is used to prevent an increase in abdominal or vertebral venous pressure. Bleeding caused by the increase of vertebral venous pressure makes sacral amputation complicated. The median incision is made approximately 10 cm longer toward the head from the planned line of sacral amputation. The gluteus maximus muscle is detached from the sacrum so that the posterior surface of the sacrum can be exposed fully. The next step of this phase involves detaching the sacrotuberous and sacrospinous ligaments and piriform muscle that fix the sacrum. After dissecting these structures, the sacral nerve plexus also can be checked.

The surgeon inserts an index finger into the pelvic cavity from the lower edge of the sacroiliac joint and checks the dissected level of the anterior surface of the sacrum to determine the level of sacral amputation. The medial sacral crest is scraped, laminectomy is performed, and the root of the second sacral nerve is identified. The caudal end of the dura usually extends to around the lower edge of the S2. The dura, together with the cauda equine, is tied and divided. The surgeon performs sacral amputation using chisel and hammer at a stretch (Fig. 4). Hemostasis is performed quickly using electric cautery and bone wax. In men, after checking the stump of the urethra, the urethra is closed tightly to prevent transurethral infection. The origins of the gluteus maximus muscle, the subcutis, and the skin are closed tightly.

Urinary diversion, prevention of pelvic sepsis, and wound closure

The patient is placed in the lithotomy position. Reconstruction of the urinary tract using ileal conduit and colostomy is performed. Mobilization of the right colon from the cecum to the hepatic flexure enables construction of a high urostoma. After constructing the ileal conduit, an ileoileostomy

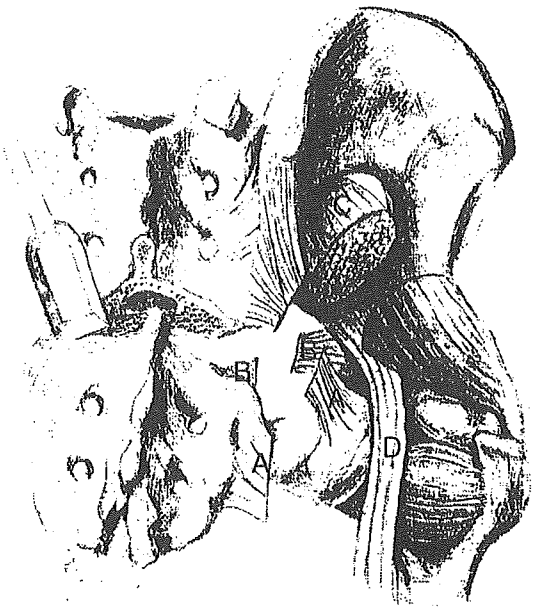

Fig. 4. Sacral amputation in prone position. (*A*) Sacrotuberous ligament. (*B*) Sacrospinous ligament. (*C*) Piriform muscle. (*D*) Sciatic nerve.

should be lifted up above the pelvic brim and fixed to the mesentery so that it will not fall in the pelvic cavity. This procedure is invariably required to prevent anastomotic leakage secondarily caused by pelvic sepsis, especially after radiotherapy. If the greater omentum is long enough with favorable blood flow, omentoplasty into the pelvic cavity should be performed. In patients who have recurrent tumor invading the perineal skin, it is necessary to combine a wide resection of the perineal skin. In such cases, reconstruction should be performed with a musculocutaneous flap [20,30]. It is appropriate that gastrostomy be performed before closing the abdomen, because enteroparalysis continues for a while after TPES. A thick drain is placed in the pelvis, and then the abdomen is closed.

Surgical invasiveness and oncologic outcomes after total pelvic exenteration with distal sacrectomy

Margins were microscopically negative in 57 patients (83%) and positive in 12. A comparison between two periods (1983–1992 and 1993–2003) showed a mean blood loss decrease from 4229 to 2102 mL ($P < 0.001$), with a favorable learning curve (Table 2). There was no difference in operative time and hospital stay. The most common level of sacral amputation was the S3 superior margin in 26 cases, followed by the S3 inferior margin and S2 inferior margin (Table 3). Overall mortality and complication rates were 3% and 58%, respectively. There was no hospital death in the latter period. The most frequent complication was sacral wound dehiscence in 51%, followed by pelvic sepsis in 39%. The incidence of pelvic sepsis in the latter period decreased significantly to 27%, compared with 72% in the former period ($P = 0.038$). Enteroperineal fistulae were observed in four cases.

Survival curves show overall 3- and 5-year disease-specific survival rates of 58% and 40%, respectively. In 57 patients with R0, including 5 patients with hepatic metastasis, 3- and 5-year disease-specific survival rates were 67% and 49%, respectively, whereas there was no 4-year survivor in patients with margin-positive, which showed significantly poor prognosis ($P < 0.001$) (Fig. 5). There was no survival difference between patients with and without radiotherapy before re-resection. Fourteen patients had lateral node metastases around the internal iliac vessels. Of these 14 patients, 6 are alive and 3 were long-term survivors for 64, 71, and 141 months, respectively.

Table 2
Surgical invasiveness and hospital stay

Operative burden	Former period (1983–1992) mean $n = 18$	Latter period (1993–2003) mean $n = 51$	P-value
Operative time (min)	769 (370–990)	702 (480–1100)	NS
Blood loss (mL)	4229 (1800–16,300)	2102 (673–8468)	$P < 0.0001$
Hospital stay (d)	37.5 (23–200)	34 (21–257)	NS

Table 3
Level of distal sacrectomy and complications

Level of sacrectomy	Sepsis in pelvis	Ileus	Fistula[a]
Middle amputation			
S2 inferior margin (n = 12)	6	2	1
S2-3 (n = 26)	9	1	1
Low amputation			
S3 inferior margin (n = 16)	8	1	2
S3-4 (n = 10)	2	1	
S4 inferior margin (n = 5)	2		

[a] Fistula: enteroperineal fistula caused by anastomotic leakage.

Of 57 patients with R0 resection, 34 developed re-recurrence. The most common site was the lung (18 patients) followed by the pelvis (12 patients).

Oncologic outcomes reported in the literature

Factors such as type of surgery, combined therapy, and postoperative follow-up period are diversified, and comparison of reported oncologic outcomes for LRRC is of small significance. For example, a study that includes patients with recurrence after local excision naturally should show favorable outcome, whereas in a study conducted only with cases of FRT, unfavorable outcome can be predicted. Lopez-Kostner et al [33] reported a 5-year survival rate of 32% in 43 patients who underwent surgical treatment, 11 of whom developed recurrence after local excision. On the other hand, Bozzetti et al [18] showed a 5-year survival rate of less than 10% in patients who underwent surgery alone and pointed out a limitation of outcome after surgical treatment alone. Regarding 5-year survival after

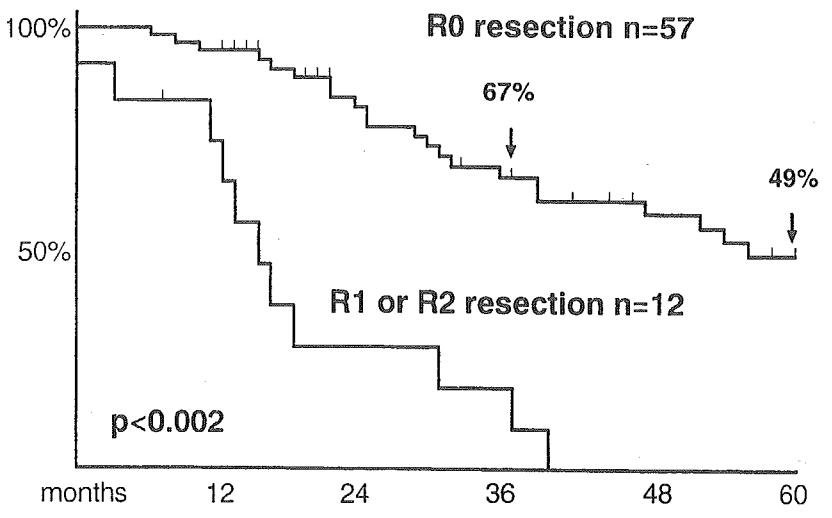

Fig. 5. Disease-specific survival curve. The difference between the two groups was significant ($P < 0.001$).

composite resection, Wanebo et al [19] reported a rate of 31%, Maetani et al [10] reported a rate of 25%, and Yamada et al [21] reported a rate of 18%. Those are not satisfactory outcomes. Incidence of local re-recurrence ranges from 27% to 61% [10,19,31].

