ORIGINAL ARTICLE

Anastomotic Leak After Low Anterior Resection

A Spectrum of Clinical Entities

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Importance: Anastomotic leak is a potentially devastating complication of bowel surgery, yet a *leak* can refer to a range of clinical problems, with disparate treatment and outcomes.

Objectives: To qualitatively categorize the spectrum of anastomotic leaks that occur after low anterior resection for rectal cancer and to describe their effect on outcomes.

Design and Setting: Retrospective review of a prospective database at an academic teaching hospital.

Participants: Two hundred ten patients with at least 1 year of follow-up data.

Intervention: Low anterior resection for rectal cancer.

Main Outcome Measures: Anastomotic leak, associated treatment, and need for permanent stoma creation.

Results: Of 198 study patients, 168 had no demonstrated anastomotic leak, free fluid, or abscess at any time after surgery. Of the remaining 30 patients, 17 had extravasation of contrast medium into the peritoneal cavity or the presacral space on a postoperative imaging study, some long after surgery. Six to 9 of these patients seemed to meet usual clinical criteria for anastomotic leak. Ten patients had only free or simple pelvic fluid collection without extravasation of contrast medium, and 3 patients had an abscess near the anastomotic site without extravasation of contrast medium. Male sex, diabetes mellitus, and radiation therapy (but not cigarette smoking) increased the risk for anastomotic leak. Anastomotic leak was correlated with the requirement for permanent stoma creation, while only free anastomotic leak was associated with an increased incidence of irregular bowel function. Notably, simple fluid without extravasation of contrast medium also correlated with irregular bowel function.

Conclusions and Relevance: A spectrum of clinical entities may be considered to represent an anastomotic leak after low anterior resection, with differing consequences. Presacral and free extravasation of contrast medium led to an increased need for permanent diversion, but even simple pelvic fluid collections were associated with irregular bowel function.

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ANASTOMOTIC LEAK IS ONE of the most dangerous and feared complications after low anterior resection, with a reported incidence varying from almost zero to 36%.[1-15] Symptomatic anastomotic leaks are associated with mortality of between 6% and 22%.[16-22] However, findings, such as presacral extravasation of contrast medium, can be seen on postoperative computed tomography (CT) even in patients with no symptoms.[23,24] The clinical significance of these clinical and radiographic findings are not well described or distinguished in the literature.

The objectives of this study were to qualitatively describe and potentially categorize the spectrum of abnormal clinical and radiological findings that are seen after low anterior resection for rectal cancer. Their eventual effect on mortality, permanent stoma creation, and bowel function outcomes was also assessed.

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METHODS

STUDY DESIGN

All patients who underwent low anterior resection for rectal cancer at Fletcher Allen Healthcare, the teaching hospital of the University of Vermont College of Medicine, Burlington, between January 1, 1996, and December 31, 2009, were identified from a prospectively maintained database of complications. Postoperative complications, including anastomotic leak and abscess, were recorded as they were detected in real time using a complication tracking system (Surgical Activity Tracking System, our prospectively maintained complication database).[25] A retrospective medical record review was then undertaken to identify potential preoperative risk factors for anastomotic leak, including age, sex, neo-

Table 1. Patient Characteristics by Anastomotic Leak Classification

Characteristic	Control Group (n = 168)	Anastomotic Leak Group		Free Pelvic Fluid Collection Group (n = 10)	Abscess Group (n = 3)
		Free (n = 6)	Presacral (n = 11)		
Age, mean, y	59	60	61	60	57
Male sex, No. (%)	87 (51.8)	5 (83.3)	10 (90.9)	5 (50.0)	2 (66.7)
Diabetes mellitus, No. (%)	23 (13.7)	2 (33.3)	5 (45.5)	1 (10.0)	2 (66.7)
Cigarette smoking, No. (%)	73 (43.5)	1 (16.7)	7 (63.6)	5 (50.0)	0
Preoperative radiation therapy, No. (%)	67 (39.9)	4 (66.7)	8 (72.7)	6 (60.0)	2 (66.7)
Primary fecal diversion, No. (%)	34 (20.2)	2 (33.3)	4 (36.4)	3 (30.0)	0
Oversewing of stapled anastomosis, No. (%)	8 (4.8)	0	3 (27.3)	0	0

adjuvant chemoradiotherapy, diabetes mellitus, and cigarette smoking. Operative details were obtained from the dictated operative report, including anastomotic technique and the use of fecal diversion. Sharp mesorectal dissection was typically performed to the level of the pelvic floor, but total mesorectal excision was confined to the most distal lesions. Tumor-specific mesorectal excision was performed for more proximal rectal lesions. The decision to perform a protective stoma was at the discretion of the operating surgeon.

