
Morbidity and Mortality After Pelvic Exenteration for Colorectal Adenocarcinoma

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A retrospective analysis was made of the complications from pelvic exenterations performed over the past 30 years for colorectal adenocarcinoma at the Roswell Park Cancer Institute. Seventy-five patients underwent exenteration, 51 for primary disease (PD) and 24 for recurrent disease (RD). Both total and posterior exenterations were included. Twenty of the fifty-one patients (39%) undergoing exenteration for PD developed severe complications, with an operative mortality rate of 6%. The most common complications were injuries to the ureter or bladder, intra-abdominal abscesses, and anastomotic leaks from the urinary diversion. After exenteration for RD, 12 of 24 patients (50%) developed severe complications, with an operative mortality rate of 4%. The most common major complication was an anastomotic leak from the urinary diversion; this occurred in 33% of all patients with RD (8/24). The authors conclude that, although exenteration for colorectal adenocarcinoma may be performed with a low operative mortality rate, patients must be carefully selected because the associated morbidity rate remains high.

PELVIC EXENTERATION FOR colorectal adenocarcinoma confined to the pelvis remains a formidable procedure today, 40 years after its initial description.^{1,2} Patients with bulky and locally advanced pelvic disease are often symptomatic. Aggressive surgical extirpation, whether performed for primary treatment or for recurrent disease, often represents the best treatment option for patients. An adequate understanding of the potential complications associated with these procedures, however, is mandatory. We have analyzed a 30-year experience with pelvic exenteration at the Roswell Park Cancer Institute in an effort to provide such information.

Materials and Methods

This is a retrospective review of the medical records of patients who underwent pelvic exenteration for primary

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or recurrent colorectal adenocarcinoma from January 1960 to March 1990 at the Roswell Park Cancer Institute. This included both total exenteration and posterior exenteration. Total pelvic exenteration was defined as the extirpation of the rectum and bladder in men, as well as the uterus (if present) in women. Posterior pelvic exenteration was defined as the extirpation of the rectum, uterus, and ovaries in women. The indications for total pelvic exenteration were either documented involvement of the base of the bladder or trigone, based on the preoperative workup, or suspected involvement on intraoperative evaluation. Only those patients who required a total cystectomy were included in the analysis of this group. The indications for posterior exenteration for primary disease included anterior or circumferential lesions in women. Suspected vaginal or uterine involvement based on intraoperative evaluation was an indication for posterior exenteration in both primary and recurrent disease.

Before exenteration, all patients underwent a mechanical bowel preparation with preoperative prophylactic antibiotics. After total exenteration, the urinary diversion was performed with a small bowel loop conduit and separate end-to-side ureterointestinal anastomoses with fine interrupted absorbable sutures as described by Bricker and Modlin.¹ Ureteral stenting usually was not performed, but there was drainage of the retroperitoneal space with Penrose and active sump drains. If a perineal dissection was required, the perineal wound was packed open and healed by secondary intent.

Surgical morbidity and mortality rates were defined as occurring within 30 days of the pelvic exenteration. Major morbidity was defined as a significant complication whose treatment required surgery, prolonged the hospital stay,

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or led to an alteration in that patient's management. All other complications were categorized as minor morbidity.

Results

Seventy-five patients underwent pelvic exenteration. There were 17 men and 58 women. The mean age was 60 years, with a range of 19 to 83 years. Fifty-one patients underwent exenteration for primary disease and 24 for recurrent disease. Of the 51 patients with primary disease, 14 underwent total pelvic exenteration, whereas 37 patients received a posterior exenteration. Of the 24 patients with recurrent disease, 14 underwent total pelvic exenteration and 10 patients received a posterior exenteration. The TNM (tumor, nodes, and metastases) classifications³ of both groups are listed in Table 1. The classification for patients with recurrent disease refers to the original primary tumor.

