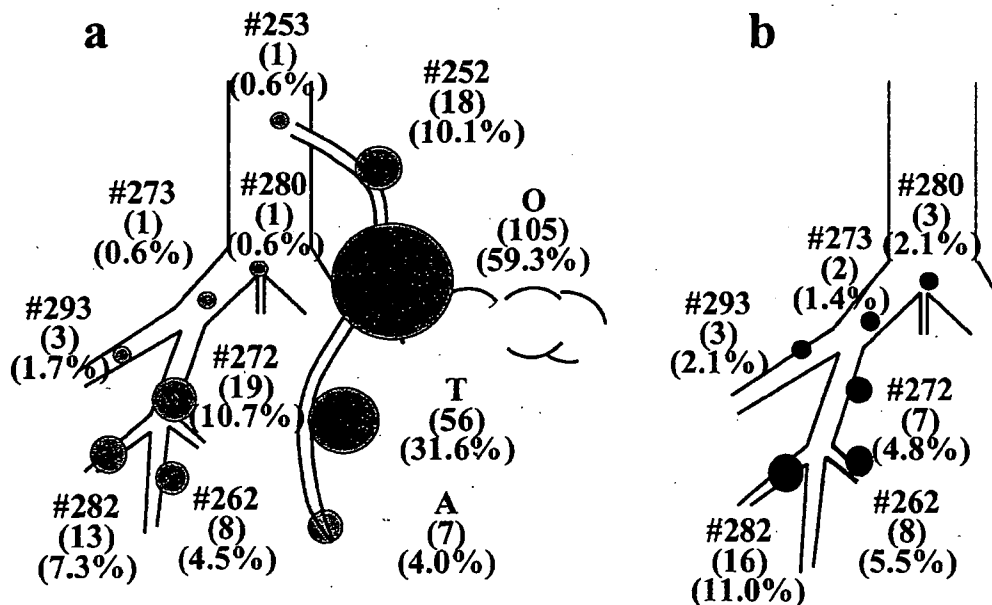
### Lateral lymph node dissection and surgical procedure

According to the Japanese classification of colorectal carcinoma [25], as shown in Fig. 1, lateral lymph node dissection refers to complete dissection of internal iliac lymph nodes (#272), middle rectal root lymph nodes (#262), and obturator lymph nodes (#282). Lymph nodes such as aortic bifurcation (#280), common iliac (#273), and external iliac lymph (#293) nodes are not necessary, but are usually included in lateral lymph node dissection. Lateral lymph node dissection is performed for curative intent in Japan while those lateral lymph nodes are categorized as distant lymph node in TNM classification. Based on our

previous studies of the incidence of lateral lymph node metastases, the pre- or intraoperative indications for lateral lymph node dissection are as follows: the primary cancer located above the peritoneal reflection (upper rectum: Ra) with invasion to the serosa, or non-peritonealized perirectal tissue or deeper, or the primary cancer located below the peritoneal reflection (lower rectum: Rb) or anal canal (P) with invasion to the muscularis propria or deeper. With regard to surgical procedures, mesorectal excision should be performed so that the detached surface is negative for cancer, whereas alignment of the autonomic nerves is confirmed. If infiltration to the nerves is suspected or if lateral lymph node metastasis is macroscopically confirmed, then the ipsilateral autonomic nerves are excised. The upper margin of mesenteric lymph node dissection is the root of the inferior mesenteric artery (#253). The anal margin distance should be 4 cm or more for Ra and 2 cm or more for Rb, and total mesorectal excision is performed for Rb. Lymph nodes located along the bowel axis are classified as lying beneath the tumor (T), on the anal side from the tumor (A), or on the oral side from the tumor (O).

### Patient characteristics

Between 1987 and 1999, 581 patients with primary, single rectal cancer underwent initial curative resection at the



**Fig. 1** Numbers of patients with HE+ lateral and perirectal lymph nodes (LN) among all 177 patients (a) and those with ITC+ in lateral LN among 145 HE-negative patients (b). Numbers in upper and lower parentheses mean the number and percentage of node-positive patients, respectively. LNs were classified as common iliac LN (#273), internal iliac LN (#272), middle rectal root LN (#262),

obturator LN (#282), aortic bifurcation LN (#280), external iliac LN (#293), inferior mesenteric trunk LN (#252), and inferior mesenteric root LN (#253). LNs along the bowel axis were classified as lying beneath the tumor (T), on the anal side from the tumor (A), and on the oral side from the tumor (O)

Department of Gastroenterological Surgery, Aichi Cancer Center Hospital. Of these patients, 177 (112 men and 65 women) underwent lateral lymph node dissection, according to our previously described indication, and were enrolled in this study. No patients have lost to follow-up. Mean patient age was 56.0 years (range, 28–78 years). The histological type was well-differentiated adenocarcinoma in 13 cases, moderately differentiated adenocarcinoma in 145, poorly differentiated adenocarcinoma in 11, and mucinous carcinoma in eight. Rectal cancer mainly affected Ra ( $n=51$ ), Rb ( $n=119$ ), and P ( $n=7$ ; Table 1).

The surgical methods comprised abdominoperineal resection (APR,  $n=82$ ), low anterior resection (LAR,  $n=91$ ), and the Hartmann procedure ( $n=4$ ). The mean number of dissected lymph nodes per patient was  $17.0\pm 7.9$  for perirectal lymph nodes and  $28.4\pm 11.3$  for lateral lymph nodes. Follow-up rate was 100%, and median duration of follow-up was 2,472 days (range, 97–5,145 days). Preoperative pelvic

**Table 1** Characteristics of the 177 rectal cancer patients who underwent curative resection with lateral lymph node dissection

Variables	Values	Percentage
Age (mean years $\pm$ SD)	56.0 $\pm$ 9.9	
Gender		
Male	112	63.3
Female	65	36.7
Tumor location		
Upper rectum (Ra)	51	28.8
Lower rectum (Rb)	119	67.2
Anal canal (P)	7	4.0
pT category		
t2	60	33.9
t3	102	57.6
t4	15	8.5
Stage (TNM)		
1	32	18.1
2	36	20.3
3	109	61.6
Histology		
Well	13	7.3
Moderate	145	81.9
Poor	11	6.2
Mucinous	8	4.5
Perirectal lymph node metastasis		
HE+	79	44.6
HE-	98	55.4
Lateral lymph node metastasis		
HE+	32	18.1
HE-	145	81.9
Harvested lymph node		
Perirectal	17.0 $\pm$ 7.9	
Lateral	28.4 $\pm$ 11.3	

pT depth of tumor invasion according to UICC  
Stage 3 included 32 lateral lymph node metastasis

irradiation was not performed, and postoperative pelvic irradiation was performed on 23 patients, most of whom had lateral lymph node metastases. Postoperative 5-fluorouracil-based chemotherapy was performed for 70 patients.