All inpatient and outpatient clinic medical records were comprehensively reviewed for mortality, anastomotic complications, postoperative CT scans, contrast medium enemas, and the need for intervention to treat an anastomotic leak. Bowel function outcomes at 1 year were recorded from the clinic note. Patients were routinely asked about their bowel function and any fecal incontinence at that visit. Based on this clinic note, an independent reviewer (H.C.) uninvolved with the patient's care decided whether irregular bowel function (eg, urgency or clustering) was a problem and whether the patient reported issues with fecal incontinence sufficient to interfere with activities of daily living. No validated assessment tools for bowel function or fecal continence were used.

Data were gathered from several different sources, including the electronic medical record system, paper inpatient medical records, microfilmed inpatient medical records, and paper outpatient medical records. Fletcher Allen Healthcare transitioned from inpatient and outpatient medical records to the electronic format during the study period.

Low anterior resection was defined as resectional surgery for carcinoma of the rectum with a colorectal anastomosis. Patients who had resection of a rectosigmoid carcinoma (>12 cm from the anal verge) or a low rectal cancer treated with a coloanal anastomosis or end colostomy were excluded from the study. A coloanal anastomosis was defined as a stapled anastomosis at or below the pelvic floor or a hand-sewn pull-through procedure. Anastomoses were routinely tested during surgery with transanal povidone-iodine instillation or insufflation of air into a saline-filled pelvis.

All patients underwent preoperative CT of the abdomen and pelvis before surgery, and their disease was locally staged with endorectal ultrasonography, almost always by the operating surgeon. Patients with T3 or N1 lesions on ultrasound were referred for neoadjuvant chemotherapy (usually infusion fluorouracil) and radiation therapy. Computed tomography or contrast medium enemas were performed postoperatively at the discretion of the operating surgeon.

A gross anastomotic leak was defined as a disruption of the anastomosis identified at reoperation or extravasation of contrast medium at the anastomotic site on an imaging study, irrespective of the presence of symptoms. This definition, while not perfect, was deemed the most straightforward and least prone to observer bias for this study. An abscess or free pelvic fluid collection without extravasation of contrast medium was considered an occult anastomotic leak. Both of these latter categories were analyzed separately; only patients with no anastomotic leak, no abscess, and no appreciable free pelvic fluid collection on an imaging study were included in the control group.

Patients were typically seen at follow-up visits every 3 months for the first 2 years, every 6 months the third year, and then annually for up to 5 years. Carcinoembryonic antigen monitoring and proctoscopic examinations were routine; CT was routinely performed annually for the first 3 years by medical oncologists in patients who had received chemotherapy. These CT images were reviewed for extravasation of contrast medium, free pelvic fluid collection, or abscess; any of these findings, no matter how long after surgery, were counted in one of the anastomotic leak categories.

STATISTICAL ANALYSIS

For categorical variables, the χ^2 test was used, and results are presented as percentages (95% CIs). For continuous variables, the *t* test was used. The study was approved by the Institutional Review Board of the University of Vermont College of Medicine.

RESULTS

Two hundred ten patients who underwent low anterior resection for rectal cancer had at least 1 year of follow-up data. Five patients were eliminated from the study because significant parts of the medical records were unavailable. Seven patients were eliminated from the study because their surgical procedures were performed before the study start date. The 198 remaining patients were divided into 5 categories based on clinical and radiographic findings (**Table 1**). Tumors were located a mean of 8.4 cm (range, 5.5-12.0 cm) from the anal verge. The median follow-up period was 6.9 years (range, 1-13 years), and 134 patients (67.7%) had at least 1 CT scan (range, 1-8 scans) after surgery. Eleven patients (5.6%) underwent a water-soluble contrast medium enema in the postoperative period.

The control group consisted of 168 patients (84.8%) who had no anastomotic leak, free pelvic fluid collection, or abscess noted clinically or radiologically at any time after surgery or in the follow-up period. Two patients had hand-sewn anastomoses, and 166 patients had stapled anastomoses; 8 of the stapled anastomoses were

oversewn at the time of the primary operation owing to the finding of a leak when the anastomosis was tested or at the discretion of the operating surgeon. Thirty-four patients underwent primary diversion with a loop ileostomy. Postoperative procedure-specific complications included the following: 1 patient who had a retained Jackson-Pratt drain, 4 patients who required permanent stoma creation for fecal incontinence, 5 patients who had narrowing diagnosed at the anastomotic site requiring balloon dilatation, 8 patients who had local recurrence at or near the anastomotic site, and 26 patients who developed metastatic disease. Two patients (1.0%) died in the first 30 days after surgery; one death was from a myocardial infarction, and the other death was from an anastomotic leak and will be described later.