The overall major morbidity rate in this series was 32 of 75 patients (43%). After exenteration for primary disease, 20 of the 51 patients (39%) developed severe complications, with three surgical mortalities (6%). The types of complications are listed in Table 2. The most common major complications were iatrogenic injury to the bladder or ureter, intra-abdominal abscesses, and abdominal wound infections. There were three anastomotic leaks, two from the ureteroenterostomy and one from the enteroenterostomy anastomosis after formation of the urinary conduit. One patient underwent a total pelvic exenteration with aortic and iliac lymph node dissection; he developed intra-abdominal hemorrhage from necrosis of the right common iliac artery, which was successfully repaired. More than one complication occurred in some patients, as noted by the total number of complications. Twelve of these twenty patients developed complications that required surgery (60%). These are noted in Table 2. The minor complications incurred after exenteration for primary disease are listed in Table 3. Urinary tract infections and neurogenic bladder were the most common mi-

TABLE 1. Stage of Primary Tumor

TNM	No. of Patients	
	Exenteration for Primary Disease	Exenteration for Recurrent Disease (Stage of Primary Tumor)
(TIS)	0	0
(T1/T2, NO)	11	3
(T3, NO)	6	9
(T4, NO)	15	1
(T1-3, N1)	6	3
(T1-3, N2)	2	3
(T4-, N1-2)	9	3
(any T, any N, M1)	2	1
Unknown	0	1

TABLE 2. Major Morbidity After Pelvic Exenteration

Complication	Primary Disease	Recurrent Disease
	No. of Patients* No Surgery (Surgery)	No. of Patients* No Surgery (Surgery)
Ureteroenterostomy or enteroenterostomy anastomotic leak	3 (2)	8 (7)
Iatrogenic injury to bladder (3 patients+) or ureter (2 patients+)	5+ (3)	1
Intra-abdominal abscess	4 (2)	1
Necrotizing fasciitis	2 (2)	—
Small bowel obstruction secondary to adhesions	2 (2)	2 (2)
Wound dehiscence	2 (2)	2 (1)
Massive lower gastrointestinal hemorrhage, cause unknown (subtotal colectomy performed)	1 (1)	—
Small bowel fistula secondary to bowel obstruction	1 (1)	—
Wound infection	4	2
Pneumonia	1	1
Vascular insufficiency requiring extremity amputation	—	1 (1)
Intra-abdominal hemorrhage secondary to external iliac artery stump disruption	—	1 (1)
Ruptured right common iliac artery	1 (1)	—
Revision of ileostomy	1 (1)	—
Total	27	19

* More than one complication occurred in some patients.

nor complications. When included with major morbidity, 36 of 51 patients (71%) undergoing exenteration for primary disease developed a complication.

After exenteration for recurrent colorectal adenocarcinoma, 12 of 24 patients (50%) developed severe com-

TABLE 3. Minor Morbidity After Pelvic Exenteration*

Complication	Primary Disease	Recurrent Disease
	No. of Patients†	No. of Patients†
Small bowel obstruction	1	—
Neurogenic bladder	5	3
Urinary tract infection	8	2
Central venous catheter sepsis	1	—
Common peroneal nerve neuroparaxia	1	2
Gastrointestinal hemorrhage	1	—
Vaginal-perineal fistula	—	1
Staphylococcus enteritis	1	—
Supraventricular tachycardia	1	—
Contact dermatitis secondary to betadine	1	—
Total	20	8

* No surgery required for resolution.

† More than one complication occurred in several patients.

plications, with one surgical death (4%). The types of complications are listed in Table 2. The most common major complication was ureteroenterostomy or enteroenterostomy anastomotic leak after urinary conduit formation, which required surgery in 7 of 8 patients. Two patients had both a ureteroenterostomy and enteroenterostomy leak. Two additional patients had enteroenterostomy leaks, and four patients had ureteroenterostomy leaks. Again, more than one complication occurred in some patients. Eight of the twelve patients (67%) who developed complications required surgery. The minor complications that developed in this group are listed in Table 3. The most common minor complication after exenteration for recurrent disease was neurogenic bladder. When included with major morbidity rate, 20 of 24 patients (83%) undergoing exenteration for recurrent disease developed a complication.

Eleven of the seventy-five patients (15%) had received prior radiation to the abdomen or pelvis-perineum. This included three of 51 patients (6%) in the group with exenteration for primary disease and eight of 24 patients (33%) undergoing exenteration for recurrent disease. The indications and possible complications that resulted from radiation in each group are shown in Table 4. Of the three patients with prior irradiation who underwent exenteration for primary disease, one (33%) developed a complication of ileostomy stomal retraction. Of the eight patients with prior irradiation who underwent exenteration for recurrent disease, all (100%) developed a complication. Of the 16 patients with no prior irradiation undergoing exenteration for recurrent disease, 10 (63%) developed a major complication.

Among the three surgical deaths in the primary disease group, all were sepsis related (abdominal abscess, necrotizing fasciitis, and pneumonia, respectively). The single death of recurrent disease died of intra-abdominal hem-

orrhage secondary to rupture of a previously ligated external iliac artery after an *en bloc* resection and femoral to femoral artery bypass.