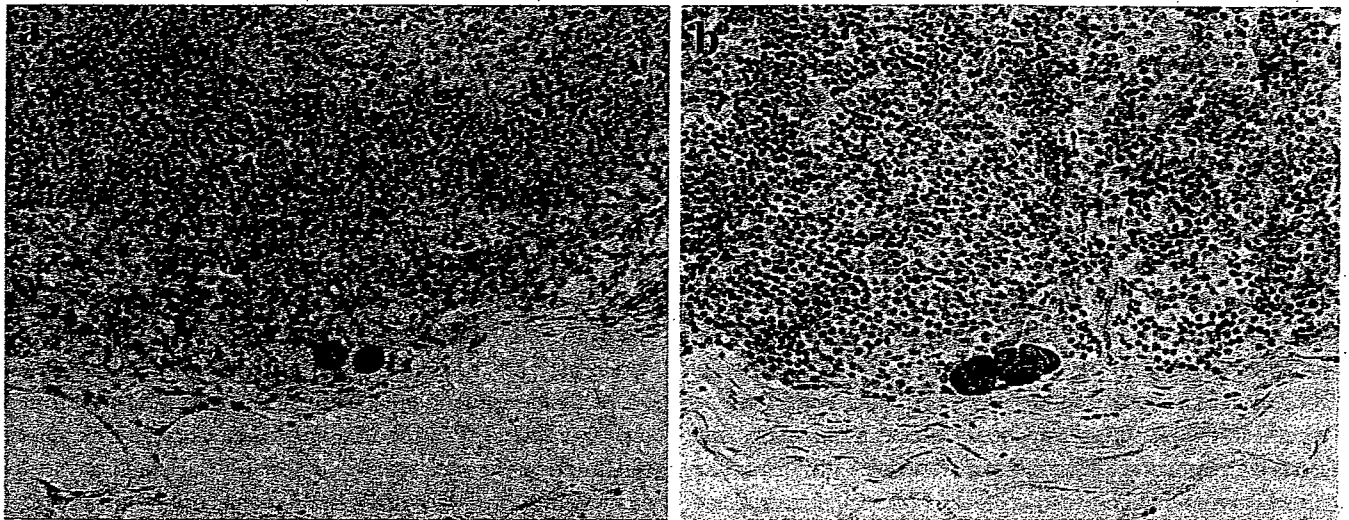
#### Immunohistochemical analysis

A total of 5,024 lateral and 3,012 perirectal harvested lymph nodes from 177 patients were examined by routine hematoxylin–eosin (HE) staining, and 32 patients were identified as having lateral HE metastasis (La HE+). Excluding those 32 patients, immunohistochemical analysis was performed on 4,035 lateral lymph nodes of 145 patients without lateral lymph node HE metastasis (La HE-). Micrometastasis was evaluated by two pathologists. Single cancer cells and small cell clusters scattered in sinusoids were regarded as ITC (La ITC+; Fig. 2), and a metastatic focus measuring between 0.2 and 2 mm in diameter was regarded as a “micrometastasis” based on the UICC criteria [22–25]. Contaminating normal epithelial cells and cancer cells from the primary tumors were carefully eliminated to avoid any false-positive results.

For immunohistochemical analysis (IHC), surgically dissected lymph nodes were fixed in buffered formalin, embedded in paraffin, and consecutive 4- $\mu$ m sections were prepared. IHC was performed using the indirect enzyme-labeled antibody technique with a mouse monoclonal antibody against a broad spectrum of cytokeratin (AE1/AE3, Dako, Copenhagen, Denmark) as the primary antibody as follows. After being deparaffinized with xylene and dehydrated in ethanol, sections were heated in a microwave oven at 98°C for 15 min for antigen retrieval. To inactivate endogenous peroxidase activity, these sections were immersed in methanol with 0.3% hydrogen peroxide for 30 min, followed by normal horse serum for 30 min to block nonspecific reactions. The sections were incubated at 4°C overnight with the AE1/AE3 antibody at 1:100 dilution in phosphate buffered saline (PBS; pH 7.2) containing 1% bovine serum albumin. After washing with PBS, the sections were incubated with a biotinylated second antibody for 30 min. The sections were washed again with PBS, and then incubated with streptavidin–peroxidase complex (Vectastain ABC kit; Vector, Burlingame, CA) for 60 min. The chromogen was developed with 0.01% diaminobenzidine, and the sections were counterstained with Meyer’s hematoxylin.

#### Statistical procedures

Log-rank test using the Kaplan–Meier method was performed, regarding the endpoint as death, including death related to other diseases. For multivariate survival analysis, the Cox hazard model was used. Chi-squared test was used



**Fig. 2** Micrometastases in lateral lymph nodes stained with anti-cytokeratin antibody. ITC of the single cell type (a) and small cluster type (b) are seen within the marginal sinus of the lymph node (original magnification, ×200)

to assess differences between groups. The level of significance was set at  $p < 0.05$ .

**Results**

**Incidence of IHC+ lymph nodes**

Of 4,035 lateral lymph nodes of 145 La HE<sup>-</sup> cases, tumor cells were detected in 43 lymph nodes from 36 patients by IHC. Of these 36 patients, one patient (0.7% of La HE<sup>-</sup>) had one lymph node “micrometastasis” as defined by the UICC, and the remaining 35 patients (24.1% of La HE<sup>-</sup> cases) were proved to have ITC consisting of the single cell type in 27 patients and the small cluster type in eight patients. The mean number of La ITC+ lymph nodes per patient was 1.2 (range, 1–2; Table 2).

**Location of lymph node metastases**

The location and incidence of HE<sup>+</sup> perirectal and lateral lymph nodes in all 177 patients and of ITC+ lateral lymph

nodes in the 145 La HE<sup>-</sup> patients are represented schematically in Fig. 1a and b, respectively. HE<sup>+</sup> and ITC+ lymph nodes were present among middle rectal root lymph nodes in 4.5 and 5.5% of cases, among internal iliac lymph nodes in 10.7 and 4.8% of cases, and among obturator lymph nodes in 7.3 and 11.0% of cases, respectively. The frequency of both La HE<sup>+</sup> and La ITC+ was higher around these arteries than in other areas. The total frequency of metastasis (i.e., total of La HE<sup>+</sup> and La IHC+) was 2–16% for each area. For lateral lymph nodes, the location and relative frequency of ITC+ lymph nodes were quite similar to those of HE<sup>+</sup> lymph nodes.

**Clinicopathological characteristics of lateral lymph node micrometastasis**

The correlation between ITC+ lymph nodes and clinicopathological characteristics was examined (Table 3). The frequency of ITC+ lymph nodes was significantly higher in patients with perirectal HE<sup>+</sup> lymph node (32.5%) than in patients without perirectal HE<sup>+</sup> lymph node (17.5%,  $p = 0.03$ ), and ITC+ patients were significantly more common among women (38.0%) than among men (17.0%,  $p = 0.005$ ). No significant differences were observed in other variables.

