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Treatment of Rectal Cancer by Low Anterior Resection with Coloanal Anastomosis

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Objective

Our institution's experience with low anterior resection in combination with coloanal anastomosis (LAR/CAA) for primary rectal cancer was reviewed (1) to determine cancer treatment results, 2) to identify risk factors for pelvic recurrence, and 3) to assess the long-term success of sphincter preservation.

Summary Background Data

Use of sphincter-preserving resection for mid-rectal and selected distal-rectal cancers continues to increase. As surgical techniques and adjuvant therapy evolve, treatment results must be carefully assessed.

Methods

One hundred thirty-four patients treated for primary rectal cancer by LAR/CAA between 1977 and 1990 were studied retrospectively. All pathologic slides were reviewed. Median follow-up was 4 years.

Results

Actuarial 5-year survival for all patients was 73%. Among 36 patients who relapsed, distant metastatic disease had developed at the time of first clinical relapse in most (86%). Pelvic recurrence was detected in 13 patients, an actuarial rate of 11% at 5 years. Mesenteric implants, positive microscopic resection margin, T3 tumor, perineural invasion, blood vessel invasion, and high tumor grade were associated with increased risk for pelvic recurrence. Eleven patients ultimately required permanent colostomy, and in eight instances the cause was pelvic recurrence.

Conclusions

Low anterior resection combined with coloanal anastomosis provides good treatment for mid-rectal cancers and for some distal rectal cancers. Pelvic recurrence is not associated with short distal resection margins but is correlated with the presence of histopathologic markers of aggressive disease in the primary tumor. Long-term preservation of anal sphincter function depends primarily on control of pelvic tumor and can be achieved in more than 90% of patients.

When the distal margin of low anterior resection (LAR) reaches the anal canal, an intrapelvic anastomosis is no longer possible, and restoration of intestinal continuity requires coloanal anastomosis (CAA). Since its introduction 20 years ago by Sir Alan Parks,[1] oncologic treatment results of LAR/CAA for rectal cancer have been reported in only a few series, with pelvic recurrence rates of 5% to 20%.[2–7]

With the advent of circular stapling devices, many mid-rectal cancers that previously required LAR/CAA are now treated using conventional LAR with a stapled anastomosis in the distal pelvis.[8,9] Therefore in the past decade, case selection for LAR/CAA has evolved toward more distal rectal tumors that lie just above the anal canal. Increasing acceptance of short distal margins[10] and increasing confidence in the benefit of adjuvant pelvic radiation[6,11] also have contributed to the increased use of LAR/CAA for low-lying tumors in which distal and lateral clearance may be minimal.

Coloanal anastomosis in combination with low anterior resection has been used to treat rectal cancer at Memorial Sloan-Kettering Cancer Center since 1977. Our early experience, first reported in 1985, focused on patients with mid-rectal cancers in whom LAR was accomplished but colorectal anastomosis was technically impossible.[4] In this report we update our experience with this procedure, assess risk factors for pelvic recurrence, and evaluate its role and adequacy as a cancer operation.

PATIENTS AND METHODS

Patients

Patients were identified by reviewing hospital charts, office records, operating room records, and a prospective clinical database established by the Colorectal Service in 1986. Criteria for LAR/CAA included complete proctectomy and restorative anastomosis to the anal canal. The superior margin, or apex, of the anal canal is defined by the anorectal ring, the sling of muscle forming the anal hiatus of the pelvic diaphragm (Fig. 1). In all cases the anastomosis was created at or below the apex of the anal canal. Conformity to these criteria was determined in each case by review of the operative note, the database entry by the operating surgeon, and the first postoperative digital/proctoscopic examination.

From June 1977 through December 1990, 142 patients had LAR/CAA at our institution. Seven patients were resected for villous adenoma and one for recurrent rectal cancer. The remaining 134 patients who had LAR/CAA for primary, invasive rectal cancer form the basis of this report.