As for outcome after multimodality therapy, there are many reports in which the ordinary dosages of radiation used preoperatively were 45 to 50 Gy. Intraoperative dosages of 10 to 15 Gy in R0 cases and 15 to 20 Gy in R-positive cases also were reported [24–29]. Valentini et al [24] reported a 5-year survival rate of 22%, and Mannaerts et al [23] reported a 3-year survival rate of 60%. In the series by Shoup et al [25], who investigated outcomes after resection plus intraoperative radiotherapy, patients with R0 had a median disease-free survival of 31 months and a median disease-specific survival of 66 months.

Lung metastasis and local re-recurrence account for nearly 90% of all re-recurrence patterns [31], and measures to prevent these two types of re-recurrence are important. Compared with 20 years ago, when the only effective antitumor agent was 5-fluorouracil, some effective antitumor agents (eg, CPT-11, UFT, capecitabine, and oxaliplatin) have become available. We think that surgical treatment, combined with composite resection and intraoperative radiotherapy, is indispensable for improving local control rates and that an effective chemotherapy regimen after re-resection is indispensable for inhibiting lung metastasis.

Prognostic factors and staging system

Several factors, such as type of initial surgery, tumor size, presence of symptoms, and serum carcinoembryomic antigen level, have been regarded as significant prognostic indicators, although a consensus has not been reached yet. Willet et al [11] and Wanebo et al [19] found improved resectability in patients who underwent initial low anterior resection compared with patients who had initial APR. If FRT developed after low anterior resection, however, there was no difference in resectability and survival between them [31]. Shoup et al [25] indicated that vascular invasion and R1/R2 resection are factors for poor prognosis. In either report, the most important factor is whether R0 resection was attained [19,24,25,27,31]. Researchers already have shown that in surgical treatment for primary rectal cancer, surgery-related and biologic factors are crucial [34]. Surgical margin status and complications are exclusively determined by a surgeon's technical skills. Complicated surgeries, such as TPES or abdominosacral resection, should be undertaken only in specialized centers with an experienced complex treatment team.

Suzuki et al [14] judged the degree of fixation to surrounding structures according to surgical and pathologic findings and proposed their own staging method. Valentini et al [24] also reported a similar staging system in

which they judged from CT scan imaging. They mentioned that degree of fixation is an independent prognostic factor. Wanebo et al [19] proposed a new staging system for stages TR1-2 to TR5, which are determined by extent of invasion. A staging system that uses degree of fixation or other prognostic factors is constructed so that treatment modalities for LRRC, especially surgical treatment, are placed in an appropriate position.

Summary

For primary rectal cancer, there is a difference in therapy between Western countries and Japan. In Western countries, initial surgery is total mesorectal excision or less limited surgery plus radiotherapy. For this reason, fibrosis caused by radiation occurs in the pelvis. On the other hand, in Japan, although preoperative radiotherapy is not given, total mesorectal excision or more extended surgery is performed as initial surgery, and the intrapelvic spaces are covered with postoperative scar tissue. In identifying an anatomic index and doing hemostasis, this scar tissue brings the surgeon more difficulty than the fibrosis caused by radiotherapy. Approximately half of our patients are irradiated preoperatively for recurrence. In those patients, operation is performed under an unfavorable condition because the fibrosis caused by radiation is added to the scar tissue caused by dissection. Composite resection, such as TPES, has been thought to be demanding and formidable because of high mortality and morbidity rates. Improvement of surgical techniques has allowed TPES to be completed with a blood loss of approximately 2000 to 3000 mL, however, which has resulted in a favorable learning curve with low morbidity and mortality rates.

We have excluded tumors that grow into the sacral promontory or sciatic notch from surgical indications. If high sacral amputation is performed, increased surgical invasiveness, more serious complications, and inevitable walking disorders are observed; as a result, a patient may have a remarkably deteriorated quality of life [6,9,12,19]. We have limited the level of sacral amputation in TPES to the S2 lower edge or below to preserve the second sacral nerve. Consequently, patients were able to have favorable quality of life after TPES, except for living with double stomas and temporary pain caused by resection of sacral nerves, and they were able to return to their original occupations [31,35].

If oncologic outcome obtained is superior to that after multimodality treatment, composite resection for FRT also may become an acceptable treatment. Finally, it should be noted that when extended surgeries, such as TPES, are performed for FRT, each of the departments concerned should review surgical indications and the surgeries must be worked on in the form of team medicine. One must realize that only through such process can negative resection margins be obtained as a great boon to patients.

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Original Paper

Postsurgical Surveillance for Recurrence of UICC Stage I Colorectal Carcinoma: Is Follow-up by CEA Justified?

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KEY WORDS:
UICC stage I colorectal carcinoma; Follow-up; Surveillance; CEA

ABBREVIATIONS:
Carcinoembryonic Antigen (CEA)

ABSTRACT

Background/Aims: This study was undertaken to investigate whether it will be possible to reduce the times and types of postoperative examinations for surveillance in patients with UICC stage I colorectal carcinoma. In addition, the value of CEA in postoperative surveillance is discussed.

Methodology: A review was performed of 541 patients who underwent curative resection for UICC stage I colorectal carcinoma between January, 1985 and December, 1998. Periodic check-up was routinely conducted to identify recurrence.

Results: The median follow-up was 82 months. The recurrence rate was 2.9% in the UICC stage Ia (pT1N0M0) group, and 5.6% in the Ib (pT2N0M0) group. Cancer-specific survival rates at 5 years were 99.3% and 97.6%, respectively (p=0.0354). Recurrences occurred more frequently in patients with lower rectal carcinoma (p=0.0415). Curative-intent salvage surgery was performed in 61.9% (13/21) for recurrent lesions. Between the patients who were CEA positive (13/21; 61.9%) and those who were CEA negative at the time of recurrence, there was no significant difference in the prognosis.

Conclusions: The incidence of recurrence was low after curative surgery in patients with UICC stage I colorectal carcinoma, and it is therefore possible to reduce times and types of postoperative examinations. CEA measurement alone appears to be sufficient.

INTRODUCTION

Currently, a main topic for discussion with regard to the surveillance after colorectal carcinoma surgery is whether intensive follow-up for detecting recurrence earlier and initiating the treatment of it practically contributes to the improvement in prognosis for colorectal carcinoma patients. In nonrandomized cohort studies and randomized studies, significant differences in the time of confirming recurrence, the surgical resectability of recurrent lesion, and the 5-year survival rate between intensive follow-up group and control group (traditional follow-up or no follow-up group) were reported (1-5). At the same time, there are other studies that have reported no significant difference in these points (6-12). However, in those previous studies, the numbers of cases that were reviewed ranged from 98 to 1247, and there were a variety of disease stages from UICC stages I through IV. One study reported that although the resectability after recurrence was higher by more than 10% in an intensive follow-up group than in the control group, no significant difference was obtained, probably due to the small number of cases (13). In two studies using meta-analysis that were reported lately, the 5-year survival rates were 9% to 14% greater in the intensive follow-up group than in the control group (14,15).