**Survival**

During more than 5 years of postoperative follow-up, a total of 57 patients died of cancer recurrence ( $n = 50$ ) or other causes ( $n = 7$ ). The 5-year overall survival rate for the 177 patients was 72.9%. When survival of patients with lateral lymph node metastasis-negative (La IHC<sup>-</sup>,  $n = 109$ ), ITC-positive (La ITC+,  $n = 35$ ), and HE metastasis-positive

**Table 2** Incidence of micrometastasis in lateral lymph nodes in 177 rectal cancer patients

State of metastasis	No. of patients positive/examined	No. of LN positive/examined
La HE <sup>+</sup>	32/177 (18.1%)	59/5024 (1.2%)
La HE <sup>-</sup> /IHC <sup>+</sup>		
ITC	35/145 (24.1%)	42/4035 (1.0%)
“micrometastasis”	1/145 (0.69%)	1/4035 (0.02%)
La IHC <sup>-</sup>	109/177 (61.6%)	3986/4035 (98.8%)

HE<sup>+</sup> Metastasis detected by HE staining, IHC<sup>+</sup> metastasis detected by immunohistochemistry, LN lymph node



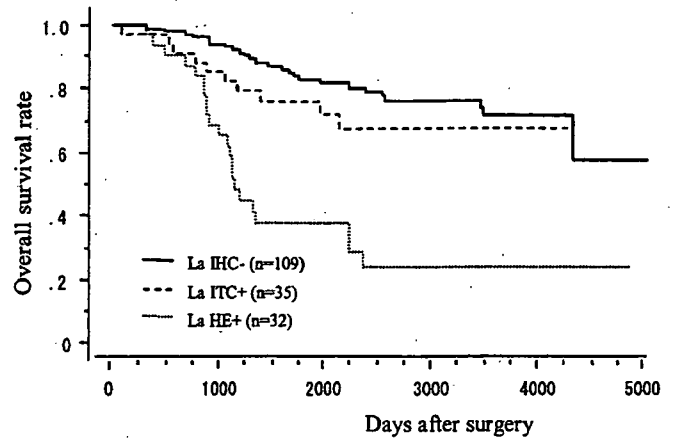
**Table 3** Correlation between ITC of lateral lymph nodes and clinicopathological parameters

Variables	ITC- (n=109)	ITC+ (n=35)	p value
<b>Age</b>			
> or =60	40 (78.4)	11 (21.6)	0.57
<60	69 (74.2)	24 (25.8)	
<b>Gender</b>			
Female	31 (62.0)	19 (38.0)	0.005
Male	78 (83.0)	16 (17.0)	
<b>Tumor size</b>			
> or =5 cm	54 (77.1)	16 (22.9)	0.69
<5 cm	55 (74.3)	19 (25.7)	
<b>Histology</b>			
Poor/mucinous	8 (61.5)	5 (38.5)	0.21
Well/moderately	101 (77.1)	30 (22.9)	
<b>Preoperative serum CEA</b>			
> or =5	34 (68.0)	16 (32.0)	0.11
<5	75 (79.8)	19 (20.2)	
<b>pT category</b>			
t3–t4	65 (71.4)	26 (28.6)	0.12
t2	44 (83.0)	9 (17.0)	
<b>Vessel invasion</b>			
Positive	78 (76.5)	24 (23.5)	0.74
Negative	31 (73.8)	11 (26.2)	
<b>Lymphatic invasion</b>			
Positive	85 (73.9)	30 (26.1)	0.32
Negative	24 (82.8)	5 (17.2)	
<b>Perirectal lymph node</b>			
HE+	52 (67.5)	25 (32.5)	0.03
HE-	47 (82.5)	10 (17.5)	
<b>Adjuvant chemotherapy</b>			
Yes	37 (78.3)	15 (21.7)	0.34
No	72 (71.2)	20 (28.8)	
<b>Postoperative radiation</b>			
Yes	6 (76.3)	3 (23.7)	0.51
No	103 (66.7)	32 (33.3)	

CEA Serum concentration of carcinoembryonic antigen. ITC- One patient with “micrometastasis” is excluded in this group.

(La HE+, n=32) was compared using the Kaplan–Meier method, the 5-year overall survival rates were 82.9, 76.1, and 38.0%, respectively. Apparently, survival of patients with La HE+ was significantly worse than the other two groups (p<0.0001). However, the survival rates of patients with La ITC+ and La IHC- were comparable and showed no significant difference (p=0.25; Fig. 3).

Multivariate analysis (Cox hazard model) of the 144 La HE- patients (excluding one patient with lateral lymph node “micrometastasis”) was performed to ascertain prognostic factors for survival (Table 4). This result showed that perirectal lymph node HE metastasis status was significant prognostic factors (p=0.001 and risk ratio 2.3), but La ITC+ status was not a significant prognostic factor (p=0.25 and risk ratio 1.2).



**Fig. 3** Survival curves of rectal cancer patients with lateral lymph node dissection stratified according to status of lateral lymph node metastases. Patients with HE+ lateral lymph node is significantly worse than the others (p<0.0001). Survival rate of patients with ITC+ lateral lymph node is not significantly different from those of patients with IHC- lateral lymph nodes (p=0.25)

**Discussion**

The relationship between lymph node micrometastasis and prognosis in colorectal cancer remains controversial. According to Greenson et al. [15], a difference in the prognosis of Dukes’ B colon cancer exists with respect to IHC+ lymph nodes. Several other studies have documented that IHC+ status is correlated with prognosis and local recurrence [16, 17]. However, Isaka et al. [17] found no significant difference in survival rates between IHC+ and IHC- when sufficient numbers of dissected lymph nodes were examined. Later studies also found no significant difference in survival rates when the number of dissected

**Table 4** Multivariate analysis (Cox model of regression) of prognostic factors in 144 rectal cancer patients

	Hazard ratio	95%CI	p value
<b>Gender</b>			
Female/male	1.3	0.9–2.0	0.15
<b>Serum CEA</b>			
<5/ or =5	0.8	0.5–1.2	0.32
<b>Histology</b>			
Well, moderate/poor, mucinous	0.6	0.3–1.2	0.16
<b>Depth of tumor invasion (pT)</b>			
t3, t4/t2	1.4	0.9–2.1	0.13
<b>Adjuvant chemotherapy</b>			
Not done/done	1.3	0.8–1.7	0.44
<b>Postoperative radiation</b>			
Not done/done	1.7	0.8–7.5	0.19
<b>Lateral lymph node</b>			
ITC+/IHC-	1.2	0.8–1.9	0.25
<b>Perirectal lymph node</b>			
HE+ / HE-	2.3	1.5–4.1	0.001

lymph nodes was high [26], and at present, no general consensus has been reached on this issue.