Discussion

Pelvic exenteration for locally advanced pelvic cancer was first described by Brunschwig in 1948.² Only one of the 22 patients in this series had a tumor of colorectal origin; the remainder were gynecologic carcinomas. The operative mortality rate was 23%. Appleby⁴ applied the same surgical principles when he reported a series in 1950 of eight male patients who had undergone "proctocystectomy." Although the morbidity rate was not reported, the operative mortality rate was 17%. In all of these patients, the urinary stream was diverted into the sigmoid colon, producing a "wet colostomy." The procedure has evolved in the 42 years since it was first described. Chief among the innovations was the development of the ileal loop conduit for urinary diversion by Bricker in 1951.¹

Pelvic exenteration for colorectal adenocarcinoma remains a formidable procedure. The indications at the Roswell Park Cancer Institute include locally advanced disease, with clinical or presumptive involvement of adjacent organs. This procedure may be performed for either primary or recurrent disease. In either case, tumor should be limited to the pelvis. Presently, contraindications at our Institution include tumor involvement of the pelvic sidewall, pubic symphysis, or major vessels or nerves. Sciatic or perineal pain suggestive of nerve root involvement are not considered amenable to this procedure. The natural history of recurrent disease that involves the sacrum, although technically resectable in some cases, is not altered by pelvic exenteration.⁵ Unilateral or bilateral hydronephrosis in recurrent disease may be a relative contraindication.⁶ The size of the tumor mass, involvement of

TABLE 4. Possible Radiation Complications

Patient	Total Radiation		Indication	Complication
	Dose (rad)			
Primary disease				
1	4320		Adjuvant rectum	None
2	3000		Prior uterine cancer	None
3	Unknown		Prior cervical cancer	Ileostomy retraction requiring surgical revision
Recurrent disease				
1	2500		Only treatment to rectal primary lesion	Neurogenic bladder*
2	5000		Adjuvant rectum	Neurogenic bladder*
3	2100		Adjuvant rectum (to liver only)	Anastomotic leak
4	5000		Pelvic recurrence	Wound dehiscence
5	8000		Pelvic recurrence	Anastomotic leak
6	Unknown		Pelvic recurrence	Neurogenic bladder*
7	Unknown		Pelvic recurrence	Anastomotic leak wound dehiscence
8	4000		History of Hodgkin's disease	Anastomotic leak, small bowel obstruction

* More likely secondary to surgical dissection rather than to radiation.

adjacent organs, previous surgery, and prior irradiation are all factors that may lead to substantial morbidity and mortality rates.

In this retrospective analysis of 75 patients undergoing pelvic exenteration for colorectal adenocarcinoma over a 30-year period, the overall operative mortality was 5%; that for primary disease, 6%; and for recurrent disease, 4%. A previous report from our Institution noted a 10% operative mortality rate among 30 patients undergoing pelvic exenteration for primary colorectal malignancies.⁷ Reports in the literature may be confusing when results from colorectal adenocarcinomas are combined with primary anal canal and gynecologic tumors, and when results from total, posterior, and anterior exenterations are not distinguished. Moreover, we believe that exenteration for primary disease should be considered separately from exenteration for recurrent carcinoma. Both mortality and morbidity rates can be expected to be higher in the latter patients. Recurrent tumors can attain considerable size and further complicate the technical aspects of a repeat procedure. In addition, many of these patients will have undergone prior radiation therapy, adding to the hazard of this procedure.

Lopez et al.⁸ reported an operative mortality rate of 21% for total pelvic exenteration in primary rectosigmoid carcinoma over a 30-year period; this decreased to 9% in the final decade. Boey et al.⁹ found a 15% 30-day mortality rate in a similar group of patients. Mortality rates range from 0% to 18% in series that also include tumors not of colorectal origin (Table 5).^{4,6-17} All three of the surgical deaths in our present series for primary disease were related to sepsis: abdominal abscess, necrotizing fasciitis, and pneumonia. None of these patients had a clinically recognized anastomotic leak to explain their subsequent course. The single operative death among patients with recurrent disease succumbed after an iliac artery graft anastomosis dehiscence. This had originally been placed af-

ter an *en bloc* resection of a portion of the artery with the tumor.