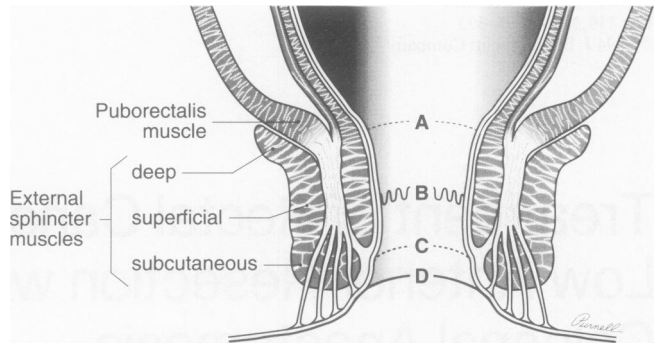

Figure 1. Surgical anatomy of the anal canal. A = anorectal ring (apex); B = dentate line; C = intersphincteric groove; D = anal verge (terminus).

We included 90 men (67%) and 34 women (33%). The median age was 59 years (range, 23 to 90 years). The height of the primary tumor was determined before operation by the attending surgeon on rigid proctoscopy in the left lateral Sims' position. The distance from the anal verge to the lowest edge of the tumor ranged from 2 cm to 11 cm, with a median distance of 6.5 cm (Fig. 2). Most tumors were clustered near the junction of the lower rectum (0 to 5 cm) and the mid-rectum (6 to 11 cm). The median tumor diameter was 4 cm (range, 1.5 to 8 cm). Most tumors were mobile; three fixed tumors were treated first with preoperative combined chemotherapy and radiation and then were resected with negative margins. Five patients had been treated by an initial transanal local excision and then resection because of positive pathologic findings and suspicion of residual disease.

Surgical Technique

Each patient was placed in the lithotomy position and explored through a midline abdominal incision. The rectum and its mesentery were sharply dissected to the anal hiatus of the pelvic diaphragm. The plane of pelvic dissection was generally the parietal pelvic (endopelvic) fascia with preservation of the sacral parasympathetic nerve roots and hypogastric nerve trunks; that is, nerve-preserving pelvic sidewall dissection.[12] Early in the series, 33 patients had pelvic lymph node dissection, defined as dissection along the adventitia of the major pelvic vessels and removal of the hypogastric lymph nodes *en bloc* with the rectum. In 15 patients thought to have early tumors, pelvic dissection was along the visceral plane of the endopelvic fascia (previously called the fascia propria of the

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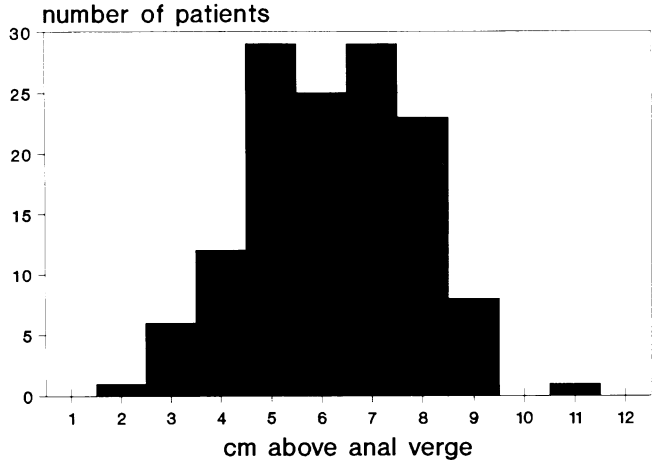

Figure 2. Distribution of the resected tumors within the rectum based on distance from the anal verge.

rectum). *En bloc* adjacent organ resection was performed in two cases, one hysterectomy and one hysterectomy plus posterior vaginectomy.

Selection for sphincter-preserving resection was based on the operating surgeon's judgment that clear distal and lateral margins could be obtained together with preservation of the pelvic diaphragm and anal canal. Transection at the distal margin of the specimen was performed from the abdominopelvic approach in 86 patients (64%) and from the transanal approach in 48 (36%). Reasons to abandon LAR/CAA in favor of abdominoperineal resection included gross disease at the distal transection margin and/or extensive tumor infiltration of the distal mesorectum that threatened the lateral margin of resection.