On the other hand, the status of micrometastasis in lateral lymph nodes of rectal cancer patients remains largely unknown because of the restricted usage of this radical dissection method in countries other than Japan. Shimoyama et al. [21] previously reported that micrometastasis in lateral lymph nodes is a prognostic factor and that the survival rate of patients with micrometastasis is similar to that of patients with overt nodal metastasis. In the present study, however, we found that ITC+ micrometastasis in lateral lymph nodes of rectal cancer patients had no prognostic significance. There are several possible explanations for this discrepancy between the two studies. One likely reason is the difference in the number of dissected lymph nodes and the number of patients. In Shimoyama's study, the number of dissected lateral lymph nodes was 13.6 per case, whereas in our study, 28.4 and 17.0 nodes per cases were dissected in lateral and perirectal lymph nodes. Tepper et al. [27] and Wong et al. [28] reported a significant difference in survival rates between patients with more than, and less than, 14 dissected lymph nodes, which was comparable to that for patients with HE+ overt lymph node metastasis. The good survival rate we found for patients with numerous dissected lateral lymph nodes is consistent with those previous reports [29, 30]. This suggests that when lymph node dissection is insufficient, which means incomplete histological examination of lymph node, the risk for overlooking HE+ lymph nodes increases. The second possible reason is the classification of micrometastasis. In the present study, almost all the minute metastases in lateral lymph nodes (97%) were identified as ITC by the surgical pathologists. In previous studies, no distinction was made between ITC and "micrometastasis" based on the UICC criteria, suggesting a difference in the extent of micrometastasis between the two studies.

Lateral lymph node metastasis is often regarded as a systemic disease, not a regional one [31, 32]. Indeed, hematogenous recurrent metastasis was common along with local recurrence in La HE+ patients. However, the 5-year survival rate in the present study was approximately 40% for La HE+ patients, as compared with 76.1% for La ITC+ patients and 82.9% for patients with IHC-, indicating relatively good survival of La HE+ patients. Lateral lymph node dissection was originally aimed at improving survival of locally advanced rectal cancer patients by decreasing local recurrence. In fact, the survival efficacy of lateral lymph node dissection due to locoregional control has been demonstrated by retrospective clinical studies in comparison with historical controls [12, 13]. Meanwhile, TME does not take into account lateral lymph node metastasis and would leave residual tumor cells in the pelvic cavity in a considerable number of cases (18.1% for La HE+ and 24.8% for La HE-

IHC+ metastasis). Several trials of TME, in combination with preoperative radiotherapy or adjuvant chemotherapy, proved to eliminate successfully those residual cells and improve locoregional control [9–11]. We therefore consider lateral lymph node dissection as an alternative for preoperative radiotherapy. However, the efficacy of lateral lymph node dissection as a therapeutic option could only be shown by prospective randomized clinical study. Adjuvant postoperative chemotherapy with 5-FU and leucovorin as key drugs for stage III colon cancer [33, 34] has been developing since the 1990s, but in Japan, the survival benefit of adjuvant chemotherapy has not yet been proved for rectal cancer. To evaluate the efficacy of systemic chemotherapy aimed at reducing both hematogenous and local recurrence, further randomized clinical trials of fluorouracil leucovorin-based postoperative adjuvant chemotherapy with and without lateral lymph node dissection are now ongoing in Japan.

In conclusion, the results of the present study have demonstrated a high incidence of ITC in HE- lateral lymph nodes of rectal cancer patients. However, the survival of patients with ITC+ lateral lymph nodes in whom a sufficient number of perirectal and lateral lymph nodes were dissected was comparable to that of patients with IHC- lymph nodes. These results suggest that ITC in lateral lymph nodes, if excised by sufficient dissection, does not affect the prognosis, unlike the case for HE+ metastases.

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# Laparoscopic Mesorectal Excision with Preservation of the Pelvic Autonomic Nerves for Rectal Cancer

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## ABSTRACT

**Background/Aims:** Laparoscopic mesorectal excision with preservation of the autonomic pelvic nerves for rectal cancer including selected advanced lower rectal cancer is now challenging. The aims of the study were to assess the surgical results and short-term outcomes of this procedure prospectively.

**Methodology:** Seventy-four of 281 rectal cancer patients, since the introduction of laparoscopic colorectal surgery in our hospital, have undergone laparoscopic rectal surgery. The location of the tumor distributed in upper rectum: 33, middle: 22, and lower: 19. The mesorectal excision with preservation of the autonomic pelvic nerves was performed for all the patients. The laparoscopic mesorectal excision was performed under 8 to 10 cmH<sub>2</sub>O CO<sub>2</sub> pneumoperitoneum and lymph node dissection was performed along the feeding artery depend on individuals. Ipsilateral lateral lymph node dissection was added for

5 cases of advanced lower rectal cancer.

**Results:** Open conversion occurred in 4 cases, 2 of those were due to locally advanced tumors and 2 technical difficulties in transaction of the distal rectum. There were 15 postoperative complications: 7 anastomotic leakage (10.6%), 3 transient urinary retention (4.1%), 4 wound infection (5.3%), and 1 small bowel obstruction (1.4%). No mortality was recorded in this series. Time of operation was 203±54 min in mesorectal excision cases and 270±42 min mesorectal excision with lateral lymph node dissection cases. Blood loss was 92±90g and 276±66g respectively. The hospital length-of-stay was 11.7 days in average.

**Conclusions:** Laparoscopic mesorectal excision with preservation of autonomic pelvic nerves for rectal cancer patients including selected advanced lower rectal cancer is favorable.

## KEY WORDS:

Laparoscopic surgery; Preservation of autonomic nerves; Mesorectal excision; Rectal cancer; Lateral Lymph-node dissection

## INTRODUCTION

Recent advances in laparoscopic surgery have led to its use for various colorectal diseases and laparoscopic surgery is now routinely used to treat malignant disease. Initially, several reports of port site metastases were published. These were thought to represent exfoliation of cancer cells during the production of pneumoperitoneum and by handling of the tissues due to inexperience with the procedure (1-4). Similar findings have been documented experimentally (5). However, the number of reports of port site metastases has decreased. By minimizing or avoiding tumor manipulation, the use of laparoscopic surgery has now been extended to advanced cancers.

Acceptance of laparoscopic surgery for rectal cancer has met resistance, even though conventional rectal surgery is associated with a high rate of the local recurrence unless complete total mesorectal excision is performed (6). We have found that a magnified view of the deep pelvis via the laparoscopy allows total

mesorectal excision with less blood loss than open procedure. Some of the latest papers, even not randomized controlled trials, have supported the laparoscopic total mesorectal excision in terms of short-term outcomes (7,8). Even for the patients with lower rectal cancer, the laparoscopic view seems to give more benefits than conventional open surgery although some controversies exist concerning the lateral lymph node dissection (9-12).