GROSS ANASTOMOTIC LEAK GROUPS

Of the remaining 30 patients, 17 (8.6%) had a gross anastomotic leak, defined by extravasation of enteric contents or contrast medium at the anastomotic site at any time in the follow-up period. These included asymptomatic patients who had incidental extraluminal presacral contrast medium noted on routine surveillance CT. Ten patients had no extravasation of contrast medium or other signs of anastomotic leak but had appreciable free fluid in the pelvis or presacral space on postoperative CT. Three patients had an abscess noted near the anastomotic site without extravasation of contrast medium.

Male sex, diabetes, and preoperative radiation therapy correlated with an increased risk for gross anastomotic leak, with relative risks of 6.0, 3.1, and 1.7, respectively (**Table 2**). Cigarette smoking was not associated with an increased risk for anastomotic leak. Fecal diversion and oversewing of the stapled anastomosis correlated with an increased risk for leak, with relative risks of 4.7 and 3.9, respectively.

The clinical and bowel function consequences associated with all categories of anastomotic leak are summarized in **Table 3**. The presence of a gross anastomotic leak increased the requirement for permanent stoma creation 8.0-fold (**Table 4**). As expected, free leaks were more consequential than presacral leaks for irregular bowel function and the likelihood of requiring permanent stoma creation (**Table 5**). When considered separately, both free and presacral leaks increased the likelihood of needing permanent stoma creation, with relative risks of 8.6 and 4.5, respectively. Irregular bowel function was noted more frequently in patients with free leaks than in patients with presacral leaks. Neither group had an increased risk for fecal incontinence. The overall mortality rate from anastomotic leak after low anterior resection was 0.5%; conversely, an anastomotic leak was associated with a 5.8% mortality rate.

Of 17 patients with gross anastomotic leaks, 6 had frank leaks with free intraperitoneal extravasation of contrast medium, and 11 had contained presacral contrast medium. All 17 patients had stapled anastomoses; 3 were oversewn, and 6 were diverted primarily. Overall, 9 gross anastomotic leaks were diagnosed between postoperative days 1 and 13 (early), 4 were diagnosed between postoperative days 14 and 45, and 4 were diagnosed on day 46 or later after surgery (late).

Of 6 patients with a free intraperitoneal leak, 3 were diagnosed before postoperative day 14, while 2 were observed between 14 and 44 days, and 1 had a late leak, which was diagnosed 5 months after anterior resection but 7 days after ileostomy takedown. Five patients required laparotomy with washout and fecal diversion; 2 eventually required permanent stoma creation, and 1 died within 30 days after surgery. The single mortality occurred in a patient who returned to the operating room for washout and diversion on the tenth postoperative day and died 4 days later of septic shock from intra-abdominal sepsis. The condition of 1 patient with a free anastomotic leak and fecal diversion was successfully managed with percutaneous drainage alone.

Of 11 patients with contained presacral extravasation of contrast medium, 6 were diagnosed early, 2 were diagnosed between 14 and 45 days, and 3 were classified as having late anastomotic leaks. The circumstances of the 3 late anastomotic leaks are described fur-

Table 2. Risk Factors for Anastomotic Leak

Risk Factor	Combined Free and Presacral Anastomotic Leaks, Relative Risk, Mean (Range)	*P* Value
Male sex	6.0 (1.4-25.5)	.02
Diabetes mellitus	3.1 (1.6-6.1)	.001
Cigarette smoking	1.0 (0.6-1.7)	.92
Preoperative radiation therapy	1.7 (1.2-2.5)	.002
Primary fecal diversion	4.7 (1.6-14.2)	.005
Oversewing of stapled anastomosis	3.9 (1.2-13.6)	.03