All resections freed the pelvis of gross disease. Six patients had synchronous liver resection for liver metastases. In four patients, unresectable liver metastases were biopsied only.

Either the sigmoid colon or descending colon were used for reconstruction. In 131 cases, anastomosis was end-to-end; in three cases colonic J pouches were used. Anastomosis was at the dentate line in 85 cases (64%); in the remaining 49 cases (36%) it was between the dentate line and anorectal ring. Coloanal anastomosis was achieved by direct transanal sutures in 87 patients (65%) and by circular stapling devices in 47 (35%). A diverting loop colostomy was created in 112 patients (84%) and in most instances was closed 2 months later.

Pathologic Findings

All specimens were examined fresh by a pathologist for gross assessment, measurements of tumor size, and inking of margins. Distal resection margin was measured in the unpinned fresh specimen from the lowest edge of the visible tumor to the distal end of the specimen. Tumor extended grossly to the transected edge of the specimen in no cases. In 128 cases, a distal resection margin was measured and recorded (range, 0.5 cm to 8 cm; median, 2 cm). In 6 cases, distal resection margin could not be assigned because the pathologist did not record the measurement (2 cases), because of re-excisions of the distal rectal stump (1 case), or because of complete tumor regression after preoperative pelvic radiation therapy (3 cases).

After fixation in 10% formaldehyde, sections were taken routinely from the primary tumor, adjacent rectum, and from the proximal, distal, and lateral margins. All lymph nodes retrieved either by visual examination or by palpation were submitted for microscopic examination. All histologic slides were reviewed by one pathologist (G.L.). For the eight cases in which slides were not available, the original pathology reports were accepted.

Three patients had no residual tumor after preoperative radiation therapy and were not assigned a tumor stage. Ten patients had synchronous liver metastases and were assigned to stage D. The remaining patients with primary tumors and no evidence of distant metastases were staged according to the Astler-Coller system: stage A, 15 patients; stage B1, 35 patients; stage B2, 31 patients; stage C1, 12 patients; and stage C2, 28 patients.[13] In addition, T stage, N stage, and M stage were assigned using the 1988 American Joint Committee on Cancer guidelines.[14]

Histologic features in the primary tumor were assessed using standard hematoxylin and eosin-stained sections and included grade, mucinous differentiation, signet ring shape, as well as blood vessel, lymphatic, and perineural invasion.[15] In 130 evaluable patients, grade was assigned as well differentiated (12), moderately well differentiated (105), or poorly differentiated (13).

Margins were considered positive if tumor cells were seen within one high-power field of the inked margin. One patient with a positive distal margin and one patient with a positive lateral margin were observed. Lymph nodes were examined for microscopic sinusoidal involvement, frank metastasis, and extension into perirectal fat. Forty-seven (36%) of 131 evaluable patients had lymph node involvement. In seven patients, microscopic nodules of tumor cells were found as separate foci within the mesorectum. These mesenteric tumor implants were generally multiple, were isolated within adipose tissue and discontiguous with the primary tumor, and were not associated with lymph nodes (Fig. 3). Presence or absence of mesenteric implants was recorded in every case but did not influence the assignment of TNM or Astler-Coller stage.

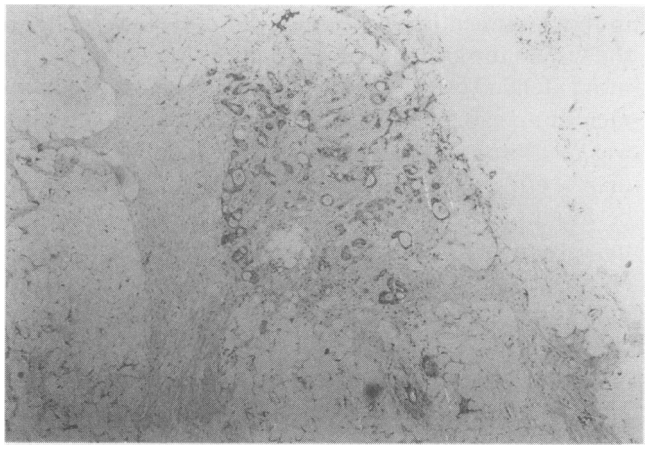

Figure 3. Mesenteric implant. Metastatic glandular elements are implanted in the mesorectum. Hematoxylin and eosin stain, × 25.