This paper focused on the mesorectal excision for rectal cancer patients with preserving autonomic nerves under laparoscopic view including some selected advanced lower rectal cancer patients with lateral lymph node dissection. The operative variables and the short-term outcomes after this surgery were assessed.

## METHODOLOGY

Three hundred and twenty-eight nonrandomized consecutive patients with a colorectal neoplasm have

undergone laparoscopic colorectal surgery in our hospital since the introduction of this procedure in 1998. During this period, of 281 rectal cancer patients, 74 (26.3%) were treated by laparoscopic anterior resection. The site of rectal neoplasm was defined according to the International Guidelines for Cancer Registrars (13). The protocol, which was changed about the indication in August 2002, was approved by the ethical committee of our hospital and patients gave informed consent. In the first edition of protocol, indication of laparoscopic surgery for rectal cancer was limited to all cases of upper and middle site and early cancers of lower site, but in the new edition that was extended to selected advanced cancers of lower site. The selected cases were identified as tumor confined to the proper muscle layer, occupying within half of the circumference, and without preoperative lymph node metastasis in the lateral region under thin-slice pelvic contrast-enhanced CT exam or MRI. In the absence of specific contraindications to laparoscopy, patients were selected for laparoscopic surgery based on the following criteria: elective surgery, absence of occlusion. Neither morbid obesity, prior major lower abdominal surgery, nor tumor occupying the pelvic space was considered a contraindication to laparoscopic surgery. Partial mesorectal excision was performed for the patients with upper rectal cancer, and a total excision for those with middle and lower. We attempted to preserve the hypogastric nerve and pelvic nerve plexus in all cases. No lymph node dissection of the lateral region was performed for the upper and middle rectal cancers. Ipsilateral lateral lymph node dissection preserving the autonomic nerves was performed in selected lower rectal cancer cases. The bowel reconstruction was basically performed primarily by the double stapling technique. For the middle and lower rectal cancer patients with a satisfactory length of sigmoid colon, J-pouch formation was performed for reconstruction. No bowel restoration of discontinuity was performed for selected lower rectal cancer patients.

Clinical parameters analyzed included patients' characteristics, operative variables, and short-term outcomes. Operative variables included type of operation, blood loss, time of operation, and conversion rate. Conversion to laparotomy was defined as unplanned incision. Short-term outcomes included days needed to regain bowel function, hospital length-of-stay, postoperative morbidity, and 30-days mortality.

### Operative Technique

Laparoscopic anterior resection was performed using 5 ports with 8 to 10 cmH<sub>2</sub>O of CO<sub>2</sub> pneumoperitoneum. The medial aspect of the rectosigmoid mesocolon was incised to mobilize the retroperitoneal space, preserving both hypogastric nerves. As lymphadenectomy in the mesenteric arterial direction was individualized on a case-by-case basis, the pelvis was approached following the division of the main artery. The rectosigmoid colon was pulled cranially after continuing the dissection laterally, providing excel-

lent exposure of the pelvic space (**Figure 1a**). The reflection of the peritoneum was incised on the anterior wall of the rectum, resecting Denonvillier's fascia to expose the seminal vesicle in men or the vaginal wall in women, and the rectum was mobilized distally so that levator ani was exposed circumferentially (**Figure 1b**).

For the selected lower rectal cancer cases, ipsilateral lateral lymph node dissection on the predominant side of the tumor was added. The lateral lymph node dissection was developed, exposing the internal and external iliac arteries. The internal iliac artery was dissected peripherally, ensuring the superior gluteal artery, obturator artery, inferior vesical artery, and middle rectal artery (**Figure 2a**). Lateral dissection was continued to resect all adipose tissue, including lymph nodes, exposing the obturator nerve to the obturator foramen (**Figure 2b**).

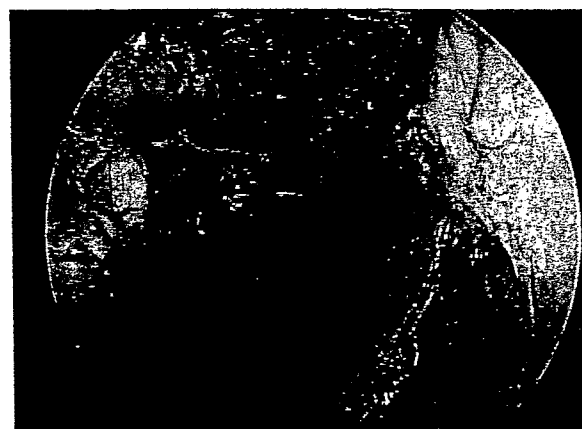
## RESULTS

### Demographics (Table 1)

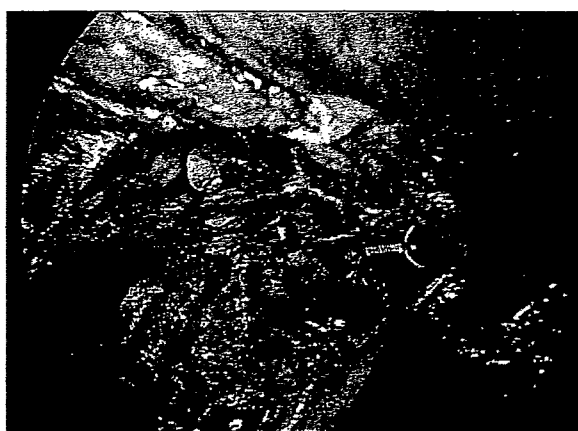
74 patients divided into 49 males and 25 females according to gender and of whom median age was 66 ranging from 42 to 94, were recruited. The location of the tumor distributed as 33 upper rectum (44.6%),



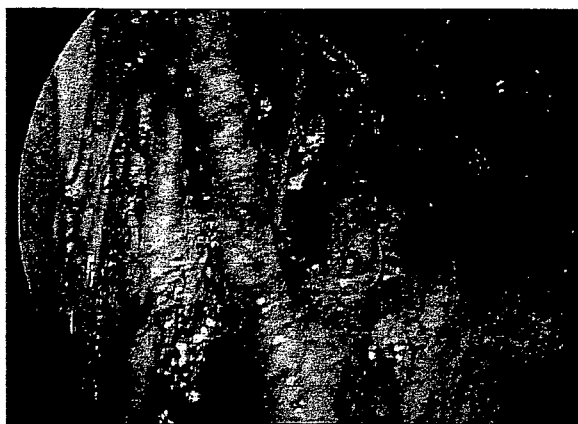
**FIGURE 1a** The rectosigmoid colon is pulled cranially by using a monofilament ligature.



