Proposed Distal Margin for Resection of Rectal Cancer

Kanji Kameda,[1] Motonosuke Furusawa,[1] Masaki Mori[2] and Keizo Sugimachi[2, 3]

[1]*Department of Surgery, National Kyushu Cancer Center, Fukuoka and* [2]*Department of Surgery II, Faculty of Medicine, Kyushu University, 3-1-1 Maidashi, Higashi-ku, Fukuoka 812*

To determine the adequate distal margin, particularly from the point of extent of lymph node metastasis, 2,333 lymph nodes from 44 patients with rectal carcinoma were evaluated, using a clearing method. The tumors were divided into two growth patterns; infiltrative and localized. Lymph node metastasis was histo-pathologically examined with special attention focused on nodes on the distal side of the tumor. The intramural spread was also given attention. The proximal pararectal lymph nodes often contained malignant cells, whereas the distal ones were rarely involved, and if involved, they were present within 1 cm from the tumor. Pararectal lymph node metastasis and intramural spread were seen with a range of 1 cm and 0.5 cm, respectively, in the localized type and 1 cm and 2.1 cm, respectively in the infiltrative type. Based on these findings, the distal margin for surgical resection of rectal carcinoma is considered to be 2 cm for the localized type and 3 cm for the infiltrative type.

Key words: Rectal carcinoma — Lymph node metastasis — Clearing method — Intramural cancer spread

In selecting the operative procedure for rectal cancer, the distance between the tumor and the anal verge is a vital factor for determining the extent of abdomino-perineal resection and the procedures to preserve anal function. A pertinent question is the minimum necessary distance which should be allowed for the distal margin. Most of the studies and reports relating to this problem[1-6] were based on factors related to intramural extension of the tumor on the distal side, and there was no consensus of opinion. Positive procedures to preserve anal function include cases of both upper and lower rectal cancer.[7-10]

To assess the most suitable line of resection for a rectal cancer, we directed our attention to metastasis to pararectal lymph nodes, in addition to intramural extension of the tumor. These metastases were systematically evaluated and a decision as to the line of resection was based on both the intramural extension of the tumor and metastasis to pararectal lymph nodes.

MATERIALS AND METHODS

This study concerned 44 patients with rectal cancer undergoing resection and extensive lymph node dissection at the National Kyushu Cancer Center between May 1983 and May 1985. All other organs were disease-free and the rectal cancer was unifocal. Ages of the patients ranged from 31 to 83 years (mean 58). There were 28 men and 16 women. A localized cancer was found in 36 and an infiltrative one was present in 8 patients. The terms "localized" and "infiltrative" are used according to

the rules established by the Japanese Research Society for Cancer of the Colon and Rectum.[11] The maximum diameter of the tumor ranged from 2.2 to 13.8 cm. The center of the tumor occupied the lower rectum below the peritoneal reflection in 26 and the upper rectum above the peritoneal reflection in 18 patients. In the 26 patients with a lower rectal tumor, a low anterior resection was performed for three patients and rectal amputation (Miles' procedure) was performed for 23 patients. In the 18 with an upper rectal lesion, a low anterior resection was performed in 14 and a rectal amputation was performed in four patients. Thirty-four patients underwent curative operation and ten patients underwent non-curative operation.

The tumor was staged according to the Gunderson-Sosin modification of the Astler-Coller staging system[12] and a summary is given in Table I. Two patients were Stage A, 14 were Stage B1, 10 were Stage B2, none was Stage B3, five were Stage C1, 11 were Stage C2 and two were Stage C3. Each specimen was resected *en bloc* and was subsequently distended. After fixation in 10% formalin solution containing 0.01% methylene blue for 48 h, the specimens were dehydrated and defatted according to the clearing method[13-15] with alcohol and acetone and made transparent with xylene for observation under transmitted light (Fig. 1). Sites occupied by the tumor, arteries, veins and lymph nodes were recorded. The distance between the pararectal lymph nodes and the tumor margin was also measured to prepare a lymph node atlas. The lymph nodes were then removed one by one. After measuring the size of each lymph node, paraffin sections were prepared by the usual method and stained with hematoxylin and eosin. The sections were

---

[3] To whom all correspondence should be addressed.

then studied under a light microscope to search for metastasis and the results were recorded in the lymph node atlas. The nodes of lymph node metastasis were analyzed based on this "lymphoadenogram."