Table 3. Functional Outcomes and Postoperative Mortality

Outcome	No./Total No. (%)					
		Anastomotic Leak Group				
	Control Group (n = 168)	Free (n = 6)	Presacral (n = 11)	Overall (n = 17)	Free Pelvic Fluid Collection Group (n = 10)	Abscess Group (n = 3)
Irregular bowel function[a]	43/139 (30.9)	3/4 (75.0)	2/9 (22.2)	**5/13** (38.4)	7/10 (70.0)	1/3 (33.3)
Fecal incontinence[a]	11/92 (12.0)	2/5 (40.0)	7/9 (77.7)	**9/14** (64.3)	7/14 (50.0)	2/3 (66.7)
Permanent stoma creation	4/168 (2.4)	2/6 (33.3)	2/11 (18.2)	**4/17** (23.5)	0	0
Postoperative mortality	2/168 (1.2)	1/6 (16.7)	0/11	**1/17** (5.9)	0	0

[a] Data not available on all patients.

ther in the "Comment" section. Four patients were initially treated with percutaneous drainage, 5 patients were treated with antibiotics only, and 2 patients required fecal diversion (both of whom underwent permanent stoma creation). There were no deaths in the group of patients with presacral extravasation of contrast medium.

FREE PELVIC FLUID COLLECTION GROUP

The next group to consider is the patients with free pelvic fluid collection after surgery. Ten patients comprised this group, 6 with presacral fluid and 4 with free pelvic fluid. These patients had no extravasation of contrast medium, showed no signs of abscess, and underwent no postoperative intervention for their radiographic findings. Four patients reported fecal incontinence at 1 year after surgery; 1 patient required permanent stoma creation. Seven patients had irregular bowel function, while 3 patients had no problems with bowel function after surgery. This correlates with relative risks of 2.2 for irregular bowel function and 2.5 for fecal incontinence in the setting of postoperative free pelvic fluid collection without signs of extravasation of contrast medium or anastomotic leak compared with the control group (**Table 6**).

ABSCESS GROUP

The final group is the abscess group. For this study, abscess was defined as a complex loculated collection on radiological evaluation without extravasation of contrast medium. Three patients comprised this group, manifesting an abscess on postoperative days 14, 27, and 75. All 3 had stapled anastomoses, and none had undergone primary diversion. All 3 underwent percutaneous drainage of their abscesses. Two abscesses were presacral, and 1 abscess was pelvic. The pelvic abscess was seen on postoperative day 14; the patient had a drain placed and did well after this, with excellent bowel function and fecal continence. The 2 presacral abscesses were identified on day 27 and day 75. The first of these 2 patients manifested back pain, had the abscess diagnosed on CT, and underwent percutaneous drain placement. Twenty days later, the patient required transanastomotic drainage. Three months after this, the patient again required drainage of the abscess and unroofing of the cavity. After this, the patient did well, with excellent bowel function and fecal continence. The third patient with an abscess, diagnosed on day 75 after surgery, initially underwent radiological drainage but 1 month later required washout and diversion with ileostomy and underwent several more interventions for drainage of the presacral abscess, despite the diversion. Eventually, takedown of the stoma was performed, but the patient did poorly again after this, with severe diarrhea and fecal incontinence, and finally underwent permanent colostomy.

Table 4. Functional Outcomes in Combined Free and Presacral Anastomotic Leak Groups

Outcome	Combined Free and Presacral Anastomotic Leaks, Relative Risk, Mean (Range)	*P* Value
Irregular bowel function	3.1 (1.1-9.0)	.04
Fecal incontinence	1.4 (0.4-5.3)	.64
Permanent stoma creation	8.0 (2.4-27.2)	.001

COMMENT

Anastomotic leak is perhaps the most dreaded complication after low anterior resection. Several studies[26-30] have been published reporting leak rates, risk factors for anastomotic leak, and the potential consequences with respect to cost, mortality, and oncologic and bowel function outcomes. A problem is the absence of consensus on definitions, classification, and criteria for diagnosis, rendering comparative analyses of outcomes and treatment difficult.

Indeed, Bruce et al[31] reported 56 separate definitions of leak in a systematic review of 97 studies looking at the leak rates after gastrointestinal anastomosis. Little controversy exists about the diagnosis in patients who develop diffuse peritonitis after surgery with a gross anastomotic disruption. However, some patients have abnormal radiographic findings that cause no clinical problems, and other patients develop postoperative infections that can be treated with antibiotics or percutaneous drainage; are these all anastomotic leaks? For example, determining whether a postoperative abscess should be included as a leak can be a largely arbitrary exercise when no extravasation of contrast medium is observed, especially when the abscess is not contiguous with the anastomosis. It is no wonder that the reported anastomotic leak rates range so broadly. A legitimate and valid comparison is critical to benchmarking performance, evaluating treatment efficacy, and identifying opportunities for improvement.