Recently, advances in diagnostic techniques have enabled the detection of colorectal carcinoma at earlier stages in Japan (16). At our institution, the proportion of UICC stage I cases in all colorectal carcinoma patients receiving the first-line treatment was 14% (12/86) in 1980, but it increased to 25% (71/284) in 2000. It is important to conduct a cost-effective follow-up in view of the risk for recurrence (17,18). In fact, for UICC stage I colorectal carcinoma patients, the rate of recurrence is lower, and hence fewer times and screening examinations may be reasonable and warranted for the postoperative surveillance, compared with UICC stages II-IV colorectal carcinoma patients (19).

In the present study, we utilized the prospective follow-up database at a single institution to analyze the long-term outcomes of UICC stage I colorectal carcinoma patients, and to investigate whether it will be possible to reduce the times and types of screening examinations for postoperative surveillance. In addition, the present study discusses the value of CEA (carcinoembryonic antigen) in performing surveillance after curative surgery for UICC stage I colorectal carcinoma.

METHODOLOGY

Between January, 1985 and December, 1998,

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2,550 primary colorectal carcinoma patients were treated at our institution. Patient information and follow-up data were prospectively collected and added to the department database. Of those patients, the present study selected 541 (21.2%) cases of UICC stage I colorectal carcinoma undergoing curative resection combined with surgical lymph node clearance, in order to review the time and form of recurrence, the changes in CEA levels at recurrence, and the rate of re-resectability. For analysis, the 541 cases of UICC stage I colorectal carcinoma were divided into two groups: 313 patients with stage Ia colorectal carcinoma (pT1N0M0) and 228 patients with stage Ib colorectal carcinoma (pT2N0M0).

In terms of the follow-up of a patient with stage I colorectal carcinoma, we routinely conducted a periodic check-up every six months until two years after the operation, and subsequently once per year from the 3rd to 5th postoperative year. Clinical examination, abdominal ultrasound, and CEA measurement were performed at each visit, and chest X-ray was performed once per year. CEA was defined as positive when the level was increased above the cut-off value. Colonoscopy or barium enema was conducted once within one year of the first surgery, and was repeated at intervals of one to two years depending on the findings of the prior examination. When a patient complained of a symptom that suggested recurrence or had an increased level of CEA without symptoms, we employed other types of examinations in addition to the periodic check-up.

The clinicopathologic parameters were compared using Student's t test and the Fisher's exact test as appropriate. Cancer-specific survival curves and disease-free survival curves were estimated using the Kaplan-Meier technique and were compared by means of the log-rank test. For cancer-specific survival, only cancer-related deaths were considered; data on the patients who died from other causes or who were still alive at the end of the study were censored. A P value of less than 0.05 was considered significant.

TABLE 1 Patient's Characteristics

		UICC stage Ia patients	UICC stage Ib patients	P value
Number of patients		313	228	
Sex ratio (Male:Female)		201:112	129:99	0.0750
Age (yr; mean and range)		60.7 (33-88)	62.0 (23-91)	0.1641
Location	Cecum	16	14	0.0003*
	Ascending colon	23	15	
	Transverse colon	18	7	
	Descending colon	7	5	
	Sigmoid colon	122	53	
	Upper rectum	28	23	
	Middle rectum	34	31	
	Lower rectum	65	80	
Operative procedures	Partial resection	45	4	
	Ileocecal resection	11	4	
	Right hemicolectomy	15	25	
	Transverse colectomy	3	5	
	Descending colectomy	7	2	
	Left hemicolectomy	0	4	
	Sigmoid colectomy	105	49	
	Anterior resection	91	93	
	Abdominoperineal resection	14	35	
	Abdominosacral resection with coloanal anastomosis	4	2	
	Transsacral partial resection	17	0	
	Hartmann's operation	1	4	
	Total pelvic exenteration	0	1	
Follow-up time (mo; range and median)		3-189 (80)	1-201 (85)	
Recurrence	Positive	9	12	0.1793
	Negative	304	216	
Sites of First Tumor Recurrence	Liver	7	5	
	Lung	1	6	
	Local			
	Pelvis	1	2	
	Anastomosis	1	1	
	Para-aortic lymph node	0	1	
Oncologic outcome	5-Year disease-free survival (%)	96.9	94.9	0.1575
	5-Year cancer-specific survival (%)	99.3	97.6	0.0354

*colon and upper/middle rectum *vs.* lower rectum.

RESULTS

The patient demographics are summarized in **Table 1**. Compared with the UICC stage Ia group, the UICC stage Ib group included significantly more patients with lower rectal carcinoma ($p=0.0003$). Recurrence occurred in 9 of 313 (2.9%) UICC stage Ia group, and in 12 of 216 (5.6%) UICC stage Ib group. However, the difference between the two groups was not significant ($p=0.1793$). Disease-free survival rates at 5 years were 96.9% for the UICC stage Ia group and 94.9% for the UICC stage Ib group **(Figure 1a)**, with no significant difference between the two groups ($p=0.1575$). Cancer-specific survival rates at 5 years were 99.3% for the UICC stage Ia group and 97.6% for the UICC stage Ib group **(Figure 1b)**; there was a significant difference between the two groups ($p=0.0354$).

The performance rate of curative-intent salvage surgery for recurrent lesions in these recurrent carcinoma patients was 61.9% (13/21) **(Table 2)**. Recurrence was found at a median time of 19 months (range 6-66) after primary carcinoma resection. Only one patient with pelvic and hepatic recurrence was found after five-year routine follow-up.

Since the proportion of lower rectal carcinoma patients was significantly elevated in the UICC stage Ib group, we divided the sites of carcinoma into the lower rectum and other parts to evaluate recurrence rates and prognoses **(Table 3)**. Recurrences occurred in 10 of 145 (6.9%) patients with lower rectal carcinoma, and in 11 of 396 (2.8%) patients with colon or upper/middle rectal carcinoma. Between these two groups, the difference in the recurrence rate was significant ($p=0.0415$). Disease-free survival rates at 5

years in patients with lower rectal carcinoma were 92.6%, and 97.3% in patients with colon or upper/middle rectal carcinoma **(Figure 2a)**, with the difference between the two groups significant ($p=0.0304$). However, the cancer-specific survival rates at 5 years were not significantly different between the groups ($P=0.2402$) **(Figure 2b)**.

Among the 21 recurrent cases, 13 (61.9%) individuals were CEA positive at the time of recurrence **(Table 4)**. With regard to the recurrent site and CEA positive rate, patients with hepatic recurrence showed a significantly higher rate of CEA positivity, compared with the patients with recurrence at other sites ($p=0.0272$). Between the patients who were CEA positive and those who were CEA negative at the time of recurrence, no significant difference in the prognosis after the detection of recurrence was found **(Figure 3a)**, in addition to in the prognosis after the first surgery **(Figure 3b)**.

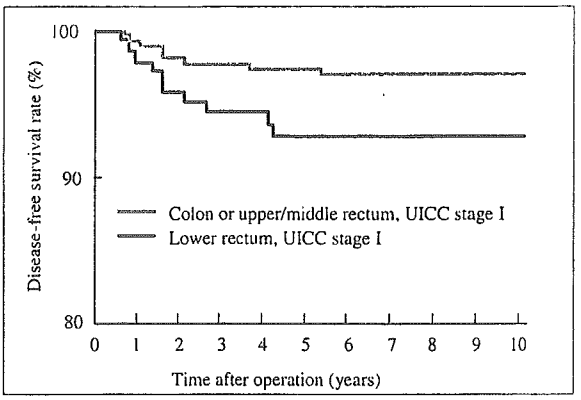

FIGURE 2a Cumulative disease-free survival curves for patients with lower rectal carcinoma and colon or upper/middle rectal carcinoma. The difference between the two groups was significant ($p=0.0304$).