Distal intramural spread of the tumor was evaluated microscopically. The distance of intramural spread was measured between the microscopic invasive edge and the macroscopic elevated edge of the tumor.

RESULTS

Among the 44 patients, lymph node metastasis was positive in 18 patients, that is, a rate of 40.9%. Of the 2,333 lymph nodes examined (53 lymph nodes per patient), positive metastasis was found in 106 (4.5%).

The rate of lymph node metastasis differed according to the histology of the tumor. Metastasis were found in 4 of 14 with a well differentiated adenocarcinoma (28.6%), in 10 of 25 with a moderately differentiated adenocarcinoma (40%), in 1 of 2 with a poorly differentiated adenocarcinoma (50%), and in all three patients with a mucinous carcinoma (100%).

The pararectal lymph nodes were divided into intervals of 5 cm from the tumor margin to determine the rate of metastasis. Rates of upward and lateral metastasis were also noted (Fig. 2). Hereafter, upward spread or metastasis means lymph node metastasis along the superior rectal, sigmoidal and inferior mesenteric arteries with no involvement of the pararectal lymph nodes. Proximal metastasis means metastasis of just attached lymph nodes along the proximal rectum. Inferior mesenteric lymph node metastasis was evident in two cases (4.5%) and in both, grossly identifiable metastasis was noted in the involved lymph nodes at the time of resection. These two were incurable.

Table I. Gunderson-Sosin Modification of the Astler-Coller Staging System[12]

Stage	Characteristics
A	Tumor limited to mucosa with nodes normal
B1	Extension through the mucosa but still within the bowel wall with nodes normal
B2	Extension through the entire bowel wall with nodes normal
B3	Extension through the entire bowel wall with adherence or invasion of adjacent organs or structures with nodes normal
C1	Lymph nodes with positive findings and tumor limited to the bowel wall
C2	Lymph nodes with positive findings and tumor through the entire bowel wall
C3	Lymph nodes with positive findings and extension through the entire bowel wall with adherence or invasion of adjacent organs or structures

Fig. 1. Observation of pararectal lymph nodes by clearing methods. Specimen observed from the adventitial side, using the clearing method. Stained pararectal lymph nodes (white arrows) and superior hemorrhoidal artery (black arrows) are visible.
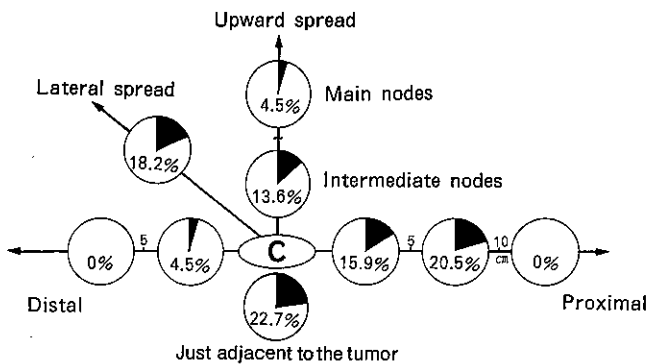
Fig. 2. Distribution of metastatic lymph nodes from rectal cancer. Metastatic pararectal lymph nodes were divided into 5 cm intervals from the tumor margin. Rates of metastasis to lymph node groups are shown.
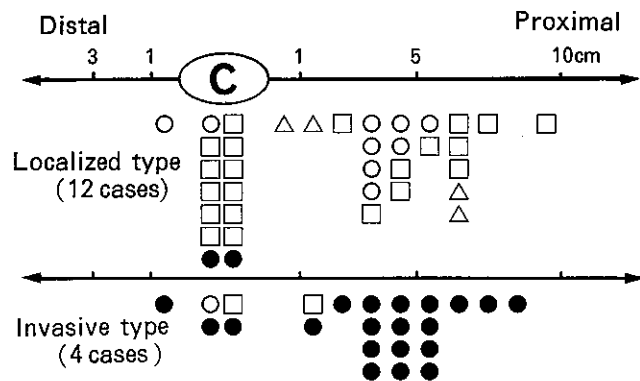