**FIGURE 1b** The rectum is entirely mobilized and the levator ani is exposed; total mesorectal excision.



**FIGURE 2a** The lateral lymph node around the left internal iliac artery is entirely dissected exposing the root of left middle rectal artery.



**FIGURE 2b** The lateral lymph node around the left internal iliac artery and left external iliac artery is entirely dissected exposing the left obturator nerve.

22 middle rectum (29.7%), and 19 lower rectum (25.7%). Preoperative stage was distributed in 35 stage I, 9 stage II, 21 stage III, and 6 stage IV. Determination of the Stage IV was 1 bone metastasis and 5 liver metastases, and a palliative resection was performed for the only distant metastasis patient. The other 5 liver metastases patients underwent curative primary resection and curative therapy for the liver recently. The curative surgery was performed for another 68 patients.

### Operative Variables

The laparoscopic anterior resection with partial mesorectal excision was performed in 26 upper rectal cancer patients, and laparoscopic total mesorectal excision was performed in 44 upper, middle and lower rectal cancer patients. Four (5.4%) had conversion to laparotomy: locally advanced tumors in 2 cases and 2 technical difficulties due to obesity and too low for division with enough wedge from the tumor in each. There were no protective diverting stoma formations in our series. The type of reconstruction divided in end-to-end anastomosis in DST for 52 cases and J-pouch formation in DST for 14 cases. No restoration

**TABLE 1** Demographics

Gender (male/female)	49/25
Age (mean: range)	66: 42-92
Location	
Upper	33
Middle	22
Lower	19
Stage	
I	35
II	9
III	21
IV	6

of digestive discontinuity was performed in 8 cases. Four patients underwent abdominoperineal rectal amputation and 4 patients Hartman's operation.

The lymphadenectomy along the mesorectum to root of the inferior mesenteric artery was performed in all cases as the appropriate levels depended on the tumor advancing in each case. The high ligation of the inferior mesenteric artery was performed in 40 cases and ligation of the superior rectal artery preserving the left colic artery was performed in 34 cases. Ipsilateral lateral lymphadenectomy on the predominant side of the tumor, preserving the hypogastric nerves and pelvic plexus, was performed in 5 cases (Table 2).

Time of operation was  $203 \pm 54$  min in partial or total mesorectal excision cases and  $270 \pm 42$  min in total mesorectal excision with lateral lymph node dissection cases regardless to reconstruction. Blood loss was  $92 \pm 90$  g and  $276 \pm 66$  g respectively (Table 3).

### Postoperative Outcomes

The overall postoperative morbidity rate was 21.1%. The incidence of various morbidities is shown in Table 4; 7 leakage (10.6%), 3 transient urinary retention (4.1%), 4 wound infection (5.3%), and 1 small bowel obstruction (1.4%). Of 7 leakages, only one case required emergency re-operation of making diverting ileostomy with peritoneal lavage and drainage in laparoscopy and the other 6 patients conservatively recovered with drain spontaneously placed during operation. All the 3 with urinary dysfunction had the drain removed within 2 weeks with medical therapy. The patient with small bowel obstruction required placing an ileus tube for a week for decompression but not re-operation. There was no mortality regarding to the operation in our series.

All patients were out of bed on the first postoperative day of surgery. Flatus was passed after 1.8 days on average. The indwelling urinary catheter was removed after the first or second postoperative day, excluding three patients who developed urinary retention due to neurogenic bladder due to surgical procedure. The hospital length-of-stay was 11.7 days on average in cases without postoperative complications and 19.9 days on average in all cases including complications (Table 5).

TABLE 2 Variables of Operation (n=76)

Open conversion	4
Operation method	
Anterior resection with end-to-end reconstruction	55
Anterior resection with J-pouch reconstruction	14
Abdominoperineal resection	4
Hartman's operation	4
Lymph node dissection	
Ligation of IMA	40
Ligation of SRA	34
Palliative	2
With lateral lymph node dissection	5

TABLE 3 Operation Results

	Operation time	Blood Loss
Mesorectal excision	203±54 min	92±90g
Mesorectal excision with lateral lymph node dissection	270±42 min	276±66g

TABLE 4 Complications (n=76)

Anastomotic leakage	7 (10.6%)
Urinary retention	3 (4.1%)
Wound infection	4 (5.3%)
Small bowel obstruction	1 (1.4%)

TABLE 5 Short-term Outcomes

Amburation	1 POD
Bowel movement	1.8±0.9 POD
Discharge	11.7±3.2 POD

## DISCUSSION

Only sporadic reports have specifically addressed the laparoscopic surgery for rectal cancer despite the increase in recent attention to laparoscopic colorectal surgery. Regarding laparoscopic colon surgery, several randomized prospective studies referring to long-term outcomes have been published. Most of those report on the equivalence of cancer related survival between laparoscopic surgery and open surgery. These trends of advocating the validity of laparoscopic colon surgery have influenced the rectal field, and some prospective studies regarding laparoscopic total mesorectal excision for rectal cancer have been reported (7,8).

Surgical techniques for lower rectal cancers are determined by more individual factors than other types of colon cancer. For example, in a narrow pelvis it can be extremely difficult to resect. Even under the best conditions, preserving pelvic function while extirpating disease can be challenging. Preservation of controlled defecation is not discussed here. Micturition and sexual function are preserved by preserving the autonomic pelvic nerves, including both the hypogastric nerves and both pelvic plexuses. The chief aim of cancer surgery is to cure the patient, even at the expense of some functional impairment. However, a high percentage of patients who undergo surgery for lower rectal cancer suffer local recurrence and have poorer survival than patients with other

types of colorectal cancer. The development of total mesorectal excision by Heald *et al.* (14) in 1982 has markedly reduced the local recurrence rate after rectal cancer surgery (6,15-18). In this procedure, the mesorectum is dissected sharply in the "Holy plane" rather than using conventional blunt dissection (19). The local recurrence rate has decreased from 25 to 30 percent to 7 to 10 percent.

We designed this study for proving feasibility and excellence of short-term outcomes of not only laparoscopic total mesorectal excision for lower rectal cancer but partial mesorectal excision for upper rectal cancer and additionally of laparoscopic lateral lymph node dissection, but not for comparing to open rectal surgery. Recruiting patients within indication for laparoscopic procedure prospectively, 2 patients with pelvic space-occupying tumor and massive invasion to the posterior pre-sacral fascia were obliged to convert to open, in whom preoperative CT scan could not detect the findings. One patient was converted to open because of technical failure of rectal division laparoscopically in the early phase of this series. Those 3 cases of conversion, however, represent a relatively appropriate rate when comparing to other reports, although upper rectum cases were included in our series.