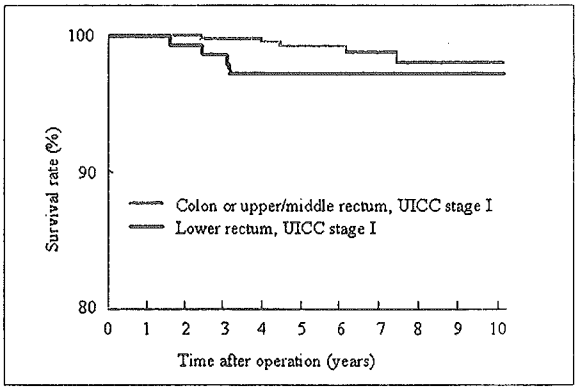

FIGURE 2b Cancer-specific survival curves for patients with lower rectal carcinoma and colon or upper/middle rectal carcinoma. The difference between the two groups was not significant ($p=0.2402$).

FIGURE 1a
Cumulative disease-free survival curves for UICC stage Ia group and UICC stage Ib group. The difference between the two groups was not significant ($p=0.1575$).

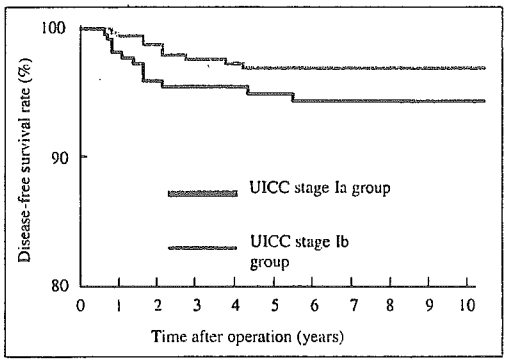

FIGURE 1b
Cancer-specific survival curves for UICC stage Ia group and UICC stage Ib group. The difference between the two groups was significant ($p=0.0354$).

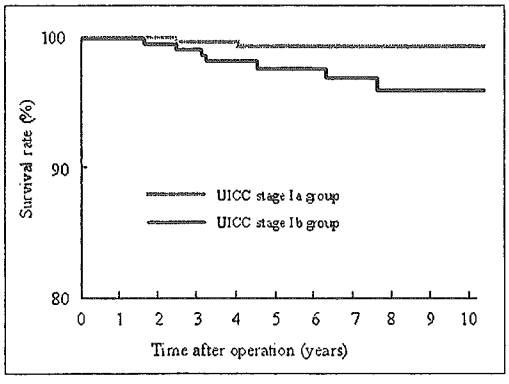

TABLE 2 Treatment of Recurrent Cancers

Treatment	No. of patients
Resection	
APR+radiation	3 (2*)
TPE+combined resection of sacrum	1 (1)
hepatic resection	9 (7*)
lung resection	5 (5)
Systemic chemotherapy	2
Hepatic artery infusion	2
Pelvic radiotherapy	1

( ), number of patients having curative-intent salvage surgery. *two patients underwent curative-intent salvage surgery for pelvic and hepatic recurrences.

DISCUSSION

For surveillance after curative surgery for colorectal carcinoma, a cost-effective method of follow-up should be established for consideration of the risk for recurrence. The probable subjects that the numbers of times and follow-up examinations can be reduced are UICC stage I patients. In the present study, we carried out follow-up examinations of a large number of UICC stage I patients over a long period at a single institution, and analyzed the data to clarify an appropriate method of surveillance. The present findings demonstrated that compared with the UICC stage Ia group, the UICC stage Ib group had a significantly lower rate of 5-year cancer-specific survival. In addition, lower rectal carcinoma involved a significantly higher incidence of recurrence. A recent study by Wichmann *et al.* (19) reported that between UICC stages Ia and Ib, there was an approximately 10% difference in the 5-year survival rate, although the difference did not achieve significance due to the small number of study patients. In the present study, however, the number of UICC stage I patients who were investigated was

much larger compared with the numbers reported in former studies, suggesting that the present study findings may help establish a method of follow-up for UICC stage I patients in the future.

In most carcinomas other than colorectal carcinoma, when recurrence is discovered after resection of the primary lesion, they are treated as a systemic disease and salvage surgery is infrequently indicated for the recurrent lesion. However, in colorectal carcinoma, resection of the recurrent lesion may improve patient prognosis. In this respect, research is required to determine whether intensive follow-up for detecting recurrence earlier and initiating the treatment of it will lead to improvement in prognosis for colorectal carcinoma patients. In earlier studies, the numbers of examinations and times of the check-up conducted were different (1-13). As a matter of course, it should be recognized that with advances in technologies, the precisions diagnostic examinations are being enhanced, and new effective methods of examination are being developed. Moreover, the treatment regimens have been changing rapidly; in recent years the indications for aggressive surgical resection for recurrent lesions have been expanded, and new chemotherapies that are useful for improving patient prognosis have been identified (20-23). For the reasons mentioned above, a study that retrospectively confirms the usefulness of follow-up will not able to avoid a bias caused by the times when the study was performed.

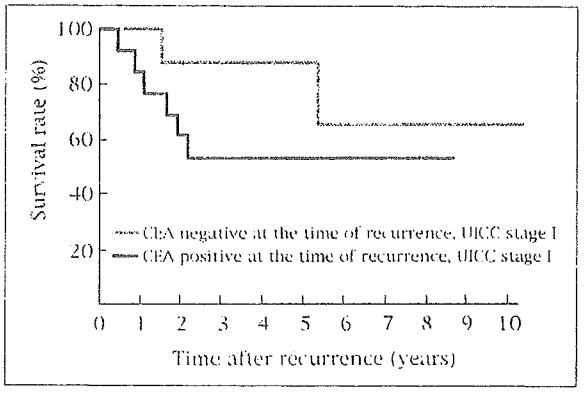

FIGURE 3a Cancer-specific survival curves after the detection of recurrence for patients who were CEA positive and CEA negative at the time of recurrence. The difference between the two groups was not significant ($p=0.2734$).

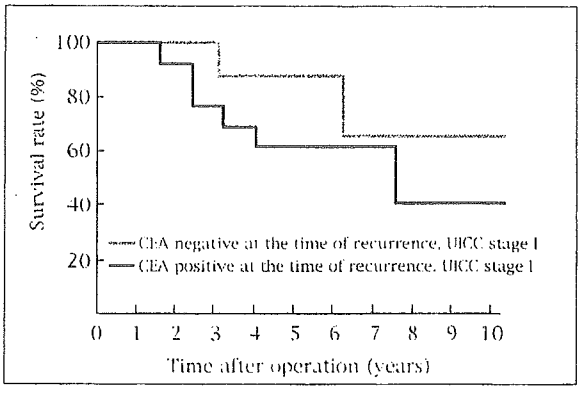

FIGURE 3b Cancer-specific survival curves after the first surgery for patients who were CEA positive and CEA negative at the time of recurrence. The difference between the two groups was not significant ($p=0.3558$).