Fig. 3. Distribution of metastatic pararectal lymph nodes in association with tumor growth pattern. In 16 of 44 cases, positive metastasis of pararectal lymph node was seen. Metastatic pararectal lymph nodes are shown, based on distance from the tumor margin. In the 12 localized cases, metastasis was found in 36 of 576 pararectal lymph nodes. In 4 infiltrative cases, 20 of 176 were positive for metastasis. Each symbol means each metastatic lymph node and its histological type. There was no correlation between the distance of the positive nodes, tumor histology and tumor growth patterns. Open circles, well differentiated adenocarcinoma. Open squares, moderately differentiated adenocarcinoma. Open triangles, poorly differentiated adenocarcinoma. Closed circles, mucinous adenocarcinoma.

Pararectal lymph node metastasis was noted in 16 of 18 positive cases. Out of 748 pararectal lymph nodes in the 16 cases, 56 were positive for metastasis. The distances of the pararectal lymph nodes from the tumor were studied with special reference to tumor histology and growth pattern (Fig. 3). There were 18 metastatic lymph nodes just adjacent to the tumor and 36 on the
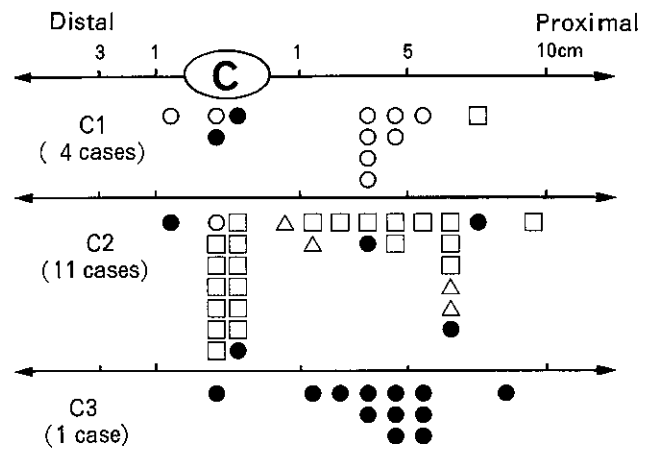

Fig. 4. Metastatic pararectal lymph nodes classified according to histological stage of the rectal cancer. In stage C1 (4 cases), metastasis of the pararectal lymph node was present in 12 of 204 examined nodes. In stage C2 (11 cases), 32 of 467 nodes were positive for metastasis. In stage C3 (one case), 12 of 45 nodes were positive. Each symbol refers to each metastatic lymph node and its histological type. Open circles, well differentiated adenocarcinoma, open squares, moderately differentiated adenocarcinoma, open triangles, poorly differentiated adenocarcinoma, closed circles, mucinous adenocarcinoma.

proximal side of the tumor, but only two on the distal side of the tumor. In the localized tumors, metastasis was found in 36 of 576 examined pararectal lymph nodes in 12 cases. The positive nodes were distributed between 1 cm distal to the inferior tumor margin and 9.5 cm proximal to the superior tumor margin. There was a metastasis from 4 infiltrative tumors in 20 of 176 examined pararectal lymph nodes. Positive nodes were found in areas between 0.5 cm distal and 8.2 cm proximal. There was no statistically significant difference between the two groups. Distal metastasis of the pararectal lymph nodes was found in two with only one lymph node in each. In one with a Stage C2 infiltrating mucinous carcinoma, significant metastasis was found in other directions, up to 7.5 cm proximal pararectal, upward and lateral nodes. In another with a Stage C1 well differentiated localized adenocarcinoma, there was no evidence of other lymph node metastasis. There was no correlation between the distance of positive lymph nodes from the main tumor and the tumor histology (Fig. 3).