Concerning complications, there were relatively high rates of leakage compared to reports of open rectal surgery. This fact was discussed in some reports regarding to laparoscopic rectal surgery (7,8). We speculate the reason of high rate of leakage in laparoscopic rectal surgery as a difference of device and method for transecting the distal rectum from open surgery. Some efforts decreasing the leakage in laparoscopic procedure are required. We introduced a novel laparoscopic technique of transaction of the distal rectum using a conventional dividing device for open surgery under pneumoperitoneum since 2002 (20). Although no evidence was showed in this article, this technique is thought to be similar to the open technique. We report the rate of anastomotic leak as 10.6%, which compares favorably with the rate of leak in other reports of open series (13,14).

The incidence of urinary retention was 4.1% in our series. As there were few reports of laparoscopic total mesorectal excision referring to urinary function, this rate compares favorably with 9% by Morino *et al.* (7) and 2% by Quah *et al.* (21). Those reports all subjected total mesorectal excision whereas our series included cases with lateral lymph node dissection despite the fact that we did not assess the sexual function. Moreover, we determined urinary retention as a slight delay in removing the urinary catheter even if they were able to improve in a fortnight conservatively. Those who were obliged to place a urinary catheter forever reported in the past report are not noticed in our series. In any case, the mortality and morbidity in our series are 0% and 21%, which compare favorably with mortality ranging from 3% to 7% (13,14) and a morbidity of 36% to 53% (7,14).

Although some reports of laparoscopic total

mesorectal excision including long-term outcomes have already been published, no reports describing laparoscopic lateral lymph node dissection have been published so far. The aim of this report is displaying results of the laparoscopic mesorectal excision preserving the autonomic pelvic nerves additionally describing the laparoscopic lateral node dissection. Not until this year did we feel that advanced tumors below the peritoneal reflection could be resected safely and completely laparoscopically. Even concerning the laparoscopic total mesorectal excision, the feasibility and benefits have been discussed (22,23). However in 2002, a technique which provides a way to obtain pelvic exposure without touching the tumor was developed (24). In the technical paper, the upper rectum is manipulated using a monofilament ligature behind the mesorectum and traction on the ligature translates into traction on the rectum.

Concerning the lateral node dissection, its propriety has been debated. Although total mesorectal excision has decreased the rate of local recurrence dramatically, all local recurrence does not arise in the mesorectum, and actually about 10% to 25% of the advanced lower rectal cancers are associated with metastasis to lymph nodes along the iliac artery, including occult metastases, in the Japanese experience (11). In fact the lateral efferent lymphatic drainage system of primary rectal cancer was recognized as early as the 1930s (25,26). Ueno *et al.* (10) investigated the determinants of survival in rectal cancer patients with lateral lymph node metastasis and discussed the possibility of lateral dissection. However, most Western surgeons have not found that survival improves with lateral lymph node dissection and do not perform it (12). Japanese surgeons have developed methods for preserving the pelvic autonomic nerves related to sexual and urinary function in conventional open surgery for advanced rectal cancer (27,28). In this article, we demonstrated the feasibility of laparoscopic lateral lymph node dissection with preservation of the autonomic nerves. Although the number of the patients was small, there were no metastases in this series. We do not recommend this

procedure for more advanced and bulky lower rectal tumors that have apparently invaded the adventitia (T3), because in such cases, the tumor would hinder the view of the pelvic bottom which is not related to indication of lateral lymph node dissection.

Lastly, we ought to refer to operation and short-term outcomes. The mean operative time and blood loss of the laparoscopic mesorectal excision regardless of digestive reconstruction is 203 minutes and 92g respectively in our series, which appeared to be permitted in general, although few reports refer to the operation time and blood loss of open rectal surgery. The mean operative time and blood loss of the 5 cases of the mesorectal excision with lateral lymph node dissection in this series were relatively long and great. In all those cases, however, the total mesorectal excision was basically performed and the precise lateral lymph node dissection was added, which requiring another 70 minutes of time and 180g of blood loss. Concerning the postoperative course, all patients could walk on the first operative day and mean days of bowel movement assessed as flatus was 1.8 days. Those were similar to past reports. Although the postoperative hospital stay tends to be longer in Japan than other countries, our results appeared to be favorable even comparing within Japan. This may be due to differences of the medical insurance system and social background.

We concluded that the laparoscopic mesorectal excision with preservation of the autonomic pelvic nerves for rectal cancer in all sites is likely to be performed favorably. We hope that this article is regarded as a cohort study of laparoscopic rectal surgery including some lower rectal cancer cases by means of pelvic autonomic nerve preservation procedure. Although not only the relatively good operative results and short-term outcomes, but feasibility of laparoscopic lateral lymph nodes dissection were showed, large-scale randomized studies comparing laparoscopic and open surgery for rectal cancer, if possible including the lower site with lateral lymph node dissection, will be necessary to evaluate the benefits and long-term clinical outcomes.

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## 特集

## 直腸癌に対する腹腔鏡手術の問題点

## 直腸癌に対する腹腔鏡下手術

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**BACKGROUND:** Laparoscopic resection for rectal cancer has been considered to be technically difficult. In this study, results of laparoscopic resection for rectal cancer were evaluated. **METHODS:** A total of 113 patients who underwent laparoscopic resection for rectal cancer from August 1996 to June 2006 were analyzed. Of these, in 62 patients who underwent laparoscopic low anterior resection (LAR), indicators for difficulty of operative procedure were evaluated. **RESULTS:** Median operative time was 215 (range 120~413) minutes and median blood loss was 100 (range 10~1020) g. Conversion to open surgery was necessary in 5 patients (4.4%). Of several postoperative complications, anastomotic leaks were found in 11 patients (9.7%). Operation time and intraoperative blood loss were affected by Tumor size -Interspinous diameter of the midpelvis ratio (T/I ratio). **CONCLUSION:** Laparoscopic resection for rectal cancer is technically demanding procedure. It is important to perform safely rectal division and anastomosis. T/I ratio was considered to be an indicator for difficulty of laparoscopic LAR and be instructive in preoperative evaluation.