TABLE 3 Site of the Primary Tumor and Recurrence

	Colon and upper/ middle rectum	Lower rectum	*P* value
Number of patients	396	145	
Recurrence			
Positive	11	10	0.0415
Negative	385	135	
Oncologic outcome			
5-Year disease-free survival (%)	97.3	92.6	0.0304
5-Year cancer-specific survival (%)	99.1	97.1	0.2402

TABLE 4 Recurrent Disease and Results of Tumor Marker Monitoring at the Time of Recurrence

Tumor marker monitoring	Elevation	No elevation	*P* value
Number of patients	13	8	
Sites of recurrence			
Liver	11	1	0.0272
Lung	2	5	
Local (Pelvis and anastomosis)	3	2	
Para-aortic lymph node	1	0	
Interval to recurrence (mo; range and median)	6-66 (19)	9-32 (18)	0.3348
Oncologic outcome 5-Year survival following first recurrence (%)	52.7	87.5	0.2734
5-Year survival after primary surgery (%)	61.5	87.5	0.3558

With regard to the value of CEA in the postoperative surveillance, some benefits have been reported from the viewpoint of earlier detection of recurrence and cost-effectiveness in detecting potentially curable recurrent disease (24-26). However, no conclusion has been reached whether the earlier detection of recurrence using CEA may influence the prognosis. In the present study, 62% (13/21) of patients with recurrence showed an increased CEA level at the time of recurrence. In these patients, the follow-up that used CEA alone might have enabled the confirmation of recurrence if diagnostic imaging was performed at the point when an increased level of CEA was recorded. However, the question here is about those cases in which recurrence was confirmed first by diagnostic imaging without showing an increased level of CEA. Of these patients, 75% (6/8) remain disease-free to date, and there is a possibility that with the follow-up using CEA alone, asymptomatic recurrences without CEA elevation may not be detected. However, these 6 patients comprised only 1.1% (6/541) of all study patients, and it may therefore be inefficient to conduct the usual postoperative surveillance while burdening the remaining 99% patients with huge costs and effort. In all UICC stage I carcinoma patients, there was a low recurrence rate of 3.9% (21/541), and in addition,

because two-thirds of recurrences could be identified using CEA, the CEA test alone may be adequate at each visit, at least for UICC stage I patients.

Another problem in the CEA examination is that encountering a patient who shows false-positivity is inevitable. Moertel *et al.* (27) reported that when the preoperative CEA level was 5ng/mL or higher, false-positivity may appear approximately in 30% of such cases. If a UICC stage I patient shows an increased CEA level during the follow-up that uses CEA alone, it may be necessary to perform examinations for other carcinoma occurrences in addition to the metastasis and recurrence of the primary colorectal carcinoma.

A noteworthy aspect of the present study was that the patients with lower rectal carcinoma showed a significantly higher incidence of recurrence. Wichmann *et al.* (19) also reported that although there was no significant difference across UICC stage I patients, rectal carcinoma involved a higher rate of recurrence, with particularly more local recurrence, compared with colon carcinoma. The CEA positive rate in patients with local recurrence of rectal carcinoma was not as high as that in patients with hepatic metastasis (2,27,28). Hence, especially in conducting follow-up examinations of patients with lower rectal carcinoma, special attention should be paid to local recurrence, and when any symptom such as pain, hemorrhage, or change in bowel habit appears, necessary examinations should be performed early.

In the present study, the UICC stage Ia group included a significantly smaller number of patients with lower rectal carcinoma. This may be because some patients who had pT1 carcinoma at the lower rectum were followed up after undergoing trans-anal resection alone. The treatment of T1 and T2 carcinoma of the lower rectum is controversial, and several studies have suggested satisfactory tumor control after local excision for lower rectal T1 and T2 carcinoma (29,30). However, recent studies suggested that local excision of T1 and T2 rectal carcinoma is followed by a much higher recurrence rate than previously reported (31,32). In our institution, a radical surgery of low anterior resection or abdominoperineal resection is often indicated for T2 lesions and most T1 lesions with adverse risk factors, especially poorly differentiated carcinoma, lymphovascular invasions, incomplete excision, or massive invasion of carcinoma to the submucosal layer. Although most patients with T1 and T2 carcinoma lesions in the lower rectum in whom local recurrence develops after local excision can be salvaged by radical resection, the long-term outcome remains unknown (33).

In the field of the postoperative follow-up examination, the value of colonoscopy has been discussed. Periodic colonoscopy may be useful for detecting anastomotic and locoregional recurrences after colorectal carcinoma operation in addition to finding metachronous colorectal carcinoma (34,35). However, in UICC stage I patients, the anastomotic and locoregional recurrences have involved a very low proportion of 1% to 3%, according to previous and the present study (19). Particularly in patients with colonic carcinoma, there have been no anastomotic or locoregional recurrences observed at our institution. Performing colonoscopy is not warranted for the purpose of detecting anastomotic and locoregional recurrences in UICC stage I patients.

In conclusion, for UICC stage I patients, the incidence of recurrence was lower, and it is therefore possible to reduce the times and screening examinations for the postoperative surveillance. Regarding screening examinations, the CEA measurement every six months until two years after the operation, and subsequently once per year until the 5th postoperative year appears to be sufficient. Nevertheless, for patients with UICC stage Ib disease and those with lower rectal carcinoma, oncologists need to pay special attention because the rates of recurrence are significantly higher.

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転移・再発時の治療戦略

藤田　伸*

はじめに

転移・再発が生じるとその治療成績は大幅に低下する．しかし，大腸がんはほかのがんに比べると，転移・再発に対して外科治療が有効であり，外科的切除できるかどうかは大きな治療上の分岐となり，当然，治療成績も大きく異なる．ここでは，大腸がんの転移・再発の部位と頻度，そして肝，肺，局所，その他の比較的まれな転移・再発の治療戦略について述べてみたい．

転移・再発部位と頻度

大腸がんの転移頻度を，大腸癌研究会の大腸癌全国登録(1998年登録症例)の結果を表1に示す．転移例の半数以上が肝転移，次いで腹膜播種，肺転移であることがわかる．次いで，国立がんセンター中央病院の1985～1995年の10年間の治癒切除症例(遠隔転移がなく，がんをすべて切除できた症例)の再発部位を表2に示す．再発部位も再発例の約半数が肝臓で，次いで肺，局所再発の順である．大腸がんに限らず消化器のがんで転移・再発頻度の高い臓器は肝臓であり，治療戦略を考えるときに最大の問題となる．

▼表1　大腸がんの転移部位と頻度

転移部位	症例数(%) 5,573(100%)
転移なし	4,451(80%)
肝	603(11%)
腹　膜	277(5%)
肺	104(2%)
その他	58(1%)

その他の転移は，骨，脳，副腎など．(大腸癌全国登録1998年症例)

▼表2　大腸がん治癒切除後の再発部位と頻度

再発部位	症例数(%) 1,955(100%)
再発なし	1,448(74%)
肝	229(12%)
肺	155(8%)
局所再発	124(6%)
腹　膜	37(2%)
その他	47(2%)

その他の転移は，骨，脳，リンパ節など
(国立がんセンター中央病院1985年から1995年症例)

肝転移・再発の治療戦略(図1)

以上述べたように，大腸がんの肝臓への転移・再発は，転移・再発症例の半数を占めるため，この治療戦略はきわめて重要である．肝転移が発見されたときの治療戦略は，まず，肝転移が切除可能かどうかを判断する．切除可能と判断されれば，手術が原則である．肝転移に対する手術の有効性に関しての臨床試験は行われていないものの，過去

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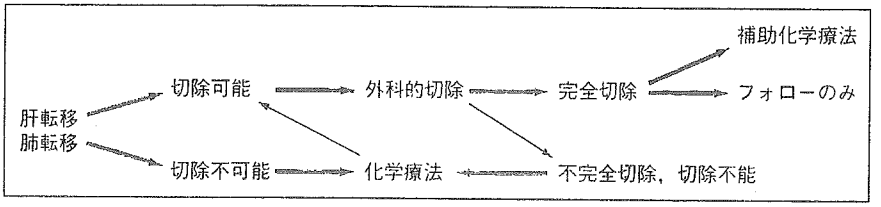