The tumor was also separated and grouped according to stage and depth of wall penetration in order to compare the spread of the metastasis into the pararectal nodes. In Stage C1 tumors (12 out of 204 examined nodes were positive in 4 cases), metastasis was present between 1 cm distal and 8 cm proximal, in Stage C2 tumors (32 out of 467 examined nodes were positive in 11

cases) between 0.5 cm distal and 9.5 cm proximal, and in Stage C3 tumors (12 of 45 examined nodes were positive in one case) between just below the tumor and 8.2 cm proximal to the tumor. There was no significant correlation between the degree of metastasis through the pararectal lymph nodes and the degree of tumor penetration into the wall (Fig. 4).

The intramural spread of the tumor toward the anus was evaluated in 36 localized tumors and 8 infiltrative tumors. In 36 localized tumors, the speread was limited to 0.5 cm. In 8 infiltrative tumors, the distance of distal infiltration was 2.1 cm in one, 1.3 cm in another and less than 1 cm in the remaining six. The cancer cell infiltration in two with distal infiltration was not due to direct cancerous invasion of the rectal wall but rather via lymph vessels. The carcinomatous lymphangitis could not be justified macroscopically; however, one tumor with a 2.1 cm distal spread involved other neighboring organs.

DISCUSSION

In the case of localized tumors, intramural extension and pararectal lymph node metastasis distal to the tumor margin were limited to 0.5 cm and 1 cm, respectively, a finding which suggests the greater significance of the latter parameter in delineating the distal extent of disease. Since the pararectal lymph node metastasis was limited to 1 cm in localized tumors, the distal margin of the tumor resection should probably include 2 cm of unaffected rectum (we consider that a safety zone of 1 cm is necessary). An operative method which preserves anal function is thus feasible except when the tumor is in too close a proximity to the anus. In cases of infiltrative tumors, intramural spread is more significant than pararectal lymph node metastasis. Since distal intramural spread was demonstrated as far as 2.1 cm, the distal line of resection should include 3 cm of rectum below the tumor margin.

In most recent studies, distal intramural spread of the rectal carcinoma was less than 1 cm, in most cases. Madsen and Christiansen[1] examined 43 rectal carcinomas for distal intramural spread. Thirty-three carcinomas (75%) showed no or only a very limited spread (0–0.5 cm). All potentially curable carcinomas would have been adequately resected with a distal margin only 1.5 cm, except for one incurable case. Williams et al.[3] did a study of distal intramural spread and of survival time in patients with rectal carcinomas. Thirty-eight of fifty (76%) were found to have no distal intramural spread. Seven (14%) had a spread of 1 cm or less and only 5 (10%) had a spread of more than 1 cm. They concluded: "The rigid, routine application of the '5 centimeter rule' of distal excision may cause patients with low rectal cancer to loose their anal sphincter unnecessarily." Izumoto[16] examined pararectal lymph node metastasis of rectal carcinomas, and concluded that metastases to distal pararectal lymph nodes were confined to within 4 cm from the tumor margin in upper rectal cancer, while in lower rectal cancer it was within 3 cm. Yasutomi[17] recommended that the distal margin of 2 cm is acceptable in the A, B_1 and C_1 stage rectal carcinomas, and 3 cm in B_2 and C_2 stage carcinomas. He found that 4 cm was needed for lymph node dissection in B_2 and C_2 stage carcinomas and this recommendation is in agreement with our conclusion. However, in our series, the distal pararectal lymph node metastasis and depth of the tumor invasion showed no correlation in advanced cases. A preoperative determination of stage of tumor can be difficult.