Figure 4. Probability of surviving cancer after low anterior resection and coloanal anastomosis.

Adjuvant Therapy

Adjuvant pelvic radiation was given to 65 patients in a variety of doses and schedules (Table 1). Most patients receiving preoperative radiation therapy were enrolled in one of three clinical trials conducted at our institution during the period of study: (1) 15 Gy administered before operation for resectable rectal cancer as part of a sandwich strategy (27 patients)[16]; (2) 50 Gy administered before operation followed by LAR/CAA as an alternative to abdominoperineal resection in selected patients with low rectal cancers 3 to 6 cm above the anal verge (23 patients)[11]; (3) 50 Gy with 5FU/leucovorin administered before operation for locally advanced rectal cancer (3 patients).[17] Ten patients received postoperative radiation therapy because of regional lymph node involvement. Sixty-nine patients received no radiation therapy. Nineteen patients received postoperative adjuvant chemotherapy.

Assessment

Four clinical end points were assessed: (1) pelvic recurrence, (2) distant recurrence, (3) need for permanent colostomy, (4) death from cancer. Pelvic recurrence was defined as any tumor recurrence within the true pelvis or anal canal. Distant recurrence was defined as any tumor recurrence outside the pelvis and included metastasis to the abdominal cavity, liver, lungs, brain, or bone. Patterns of recurrence were assigned at the time of first clinical relapse. Follow-up information was obtained from office charts, hospital records, and telephone interviews. Three patients were lost to follow-up before 3 years. Median follow-up was 4 years. Probability curves for pelvic recurrence and survival were generated by the method of Kaplan and Meier; all patients who died from other causes were censored at the time of death.[18] Univariate analysis of prognostic factors for local recurrence was performed using the log-rank test. Characteristics of patients with short *versus* long distal resection margins were compared using the chi square test. Statistical significance was assigned to a value of $p < 0.05$.

Table 1. ADJUVANT PELVIC RADIATION

Preoperative Dose	Postoperative Dose	n
—	—	69
—	50 Gy	7
15–30 Gy	—	29
15 Gy	45 Gy	3
50 Gy	—	26

RESULTS

Survival

There were no hospital deaths. Twenty-nine patients have died of rectal cancer, 4 with persistent liver metastases and 25 with recurrence. Three patients are alive with disease. The actuarial probability of surviving cancer for 5 years is 73% (Fig. 4). Among those who died from cancer, the median time to cancer death was 3.8 years. Actuarial survival at 5 years for patients stratified by stage is as follows: stage A, 100%; stage B1, 79%; stage B2, 70%; stage C, 58%; and stage D, 13%.

Patterns of Recurrence

Thirty-six patients had relapse after potentially curative resection. The sites of tumor recurrence are listed in

Table 2. PATTERNS OF RECURRENCE

Site of Recurrence	n	Percent of Recurrences
Pelvis only	5	14%
Pelvis + distant sites	8	22%
Distant sites only	23	64%

Table 2. In 64% of recurrences, relapse was at distant sites only. Pelvic recurrence was seen in 13 patients; in 8 instances this occurred as a component of systemic failure. Of the 8 patients who returned with combined distant and pelvic relapse, 6 patients had microscopic tumor implants in the mesentery of the resected rectum, which was uniformly associated with rapid local and systemic recurrence after surgical resection.