▶図1　肝転移，肺転移の治療戦略
太い矢印は現在の主流を示し，細い矢印は主流ではないか，臨床試験が必要なものを示している．

の多数の肝転移切除の成績が5年生存率で30～40％を示していることと，他の治療法ではそのような高い生存率は示されていないため，現段階では他の治療法との比較試験は，倫理的に実施できない．その点は，ほかの転移・再発の治療も同様である．

肝切除が可能な条件は，

(1)　適度の残肝量（術後の侵襲に耐え生体を維持できる量のことで，術前ICG値と切除予定量で判断する）を保って，肝転移を切除可能なこと

(2)　原発大腸がんが完全切除可能なこと，あるいはされていること

(3)　肝臓以外に転移・再発がないこと

の以上3点で，単純に肝転移個数，大きさで決めているわけではない．もちろん，転移個数が増えるにつれて切除の可能性は低下するので，一般的には，転移個数4～6個程度が切除の適応であると理解しておくのがわかりやすい．肝切除法は，その部位，個数により異なるが，できるだけ正常肝を温存して，病巣を切除するので，原則的に部分切除を行い，必要に応じて区域切除，葉切除，拡大葉切除を行う．個数が多ければ，これらを組み合わせた，たとえば，部分切除と葉切除という切除も行うこともある．

肝転移切除後の補助化学療法の有効性は証明されていないため，補助化学療を行うのであれば，臨床試験として行うか，患者に十分説明し，インフォームド・コンセントを得る必要がある．

肝転移切除後の再発パターンは，表2と同様の傾向で，再発例の約半数が残肝に再発している．残肝再発の場合でも切除可能と判断されれば切除を行うことで，肝臓の1回のみの切除例と同等の治療成績が得られている．

切除できない場合には抗がん剤治療となり，全身化学療法が行われる．転移巣が肝転移のみの場合には，肝動注療法が積極的に行われていたが，これまでの臨床試験の結果では，残肝再発率は全身化学療法に比べ明らかに低下するものの，生存率の改善効果は示されていない．このため，現在この治療を行うのであれば，臨床試験か，インフォームド・コンセントを得た上で行う必要がある．一般に大腸がんにおける化学療法の位置づけは，がんの治癒を目指すというより，QOLを保ったまま延命を目指すものであるが，ごく少数例ではあるが，化学療法により肝転移の大きさ，数が縮小し，肝転移が切除可能となる症例があるので，奏効例では肝臓外科医との連携が重要となる．

肺転移・再発の治療戦略（図1）

肺転移・再発の治療戦略は，肝転移・再発の治療戦略とほぼ同様である．肝転移と同様，切除可能と判断されたならば外科的手術を行う．切除可能の条件は，肝転移とよく似ており，

(1)　必要な肺機能を保って，肺転移が切除可能なこと

(2)　原発大腸がんが完全切除可能なこと，あるいはされていること

(3)　肺以外に転移・再発がないこと

の以上3点である．やはり肝転移と同様，転移個数，大きさで，切除可能かどうかを決められない．一般的には，転移個数は1～3個程度が切除適応であると理解しておくとわかりやすい．肺切除法も，肝切除と同様，転移個数，部位により異なるが，正常肺をできるだけ温存するため，部分切除が原則で，それで困難であれば，区域切除，葉切除を行う．肺全摘術は，手術侵襲，予後からあまり行われない．肺切除後の治療成績も肝転移とほぼ同等で，5年生存率は30～40％である．

補助化学療法も，肝転移と同様，その効果は証明されていないため，術後は，無治療でのフォローアップを行う．

●ICG：インドシアニン・グリーン indocyanine green

また，肝転移切除後の肺転移・再発例，あるいは数は少ないが肺転移切除後の肝転移例は，先に示した切除可能条件が満たせば，切除を行うことで，症例数は少ないものの長期生存した症例もある．

腹膜播種・再発の治療戦略

表1，2に示したように，腹膜播種・再発の頻度は，転移部位としては，肝転移についで2番目，全大腸がん症例の5%，再発部位としては肝・肺再発に次いで3番目，治癒切除例の2%に生じる．腹膜再発の診断は画像上困難であるため，実際にはもっと頻度は高いと考えられる．

原発大腸がん切除時の術前から腹膜播種と診断される場合は少なく，ほとんど開腹時に診断される．腹膜播種が，わずかに存在する程度であれば，切除をすることが多いが，肝転移，肺転移と異なり，切除で治癒することはなく，あくまでも腹膜再発までの期間を延長して，QOLの向上をはかる姑息的な切除である．また多数の腹膜播種がある場合には，原発巣の切除をしないでバイパス術や人工肛門のみを作製する場合もある．したがって，腹膜播種・再発時には，化学療法が原則となる．

腹膜再発の診断は困難で，腹水や腸閉塞の症状で発見されることが多く，一般に多発再発のため，治癒的な切除が可能なことはほとんどないが，きわめてまれに1個所だけの再発であれば，切除により長期生存が得られる場合がある．腸閉塞症状がある場合は，人工肛門の作製を考慮する．

がんが漿膜まで浸潤している場合には，手術時に，肉眼的に腹膜播種が認められなくても，手術開始時の腹腔内洗浄液の細胞診でがん細胞が見つかることがある．当院での頻度は約5%である．この場合，約半数の症例で腹膜播種・再発が生じるため，大きな予後不良因子であるが，術中の腹腔内への抗がん剤の投与や補助化学療法の有効性は明らかでない．

局所再発の治療戦略

大腸がんで局所再発をきたすのは，ほとんど直腸がんであり，結腸がんでは吻合部再発がまれに見られる程度である．吻合部再発は，ほかに転移がなければ．吻合部を含めた腸管を切除して再度吻合する，直腸の吻合部再発で再吻合が困難である場合には，永久人工肛門とする．

直腸がんの局所再発率は5～10%で，がんが肛門に近いほど頻度が高くなり，下部直腸がんの局所再発率は上部直腸がんの約4倍の頻度である．直腸がんの局所再発は，いま述べた吻合部再発もあるが，ほとんどが仙骨前面や骨盤側壁，会陰創の再発である．この局所再発に対して，大腸骨盤外科，腫瘍内科，放射線治療科の3科が連携した治療，すなわち集学的治療が必要ある．

骨盤内の局所再発で切除可能と判断されれば，切除を考える．切除の適応は，

(1)　がんを遺残なく切除てきること
(2)　遠隔転移がないこと
(3)　手術に耐えられること

などは，肝・肺転移の切除適応と同様であるが，さらに

(4)　再発巣は1個所のみであること
(5)　骨盤内に再発巣が広範に存在することを示唆する所見(仙骨上部あるいは骨盤側方壁への進展，下肢の浮腫，坐骨神経痛など)がないことである．

ただし，切除可能と判断されても，骨盤内臓全摘術，さらにほとんどの症例で中下部仙骨の合併切除を加えた手術が必要となるため，手術可能と判断された場合には，患者に，

(1)　手術時間が平均12時間，出血量も平均3,500 ml(国立がんセンターの平均)と大きな侵襲を伴う手術であること
(2)　人工肛門，人口膀胱(回腸導管)となること
(3)　完全に切除できたとしても5年生存率は30～40%であること

を十分に説明し，インフォームド・コンセントを得ることが必要となる．

手術前後に，放射線療法，あるいは放射線化学療法を加えることがある．術前の放射線治療は，腫瘍辺縁のがん細胞を死滅させ，切除断端にがんが遺残しないように，また場合により縮小手術を可能とする，たとえば，仙骨合併切除をしなくて済む，あるいは，骨盤内臓全摘術を行わなくて済むようにする目的で行うが，その効果は明らかでない．術後の放射線療法は，手術で再発巣の完全切除ができなか