Although the operative mortality rate was low in our experience, a considerable number of our patients developed complications. After exenteration for primary disease, 39% developed major complications, of which 60% required surgery. Among patients with recurrent disease, 50% developed complications that met our criteria for major morbidity, of which 67% required surgery. When minor complications are included, the overall morbidity rate for primary and recurrent disease was 71% and 83%, respectively. Because the criteria for postoperative morbidity may vary among authors, we have attempted to categorize our complications into major and minor groups in an admittedly subjective fashion. Major morbidities were those that required surgery, prolonged hospitalization, or were thought to have caused a significant change in patient management. We believe that when interpreting morbidity data for the individual patient, such "major" factors are most likely to affect the physician's decision to select a particular operation.

With these caveats in mind, the reported morbidity rates vary widely in the literature, ranging from 13% to 77%.^{1,7,12-14,18} Complications related to the urinary diversion were most often cited.^{7,9,14,15} Gastrointestinal complications, particularly small bowel obstruction and fistulas, are also commonly reported.^{8,9,13-15}

A ureteroenterostomy or enteroenterostomy anastomotic leak occurred in eight of 24 patients (33%) with recurrent tumor in our series. An additional element in those patients with recurrent disease who developed anastomotic leaks was a history of prior radiation therapy. Four of the eight patients (50%) who developed an anastomotic leak received radiation therapy. Radiation therapy had been used in only 15% of our patients before their exenteration, although fully one third of those with recurrent disease had been so treated. It may have been

TABLE 5. Reported Data on Pelvic Exenteration for Colorectal Adenocarcinoma

Reference	Year	Primary Lesion	Surgery/indication	No. of Patients	Morbidity (%)	Mortality (%)
Appleby ⁴	1950	CR	TPE/PD	6	—	17
Brintnal and Flocks ¹⁰	1950	CR	TPE/PD	9	—	33
Kiselow et al. ¹¹	1967	CR	TPE/PD	43	—	16
Olsson et al. ¹²	1976	CR + bladder + cervix	TPE, AE/PD, RD	18 (7 CR)	45*	6
Eckhauser et al. ¹³	1979	Rectum	TPE, PE/PD	12	75*	8
Ledesma et al. ⁷	1981	CR, anus	TPE/PD	30	13	10
Boey et al. ⁹	1982	CR	TPE, PE/PD	49	51	18
Jakowatz et al. ¹⁴	1985	CR + others	TPE, PE, AE/PD, RD	104 (31 CR)	49	3
Lindsey et al. ¹⁵	1985	CR + others	TPE, PE, AE/PD, RD	68 (29 CR)	30	14
Takagi et al. ¹⁶	1983	CR	TPE/PD	13	—	8
Lopez et al. ⁸	1987	CR	TPE/PD, RD	24	26	20
Hafner (current series)	1991	CR	TPE, PE/PD, RD	75	43	5

* Includes early and late complications.
CR, colorectal; TPE, total pelvic exenteration; PD, primary disease;

AE, anterior exenteration; RD, recurrent disease; PE, posterior exenteration.

involved in one complication for primary disease, where a retracted ileostomy required surgical revision. However, technical errors during the initial surgery also could have contributed to this complication. Additionally, three patients with recurrent disease who received prior radiation developed a neurogenic bladder, but this complication was more likely secondary to nerve injury during the pelvic dissection.

Other groups have found radiation therapy to be a significant complicating factor. Jakowatz et al.¹⁴ noted that 49% of their pelvic exenterations developed complications involving the gastrointestinal tract, urinary tract, or abdominal wound. Prior radiation led to a much higher morbidity rate compared with those without such treatment (67% versus 26%, respectively). This group recommended reconstruction of the irradiated pelvis by an omental flap, colonic advancement, or a myocutaneous flap to decrease the complication rate. Lopez et al.⁸ reported that three of four patients (75%) with and two of 15 patients (13%) without prior irradiation who survived the operation had major complications ($p < 0.005$).

It has been shown in our series and others that pelvic exenteration may be carried out with a low mortality rate. We have reported a significant morbidity rate for both primary and recurrent disease. Radiation therapy was used in relatively few of these patients, but may have contributed to the morbidity rate. With the recent National Institutes of Health (NIH) consensus on adjuvant radiation and chemotherapy for stage II and III rectal adenocarcinoma,³ the treatment of local-regional recurrence will be largely limited to surgery. We continue to advocate an aggressive posture for locally advanced colorectal adenocarcinoma, whether for primary or recurrent cancer. Our data do serve to emphasize, however, that careful patient selection is imperative before undertaking a procedure of this magnitude.

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