Pelvic Recurrence

For 121 of 134 patients, pelvic disease was controlled by LAR/CAA with or without radiation therapy. Pelvic recurrence developed in 13 patients (Table 3). The crude rates of relapse according to stage were stage A, 0 of 15 (0%); stage B1, 1 of 35 (3%); stage B2, 5 of 31 (16%); stage C1, 1 of 12 (8%); stage C2, 5 of 28 (18%); and stage D, 1 of 10 (10%). The actuarial probability of pelvic recurrence at 5 years was 11% (Fig. 5). Median time to pelvic recurrence for the 13 patients was 18 months (range, 3 to 51 months).

A suture line recurrence in the anal canal developed in 1 one patient and was cured by abdominoperineal resection. Of the 12 patients in whom true intrapelvic recurrence developed, 7 had special risk factors for recurrence (Table 3): microscopic involvement of a resection margin (2 patients) and mesenteric tumor implants (6 patients). In the absence of these special findings, there were 5 pelvic recurrences in 124 patients, a 4% local failure rate. In this group with traditional T3 and N1–2 risk factors, pelvic recurrence rates by stage were stage A, 0 of 15 (0%); stage B1, 0 of 34 (0%); stage B2, 3 of 28 (11%); stage C1, 1 of 12 (8%); stage C2, 1 of 23 (4%); stage D, 0 of 9 (0%).

Of the 12 patients with intrapelvic recurrence, 9 are dead of their disease, 2 are alive with disease, and 1 has no evidence of disease 18 months after salvage abdominoperineal resection.

Prognostic Factors for Pelvic Recurrence

To understand the causes of local failure, we performed a univariate analysis of possible risk factors. We examined patient factors, tumor factors, and treatment factors for statistical correlation with the development of pelvic recurrence (Table 4).

Of the patient and tumor factors, mesenteric tumor implants, perineural invasion, blood vessel invasion, transmural penetration of tumor (T3), and poorly differentiated histology were significantly associated with pelvic recurrence. Lymphatic vessel invasion also correlated with recurrence but fell just short of statistical significance ($p = 0.06$). Age, sex, tumor height above the anal verge, tumor size, and lymph node metastases had no demonstrable effect on pelvic recurrence.

Of the treatment factors, only positive microscopic involvement of a resection margin was predictive of pelvic recurrence. In two cases margins initially thought to be negative at surgery were found to be positive on final histopathologic examination, and pelvic recurrence developed in both patients (Table 3). In one patient a compromised distal margin occurred despite a 3-cm gross resection margin below the tumor. Permanent histologic sections of the distal margin revealed unsuspected adenocarcinoma arising within an adenomatous polyp at the edge of the resected specimen. In a second patient, compromised lateral margins occurred with extensive multifocal involvement of the mesorectum by tumor implants, one of which extended to the lateral pelvic margin. In both cases, positive resection margins were attributed to locally advanced tumors with unsuspected, discontiguous foci of disease rather than grossly unsafe resection margins selected by the surgeon.

The length of the distal resection margin below the tumor (< 2 cm compared with ≥ 2 cm) had no statistical relation to pelvic recurrence (Table 4). In patients resected with short distal margins, the crude rate of local control was 94% (45 of 48 cases) compared with a crude rate of 89% (71 of 80 cases) in those with longer margins. The favorable outcome with short distal margins is unlikely to be related to a selection bias because patients with short and long distal margins had similar distributions of tumor stage and received adjuvant pelvic radiation in similar schedules and frequencies (Table 5). Neither adjuvant chemotherapy nor adjuvant radiation therapy had any correlation with pelvic recurrence in this series (Table 4).

Permanent Colostomy

One hundred twenty-three patients maintained intestinal continuity during follow-up. Eleven patients needed permanent colostomy (Table 6). Eight of these colostomies were performed for pelvic recurrence. One patient declined reversal of his loop colostomy. One severe anastomotic stricture and one intractable rectourethral fistula, both occurring in patients treated with post-