**Key words:** Laparoscopic surgery, LAR Difficulty

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## はじめに

直腸癌に対する腹腔鏡下手術は、開腹術に比べ、骨盤内視野の点で非常に良好で利点も多い<sup>1)</sup>。しかし、手技的に難度が高く、手術進行に困難な状況をしばしば経験する。今回われわれは、当科における腹腔鏡下での直腸癌に対する手術成績を検討し、手術難度の指標についても検討を加えた。

## 1. 対象と方法

1996年8月~2006年6月までに、当科にて施

行した腹腔鏡下大腸切除手術506例中、直腸癌に対して施行した113例を対象とした。これらの、患者背景、手術関連因子、および術後短期成績を検討した。術後短期成績については、観察期間を術後在院期間および退院後1カ月間とした。

また、腹腔鏡下手術における難度の評価については、開腹移行例、人工肛門造設例、他臓器合併切除例を除く直腸癌低位前方切除手術62例を対象とし、手術時間、出血量を指標とした検討を行った。そして、これらに影響を与える因子(腫瘍占居部位、BMI、開腹歴の有無、リンパ節郭清度、腫瘍最大径(mm)・坐骨棘間距離(mm)の比(T/I比))の検討を行った。坐骨棘間距離についてはCTでの骨盤計測法<sup>2)</sup>を用い計測した(図1)。

統計学的解析は、ロジスティック解析を用いて

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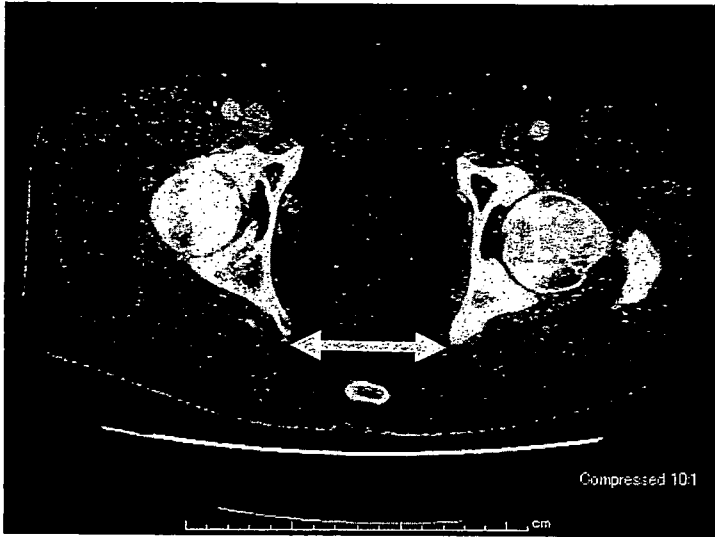


図1 CTでの骨盤計測法を用いて、大腿骨頭レベルにおける骨棘間距離(矢印)を計測



図2 全直腸間膜切除(TME)

多変量解析を行い、 $p$ 値0.05未満を有意差ありと判定した。

## 2. 腹腔鏡下直腸癌手術の適応

当科における手術適応については、1996年の腹腔鏡下大腸手術導入当初、Rs, Raの進行癌とRbの早期癌としていたが、2002年8月よりRbでも術前深達度がMPにとどまり、半周性以下の進行癌を含めている。

## 3. 手術手技

当科で行っている腹腔鏡下低位前方切除術手術は5ポートで行っている。内側アプローチを行っており、まず、岬角のレベルで直腸S状部の間膜を切離し、後腹膜下筋膜を温存する層にて頭側へ剥離を進める。進行度に応じてリンパ節郭清範囲は異なるが、下腸間膜動脈あるいは上直腸動脈の切離に引き続き、直腸S状部後面から左側に向かって剥離を進める。S状結腸間膜左外側の切離に移り、内側からの層と連続させる。次に、下腹神経から骨盤神経層を温存しつつ、尿管下腹神経筋膜の前面で、直腸固有筋膜を破らないように尾側へ剥離を進める。この際、上部直腸をモノフィラメント糸で絞り、左右に交互に牽引することにより、良好な骨盤内視野を得ることができ

る<sup>1)</sup>。前面はDenonvilliers筋膜を切除側につけるように剥離を行い、全周性に進め、肛門挙筋を確認する(図2)。このように、全直腸間膜切除(TME)を原則としているが、Rsに対しては肛門側の切除範囲は縮小する。Rb進行癌では骨盤神経叢を温存した片側の側方リンパ節サンプリングを行う。

肛門側直腸の切離・吻合において、当初は腹腔鏡用デバイスを用いていたが、2002年8月以降は、恥骨上に横方向に約5~6cmの小開腹(Pfannenstiel incision)をおき、ラップディスク®(八光商事)などを装着し、気腹下に開腹用デバイスを使用し切離する(図3)か、あるいは、肛門側直腸の肛門側への翻転法を用いて切離するかしている<sup>3)</sup>。

## 4. 結果

当科で行った腹腔鏡下直腸癌手術113例では、男性74例、女性39例で、平均年齢66.0歳であった。腫瘍占居部位は、Rs48例、Ra37例、Rb28例であった。EMR後の追加切除が5例あった。開腹術既往のある例は23例で、虫垂切除12例、産婦人科領域手術7例、開腹下胃切除術およびS状結腸切除術がそれぞれ1例、腹腔鏡下胆嚢摘出術が1例であった(表1)。術式は、高位前方切除術24例、低位前方切除術76



図3 気腹下に開腹用デバイスを使用し、肛門側直腸を切離

例, Hartmann手術4例, 直腸切断術8例, 内肛門括約筋切除1例を経験している。吻合はほとんどの症例で, Double stapling technique を用いた。手術時間の中央値は215分, 出血量の中央値は100gであった。開腹移行例は5例(4.4%)に経験し, 他臓器浸潤によるものが2例, 切離・吻合のトラブルによるものが3例であった(表2)。術後合併症については, 縫合不全11例(9.7%), 創感染5例(4.4%), 吻合部出血4例(3.5%)および排尿障害3例(2.7%)を認めた。死亡例はなかった(表3)。

今回, T/I比の計測を行ったが, 腫瘍径の平均値は38.8mm, 骨盤横径の平均値は93.4mmで, 今回検討した症例におけるT/I比の平均値は0.44であった。手術難度について, まず, 手術時間に影響を与える因子を検討したところ, T/I比のみ有意に関連していた(表4)。同様に, 出血量について検討したところ, T/I比が出血量に影響している傾向にあった(表5)。

### 5. 考察

近年, 腹腔鏡を用いた結腸癌手術の有用性が示されている。とくに, 直腸癌に対する腹腔鏡下手術では, 開腹術に比べ, 骨盤内視野の点で非常に良好で利点も多い<sup>1)</sup>。しかし, 手技的に難度が高

表1 患者背景

性別	男性74例, 女性39例
年齢	平均66.0(41~94)歳
腫瘍占居部位	
Rs	48例
Ra	37例
Rb	28例
AVからの距離	平均10.0(2~20)cm
術前治療	
EMR	5例
放射線化学療法	1例
開腹術既往	
虫垂切除	10例
産婦人科領域手術	7例
開腹胃切除術	3例
開腹S状結腸切除術	1例
腹腔鏡下胆嚢摘出術	1例
腹部外傷手術	1例

く, 手術進行に困難な状況をしばしば経験する。そして, 根治性の面から, 低位の直腸癌手術においてはTMEが標準手術となってきており<sup>4,5)</sup>, さらなる技術が要求される。自験例における術後合併症の発生をみると, 低位の術式にみられ, 高位前方切除術ではみられなかった。手術難度も影響しているものと思われた。当科で行った腹腔鏡下直腸癌手術113例の中では, 縫合不全を11例(9.7%)に認めた。これまでの報告においても,