った場合に行われる．

手術不能例，手術拒否例に対しては，放射線療法と化学療法を行う．これらの治療の目的は，一般の大腸がんの化学療法と同様，症状の緩和と延命であるが，最近，放射線医学総合研究所（千葉市）での重粒子線による局所再発の治療が比較的良い成績をあげており，まだ長期フォロー症例が少ないため予後の改善効果は不明であるが，期待できる治療である．とくに手術拒否例には勧めたい治療の1つであるが，保険適用外で高度先進医療として行われているため，患者の自己負担額が314万円と高額なのが難点である．

その他再発の治療戦略

リンパ節再発の頻度は，表2にも示したように，さほど高いものではない．リンパ節再発の場所としては，腹部動脈周囲リンパ節，骨盤内リンパ節である閉鎖リンパ節，鼠径リンパ節である．画像上1個だけの再発でほかに再発を認めなければ切除を考えてもよい．ほかの転移を認める場合には，例外もあるが化学療法を行う．いずれの再発も初回手術から時間を経過しての孤発性の再発で切除可能であれば，比較的予後はよい．

脳転移・再発の頻度は低いものの，神経症状が前面に出るため患者のQOLを大きく損ねる．大腸がんからの脳転移は，すべての脳転移例の約5％といわれている．術後，外来検査では脳転移の検索は行わないため，頭痛やさまざまな神経麻痺，痙攣などで発症して，脳CT検査ではじめて発見される場合がほとんどである．単発性の転移でほかに転移がなければ，切除も考えるが，一般に多発であることが多く，また他臓器にも転移があることが多いため，治療は放射線療法が主体となる．脳転移に対しては，化学療法は一般には有効でない．

骨転移・再発も，脳転移同様，転移頻度は高くはないが，患者のQOLを大きく損ねる再発である．椎骨への転移頻度が高く，病的骨折により不可逆性の神経麻痺が生じるので，診断がついた時点で早急な対応をしなければならない．治療は，脳転移同様，放射線治療である．また，病的骨折に対しては，コルセット，必要であれば骨の固定を行う．

おわりに

転移・再発は，切除できれば，一般に30～40％の5年生存率が得られるが，切除できなかった場合には，化学療法，放射線療法，あるいはその併用療法となる．しかしながら，長期生存例は少なく，これらの治療の目的は，延命，症状の緩和である．このような患者には医師よりも看護師の役割が大きく，病態，治療を理解して，積極的にかかわってもらいたい．

大腸がんの治療戦略，ガイドライン，臨床試験

藤田　伸*

はじめに

大腸がん治療の主役は外科的切除であるが，深達度，臨床病期により手術法が異なるため，それぞれの治療法を知らなくてはならない．ここでは，遠隔転移のないがんを対象に，深達度別・臨床病期別の治療戦略，そして結腸がんにくらべ治療戦略が複雑な直腸がん，最後に大腸がんガイドラインと臨床試験について述べてみたい．

深達度別大腸がんの治療戦略(図1)

がんは粘膜より生じ，進行するにしたがって，大腸壁外に向かって浸潤する．このため，深達度(大腸壁のどこまで浸潤しているか)が，がんの進行度の指標の1つとなっている．当然，深達度により治療戦略が異なるので，それぞれの治療戦略を概説する．

❖ 良性腫瘍ならびに粘膜内がん(mがん，早期がん)

粘膜内がんは，その言葉のごとく粘膜内にとどまるがんを指す．粘膜から生じる悪性腫瘍を「がん(癌)」と呼ぶため，粘膜内がんは，もっとも早期のがんである．胃の粘膜内がんと異なり，大腸の粘膜内がんは完全に切除されれば，転移，再発の可能性がないため，治療は内視鏡的切除が原則である．粘膜内がんかどうかの診断は，その大きさ，形態，ピットパターン(腫瘍粘膜の微細構造)により診断される．その結果，良性腫瘍あるいは粘膜内がん，あるいは次項で述べる粘膜下層がんが疑われても浅い浸潤と判断されるものも内視鏡切除の適応である．ただし，あまりに大きな粘膜内がんは内視鏡切除が困難となるため，その場合には外科的切除を行う．また，直腸の腫瘍で肛門に近い腫瘍では，経肛門的に切除することもある．有茎性(キノコ状)の腫瘍であれば，粘膜内がんと診断されれば，大きさに関係なく切除可能であるが，平坦な腫瘍の場合は，一般に直径3 cm程度までが内視鏡切除の限界である．

病期は，Stage 0と分類され，治療成績は，遠隔転移がないがんのため，がんによる死亡はなく，5年生存率は100%である．

❖ 粘膜下層がん(smがん，早期がん)

粘膜下層がんは，粘膜下の粘膜下層にがんが浸潤したものを指す．粘膜内がんとの違いは，リンパ節転移，さらに遠隔臓器転移の可能性が生じることである．このため，リンパ節郭清を伴う外科的腸管切除が原則となる．ただし，粘膜下層への浸潤が1 mm未満のものは，リンパ節転移の可能性がほとんどないため，内視鏡的切除だけで外科的切除の必要はない．また，がんの粘膜下層の浸潤度だけでなく，内視鏡切除標本で，リンパ管内にがんが認められたときには，リンパ節転移の確率が高くなるため，外科的切除を勧める．

粘膜下層がんは，原則，外科切除ではあるが，がん病巣そのものを内視鏡的に切除したものは，遺残がなければがんの病巣そのものはすでに取り除かれているので，切除の目的は，リンパ郭清であるが，リンパ節転移の確率が高いといっても約10%であるため，手術の絶対適応ではない．

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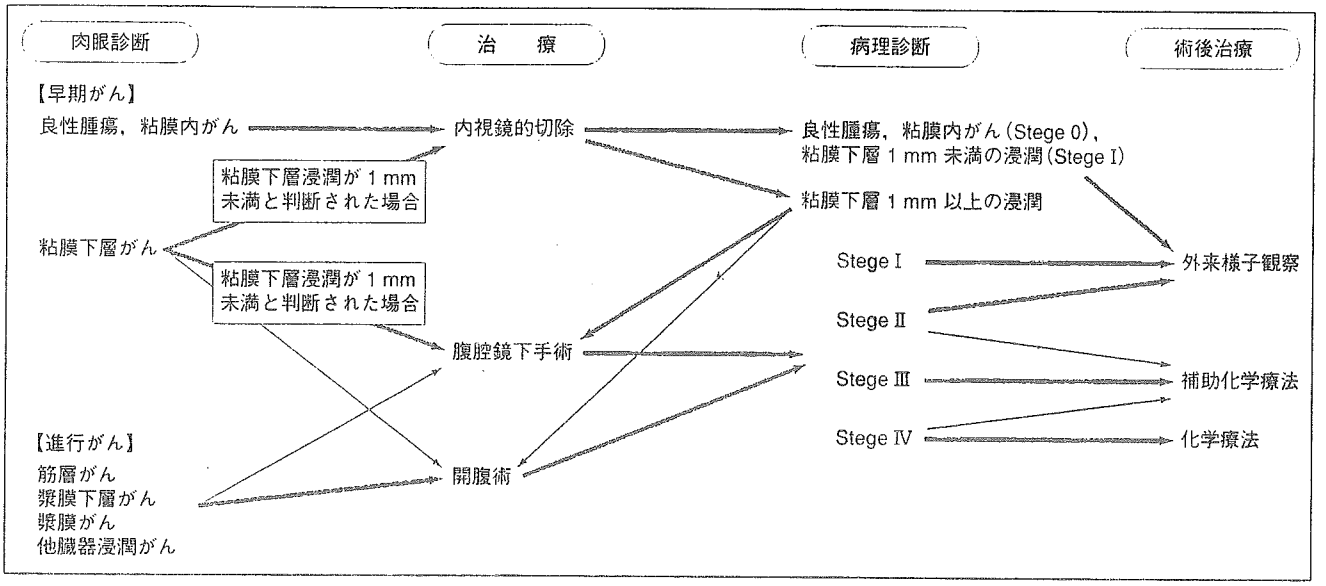