Table 3. CLINICAL AND PATHOLOGICAL FEATURES OF PATIENTS WITH PELVIC RECURRENCE

Patient	From AV	Distal Surgery Margin	T Stage	No. of Positive LNs	Grade	Special Histopathologic Risk Factors‡	Status
1	2 cm	0.5 cm	T3	1	Moderate		NED
2	3.5 cm	1.8 cm	T2	2	Well		AWD
3	4.5 cm	1.6 cm	T3	1	Poor	Mesenteric implants	DOD
4*	4.5 cm	Undetermined	T3	0	Moderate		DOD
5	5 cm	3.7 cm	T3	2	Moderate	Mesenteric implants	DOD
6	6 cm	3 cm	T2	0	Poor	Mesenteric implants	DOD
7	6 cm	2 cm	T3	5	Poor	Mesenteric implants	DOD
8†	7 cm	3 cm	T3	0	Moderate		
	3 cm		T2	0	Moderate	Positive distal margin	AWD
9	7 cm	2 cm	T3	0	Moderate		DOD
10	7 cm	2.5 cm	T3	0	Moderate		DOD
11	8 cm	7 cm	T3	0	Poor	Mesenteric implants	DOD
12†	8 cm	4 cm	T3	2	Moderate		NED
13	8 cm	3.5 cm	T3	0	Moderate	Mesenteric implants Positive lateral margin	DOD

* Distal margin re-excised twice.
† Index lesion at 7 cm, malignant polyp found in resected specimen at distal margin, true suture-line recurrence.
‡ Positive margin indicates microscopic involvement.
NED = no evidence of disease; AWD = alive with disease; DOD = dead of disease.

operative adjuvant radiation, resulted in permanent colostomy.

DISCUSSION

The primary goal of operations for rectal cancer is complete resection of all regional disease to achieve the best chance for local control and cure. Operative technique effects rates of pelvic recurrence, which range from under 10% to nearly 40%.[19,20] Sharp dissection along the pelvic sidewalls and complete excision of the mesorectum are important means to achieve complete resection.[21,22]

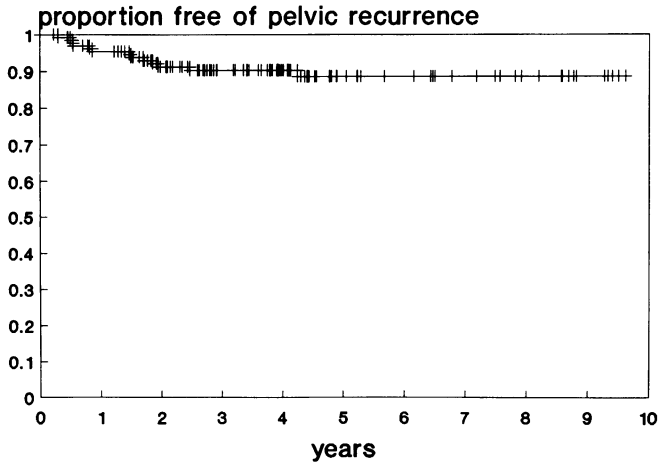

Figure 5. Probability of remaining free of pelvic recurrence after low anterior resection and coloanal anastomosis.

The decision to proceed with LAR/CAA is made in the operating room and is based on two judgments by the surgeon: (1) that the rectal tumor can be adequately resected without violating the levator ani and anal sphincter muscles, and (2) that intrapelvic anastomosis is technically impossible. This circumstance occurs most often with tumors located at or near the junction of the lower third and middle third of the rectum; that is, about 6 cm above the anal verge. Two thirds of our patients were men; this reflects the added difficulty of constructing a low anastomosis beneath the prostate gland in a narrow male pelvis. Pathologic distal margins were relatively short (range, 0.5 to 8 cm; median, 2 cm). Together these data confirm that LAR/CAA was used on a highly selective basis for tumors lying near the pelvic floor but not grossly invading either the levator ani or the anal canal.