We wish to emphasize that rectal carcinomas can be divided into two groups, 'localized' and 'infiltrative,' when considering the distal line for purposes of resection. The distal margin should be assessed from the viewpoint of both intramural spread and lymph node metastasis.

REFFRENCES

1) Madsen, M. and Christiansen, J. Distal intramural spread of rectal carcinomas. *Dis. Colon Rectum,* **29,** 279–282 (1986).

2) Hughes, T. G., Jenevein, E. P. and Poulos, E. Intramural spread of colon carcinoma. *Am. J. Surg.,* **146,** 697–699 (1983).

3) Williams, N. S., Dixon, M. F. and Johnston, D. Reappraisal of the 5 centimeter rule of distal excision for carcinoma of the rectum: a study of distal intramural spread and of patients' survival. *Br. J. Surg.,* **70,** 150–154 (1983).

4) Grinnell, R. S. Lymphatic block with atypical and retrograde lymphatic metastasis and spread in carcinoma of the colon and rectum. *Ann. Surg.,* **163,** 272–280 (1966).

5) Polk, H. C., Jr. Extended resection for selected adenocarcinomas of the large bowel. *Ann. Surg.,* **175,** 892–899 (1972).

6) Pollett, W. G. and Nicholls, R. J. The relationship between the extent of distal clearance and survival and local recurrence rates after curative anterior resection for carcinoma of the rectum. *Ann. Surg.,* **198,** 159–163 (1983).

7) Hojo, K. Anastomotic recurrence after sphincter-saving

resection for rectal cancer: length of distal clearance of the bowel. *Dis. Colon Rectum,* **29,** 11–14 (1986).

8) Enker, W. E., Pilipshen, S. J., Heilweil, M. L., Stearns, M. W., Jr., Janov, A. J., Hertz, R. E. L and Sternberg, S. S. *En bloc* pelvic lymphadenectomy and sphincter preservation in the surgical management of rectal cancer. *Ann. Surg.,* **203,** 426–433 (1986).

9) Thorlakson, R. H. New upper and lower clamps for use in anterior resection of the rectum by hand suture or stapling techniques. *Surg. Gynecol. Obstet.,* **163,** 569–572 (1986).

10) Adloff, M., Arnaud, J. P., Thibaud, D. and Bergamaschi, R. Facilitating low colorectal anastomosis. *Am. J. Surg.,* **151,** 286–288 (1986).

11) Japanese Research Society for Cancer of the Colon and Rectum. General rules for clinical and pathological studies on cancer of the colon, rectum and anus. *Jpn. J. Surg.,* **13,** 557–573 (1983).

12) Gunderson, L. L. and Sosin, H. Areas of failure found at reoperation (second of symptomatic) following "curative surgery" for adenocarcinoma of the rectum. *Cancer,* **34,** 1278–1292 (1974).

13) Pickren, J. W. Significance of occult metastasis: a study of breast cancer. *Cancer,* **14,** 1266–1271 (1961).

14) Moormann, P. S., Thomas, C., Pohl, C. and Sohn, R. Patho-anatomical demonstration of lymph node metastasis in a surgical specimen. *Pathol. Res. Pract.,* **174,** 403–411 (1982).

15) Gawthorn, S. J., Gibbs, N. M. and Marks, C. G. Clearance technique for the detection of lymph nodes in colorectal cancer. *Br. J. Surg.,* **73,** 58–60 (1986).

16) Izumoto, G. Studies on the lymph node metastasis of the colorectal cancer by the modified clearing method. *Med. J. Kinki Univ.,* **9,** 239–253 (1984).

17) Yasutomi, M. Functional preservation in rectal cancer surgery. *J. Jpn. Surg. Soc.,* **89,** 1331–1334 (1988).