▲図 1　大腸がんの治療戦略
太い矢印は現在の主流を示し，細い矢印は主流ではないか，臨床試験が必要なものを示している．

したがって，患者にそのことを十分術前に説明して，同意（インフォームド・コンセント）を得る必要がある．ほとんどの患者は手術を希望するが，手術を受けないで様子観察することを希望する患者も少数ではあるが存在する．

手術は，病巣を中心に 10～20 cm の腸管を切除し，リンパ節は，腸管に沿うリンパ節と，名前のついた血管の一部または根部まで切除する．この手術は，通常の開腹か，腹腔鏡下手術に慣れた施設では腹腔鏡下で行う．

リンパ節転移の有無により病期が変わり，リンパ節転移がなければ，Stage I，あればStage IIIとなる．粘膜下層がんの場合，Stage I でもStage IIIでも，5 年生存率は大きな差はなく，いずれも 95％程度である．

❖ 筋層がん，漿膜下層がん，漿膜がん，他臓器浸潤がん（進行がん）

このがんから進行がんと分類され，すべて外科的切除の適応となる．手術は，通常の開腹で行い，大腸を 20～30 cm 切除し，リンパ節は，名前のついた血管の根部まで切除する．腹腔鏡下手術を行うこともあるが，開腹術を同等の治療成績を示せるかどうかまだ完全に証明されていないので，まだ標準治療ではなく，現在，臨床試験中である．

開腹時には，腹腔内をよく検索し，肝転移の有無，腹膜播種の有無を確認するが，術前の検査で発見できなかった肝転移や腹膜播種がみつかる場合がある．その場合にはStage IVとなり，転移の部位，程度に応じて治療法が異なる．詳細は，別項を参照してほしい（232 頁）．転移・再発の項目．

深達度とリンパ節転移の有無により病期が変わる．リンパ節転移があれば，深達度に関係なくStage IIIで，5 年生存率は，結腸がんで 75％，直腸がんで 65％である．リンパ節転移がない場合には，深達度によりStage が異なり，筋層がん（mp がん）は，Stage I で，5 年生存率は 93％程度，筋層より深層に浸潤しているものは，他臓器に浸潤がなければ，Stage II で，5 年生存率は，結腸がんで 85％，直腸がんで 80％である．他臓器に浸潤しているがんは，日本の「大腸癌取扱い規約」の分類では，Stage IIIと分類されるが，ほかの分類ではStage II と分類される．治療成績はStage IIIに近い．

切除後の臨床病期別治療戦略（図 1）

◉Stage 0

粘膜内がん（m がん）であり，これは内視鏡治療で完全に治癒するため，切除後は内視鏡の定期的検査を受けるだけで十分である．

◉Stage Ⅰ

リンパ節転移のない粘膜下層がん(sm がん)と筋層がん(mp がん)である．予後は良いが，肝転移や肺転移などの遠隔転移の可能性があるため，1年に1回程度の定期的な外来検査で，腫瘍マーカー(CEA, CA19-9)，胸部X線検査や超音波，CT検査などが必要となる．しかし，再発予防のための補助化学療法は不要である．

◉Stage Ⅱ

リンパ節転移のない筋層を超えて浸潤するがんで，遠隔転移の可能性が高いため，6ヵ月に1回程度の頻度で遠隔転移の有無を検査する．補助化学療法は，この病期では有効性が証明されていないため，通常は行わない．しかしながら，この病期であっても予後が悪いものも存在するため，予後が悪いと診断された患者には，臨床試験として補助療法を行ったり，あるいはこの病期での補助化学療法の現状について説明をして，インフォームド・コンセントを得た上で補助療法を行うことはある．

◉Stage Ⅲ

がんの深達度に関係なくリンパ節転移のあるがんである．StageⅡ以上に，遠隔転移の可能性が高いため，3～4ヵ月に1回程度の頻度で遠隔転移の有無を検査する．過去の多数の臨床試験で，補助化学療法の有効性が証明されているため，この病期では，補助化学療法を行うのが標準治療である．5FUとロイコボリン(アイソボリン®)の2剤を用いて，持続投与か週1回投与で6ヵ月間静注を行うのが標準的な方法であるが，わが国では経口薬で代用していることが多い．最近，さらにこの2剤に，イリノテカン(トポテシン®，カンプト®)やオキサリプラチン(2005年1月承認)などを加えた多剤併用療法がさらに有効な成績を示しているが，補助療法として一般に利用するには，もう少し臨床試験の結果を待たなくてはならない．

◉Stage Ⅳ

がんの深達度，リンパ節転移に関係なく他臓器へ転移のあるがんである．別項(232頁)で詳細に説明するので，ここでは簡単に触れるのみとするが，肉眼的にすべての腫瘍が切除されている場合と明らかに残存している場合で治療方針が異なる．肉眼的にすべて腫瘍が切除されている場合には，補助化学療法を行いたくなるが，これまでの臨床試験の結果を見る限り補助化学療法の有用性は残念ながら示されていない．したがって，StageⅡの場合と同じく，補助化学療法を行うのであれば，臨床試験のかたちか，患者のインフォームド・コンセントを得た上で行う．外来では，3ヵ月に1回程度で遠隔転移の有無を検査する．転移巣が切除できない場合には，化学療法を行うが，その詳細は別項(232頁)を参照してほしい．

直腸がんの治療戦略(図2)

直腸がんは，結腸がんと異なり，人工肛門，性機能障害，膀胱機能障害の問題があるため，直腸がん特有の治療戦略が必要である．直腸は，直腸S状結腸部，上部直腸，下部直腸の3つに分類され，下部直腸より肛門側は，肛門管と呼ばれる．肛門管は，肛門括約筋が存在する部位で，肛門縁から約3 cmにわたって存在する．下部直腸は，肛門管の上から腹膜翻転部までの部位で，肛門縁から約3～7 cmの部位である．上部直腸から腹腔内の直腸で，肛門縁からは約7～11 cm，直腸S状結腸部は，肛門縁からは約11～15 cmと記憶しておくと理解しやすい．直腸がんの治療戦略上，腹膜翻転部以下の下部直腸がんと肛門管がんが問題となる．

下部直腸がんは，手術はマイルズ(Miles)手術(永久人工肛門となる手術)という時代が長らくあったが，自動吻合器の進歩と腫瘍肛門側へのがんの広がりの理解，さらには肛門括約筋の一部を切除する究極ともいえる肛門温存術の導入で，マイルズ手術は大幅に減少している．とくに，腫瘍肛門側へのがんの広がりの理解は重要で，多数の研究の成果から，直腸間膜(直腸周囲の脂肪組織)内にがんが広がっていることと，がんの肛門側への進展は，ほとんどないかあっても1 cm以内であることが示されている．したがって，理論的には，直腸間膜をすべて切除し，肛門側の直腸切離線は腫瘍下縁から少なくとも1 cmとれば，がんの根治性を損なうことなく肛門の温存が可能である．したがって，肛門管の長さが約3 cmであることから，肛門縁から腫瘍の下縁までの距離が4 cmあれば，肛門括約筋を切除することなく肛門の温存が可能で，それ以下の腫瘍であっても，内肛門括約筋の一部または全部(内肛門括約筋切

●CEA：がん胎児性抗原 carcinoembryonic antigen
●CA19-9：糖鎖抗原 19-9 carbohydrate 19-9