The overall treatment results were good: 73% survival and 89% local control rates at 5 years. Approximately two thirds of all relapses were at distant sites alone. Risk factors for pelvic recurrence (Table 4) were primarily pathologic indicators of locally advanced or aggressive disease that relate to the degree and pattern of tumor spread into perirectal tissues: tumor implants in the

Table 4. UNIVARIATE ANALYSIS OF RISK FACTORS FOR PELVIC RECURRENCE

Feature	Group	No. of Recurrences/ N (%)	p
Patient factors			
Gender	Male	10/90 (11%)	0.33
	Female	3/44 (7%)	
Age	<60 yr	6/69 (9%)	0.56
	≥60 yr	7/65 (11%)	
Tumor factors			
Mesenteric implants	Present	6/7 (86%)	0.000003
	Absent	7/127 (6%)	
Perineural invasion	Present	2/4 (50%)	0.0004
	Absent	11/127 (9%)	
T stage	T1-2	2/64 (3%)	0.008
	T3	11/67 (16%)	
Blood vessel invasion	Present	3/8 (38%)	0.005
	Absent	10/123 (8%)	
Grade	G1-2	9/118 (8%)	0.01
	G3	4/13 (31%)	
Lymphatic invasion	Present	4/18 (22%)	0.06
	Absent	9/113 (8%)	
Mucinous	Present	2/11 (18%)	0.28
	Absent	11/120 (9%)	
Size	<4 cm	7/77 (9%)	0.54
	≥4 cm	6/54 (11%)	
N stage	N0	7/84 (8%)	0.42
	N1-2-3	6/47 (13%)	
Above anal verge	<6 cm	5/48 (10%)	0.76
	≥6 cm	8/86 (9%)	
Treatment factors			
Microscopic margins	Positive	2/2 (100%)	0.000003
	Negative	11/132 (8%)	
Anastomosis	EEA	3/47 (6%)	0.26
	Handsewn	10/87 (11%)	
Adjuvant chemotherapy	Any	1/19 (5%)	0.66
	None	12/115 (10%)	
Radiation therapy	≥45 Gy	5/36 (14%)	0.80
	None	8/69 (12%)	
Surgical distal margin	<2 cm	3/48 (6%)	0.42
	≥2 cm	9/80 (11%)	

mesorectum, perineural invasion, blood vessel invasion, transmural tumor, and poorly differentiated histologic findings. The local control rate of 89% compares favorably with the results reported for conventional LAR[23,24] and indicates that complete resection of regional disease is achieved for most tumors. Radical resection with strict attention to surgical technique, particularly sharp dissection along the parietal pelvic fascia to the anal hiatus, is essential for good results.

Mesenteric implants, a form of regional metastasis seen in 5% of our cases, have not been widely recognized in the literature. The dramatic failure rate (rapid local and systemic relapse in six of seven patients) calls for aggressive adjuvant treatment with chemotherapy and radiation. Recognition of this metastasis, its correlation with other unfavorable pathologic features, and its distinction from lymph node metastases, warrant further study.

Table 5. COMPARISON OF PATIENTS WITH SHORT AND LONG DISTAL RESECTION MARGINS: DISTRIBUTION OF TUMOR STAGES AND DOSES OF PELVIC RADIATION THERAPY

	Patients with Distal Margin < 2 cm N (%)	Patients with Distal Margin > 2 cm N (%)	p
Tumor stage			
T12N0	20 (42%)	30 (38%)	0.42
T3N0	9 (19%)	23 (29%)	
T12N123	7 (15%)	6 (8%)	
T3N123	12 (25%)	21 (26%)	
Adjuvant pelvic radiation			
None	28 (58%)	39 (49%)	0.56
15–30 Gy	10 (21%)	19 (24%)	
≥45 Gy	10 (21%)	22 (28%)	

Short distal resection margins were not significantly associated with pelvic recurrence in this series ($p = 0.48$; Table 4). These figures suggest that for this operation, as shown for conventional LAR,[10,25] longer distal margins do not improve cancer treatment. In experienced hands, compromise of resection margins is rare; gross findings in the operating room will guide the surgeon appropriately.

Long-term sphincter preservation was achieved in 92% of patients; most colostomies were required because of pelvic recurrence. These data underscore that the first priority of sphincter preservation must be successful cancer treatment.

Adjuvant pelvic radiation reduces local recurrence of rectal cancer after conventional resection and is usually recommended in combination with 5-fluorouracil–based chemotherapy after resection of transmural tumors (T3–4) and node-positive (N1–2–3) tumors.[26,27] Our data indicate that, in the absence of other adverse

Table 6. PATIENTS REQUIRING PERMANENT COLOSTOMY

Reason for Colostomy	No. of Patients
Pelvic recurrence	8
Declined reversal of loop colostomy	1
Severe anastomotic stricture	1
Refractory rectourethral fistula	1

factors, T3 and N1 disease are well controlled by radical resection with or without radiation therapy. Additional adverse histologic features in the primary tumor—perineural invasion, blood vessel invasion, and poorly differentiated histologic findings—increase the likelihood of extrarectal spread. Mesenteric tumor implants indicate advanced extrarectal dissemination. Combined with T3 disease, these adverse pathologic features predict most surgical failures and should serve as strong indicators for adjuvant chemotherapy and radiation treatment.

A short surgical resection margin below the tumor, provided it is confirmed to be microscopically free of tumor, should not by itself be considered an indication for adjuvant therapy. Microscopic involvement of the distal margin despite a grossly clear surgical margin occurs rarely and almost always with advanced, aggressive, multifocal disease.[28] If detected in the operating room, re-excision of the anal stump or abdominoperineal resection should achieve a clear margin. If detected after operation, associated aggressive disease and advanced tumor stage generally dictate use of adjuvant therapy.

Our experience indicates that postoperative radiation, when used in combination with LAR/CAA, has significant risks and deleterious effects. Of 10 patients receiving full-dose, postoperative pelvic radiation after LAR/CAA, 2 required permanent colostomy for radiation-related complications (Table 5). In addition, a detailed survey of long-term anorectal function in the patients who maintain intestinal continuity showed impaired function in the group receiving postoperative radiation.[29] Considering the relatively low pelvic recurrence rate observed in T3N0 lesions and N1–2 lesions and the high incidence of additional histopathologic risk factors in those tumors that did recur in the pelvis, routine use of postoperative pelvic irradiation for all T3 or N1 tumors may be excessive. A more selective use based on the extent of transmural penetration, the number of lymph nodes involved, and the presence or absence of additional histopathologic risk factors identified here should be possible. In cases of early transmural spread or involvement of a single pericolonic lymph node and with no additional adverse factors, we recommend a careful discussion with the patient of the potential risks and benefits of adjuvant therapy before referral for postoperative chemotherapy and radiation.

Preoperative pelvic radiation followed by LAR/CAA, on the other hand, was well tolerated in our patients. As better preoperative selection criteria for high-risk tumors become available, this sequence of therapy should be used more widely.

We used preoperative radiation in combination with LAR/CAA primarily for low-lying rectal cancers (3 to 6 cm above the anal verge) that might otherwise require abdominoperineal resection.[7] In 22 patients treated by this approach between 1986 and 1992, 5 had local recurrence, with median follow-up of 29 months (4-year actuarial rate of pelvic recurrence is 32%).[12] Attempts to extend sphincter preservation to this subset of low rectal cancers remain investigational; our protocol used preoperative radiation in combination with 5-fluorouracil and leucovorin.[19]

Our experience also supports the use of LAR/CAA in patients with liver metastases if liver involvement is not massive. Ten such patients in our series have survived for a median of 32 months (range, 9 to 53 months). All had their diverting colostomies closed, and quality of life was enhanced for most. However, there is a well-recognized and often stressful 6- to 12-month period of functional adaptation after colostomy closure. Patients who are not expected to survive much beyond this period may be better served by local excision.

Current guidelines for LAR/CAA provide good treatment for rectal cancer without compromising local control or survival. Careful attention to patient selection and operative technique is important to obtain good results. A pelvic recurrence rate of 11% has been observed, and most recurrences are associated with extraordinary risk factors. Current evidence suggests that preoperative pelvic radiation is significantly better tolerated than postoperative radiation. Overall more than 90% of patients avoid permanent colostomy.

Acknowledgments

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