Our data demonstrate a broad spectrum of abnormal findings on imaging studies that can reasonably be described as an anastomotic leak. Overall, we had 9 patients who had leaks of some kind (3 free and 6 presa-

Table 5. Functional Outcomes in Free vs Presacral Anastomotic Leak Groups

	Free Anastomotic Leak Group		Presacral Anastomotic Leak Group	
Outcome	Relative Risk, Mean (Range)	*P* Value	Relative Risk, Mean (Range)	*P* Value
Irregular bowel function	2.2 (1.2-3.9)	.01	0.8 (0.2-2.7)	.75
Fecal incontinence	2.5 (0.5-13.4)	.27	0.9 (0.1-6.0)	.93
Permanent stoma creation	8.6 (2.2-33.1)	.002	4.5 (1.1-19.6)	.04

Table 6. Functional Outcomes in Free Pelvic Fluid Collection Group on Computed Tomography

Outcome	Free Pelvic Fluid Collection Group, Relative Risk, Mean (Range)	*P* Value
Irregular bowel function	2.2 (1.4-3.5)	.001
Fecal incontinence	2.5 (0.8-7.2)	.10

cral) diagnosed in the first 14 days after surgery; perhaps these can be called true leaks, but more than half of these were managed nonoperatively, at least initially. Only 4 patients required reoperative surgery during that period. Based on previous analysis, we were not surprised that almost one-quarter of the gross anastomotic leaks were diagnosed between 14 and 45 days after surgery. A previous study[32] of 1223 intestinal anastomoses at our institution demonstrated a 2.7% anastomotic leak rate; 14 of 33 leaks were discovered only after hospital readmission, and 12.0% of these clinical leaks were diagnosed after 30 days.

However, we were surprised by the clinical consequences herein of presacral extravasation of contrast medium detected on surveillance CT beyond 45 days, often 1 year or longer after surgery. Although 2 patients remained entirely asymptomatic during the follow-up period, 2 patients ultimately developed serious problems. One patient presented to the hospital with hemorrhage from the presacral space longer than 2 years after surgery, and another patient required an ileostomy for persistent sepsis almost 18 months after surgery. Similarly, we were surprised by the remarkably poor bowel function in the subgroup of patients with free fluid seen on postoperative CT. In prior radiological investigations, the incidence of presacral fluid collection has been as high as 30% in patients without anastomotic leak.[24] Despite the absence of extraluminal air or contrast medium or the need for any intervention, most of these patients had a poor functional outcome in terms of irregular bowel function and fecal incontinence at 1 year. As such, neither incidental extravasation of contrast medium into the presacral space nor free fluid is necessarily a benign radiological finding.

Our study has several limitations. No validated tools were used to measure bowel function or fecal incontinence at 1 year; as such, the functional outcomes described are largely subjective. Furthermore, not all patients had routine CT after surgery or at follow-up visits; therefore, patients who had stage I disease or those who refused adjuvant therapy would likely be underrepresented in the gross anastomotic leak groups. In addition, a far more comprehensive analysis of risk factors (eg, level of the anastomosis) would be required to make any definitive statements about their relative contribution to the development of a leak. However, this was not the aim of this study, and the issue has been extensively studied by many other investigators.[1-14]

Rather, we attempted to qualitatively describe and define the broad spectrum of clinical events that occur after low anterior resection and highlight that they may all be significant but different in clinically meaningful ways. As we observed, many different clinical scenarios can be considered an anastomotic leak after low anterior resection, and great caution is needed in making sweeping statements on incidence and treatment. Certainly, our data do not allow for any sort of definitive recommendation about the most appropriate treatment for anastomotic leaks; rather, we aimed to highlight the inadequacies of the present nomenclature and point out the need for a classification scheme as a starting point for comparative analysis. In this light, we propose the following grading system of anastomotic leaks after low anterior resection based on clinical or radiological criteria:

Class 1, free pelvic or presacral fluid on CT, with no extravasation of contrast medium and no abscess;

Class 2, postoperative abscess with no extravasation of contrast medium,

A with perianastomotic abscess and

B with remote intra-abdominal abscess;

Class 3, confined presacral extravasation of contrast medium; and

Class 4, free extravasation of contrast medium.

We have no doubt that this classification could be much improved on and requires validation; furthermore, our data suggest that the time to diagnosis may also have a prognostic role. However, we anticipate this will facilitate the kind of apples-with-apples comparison that the classification by Hinchey et al[33] has provided for complicated diverticulitis, enabling outcomes and treatment to be measured and compared in analogous settings.

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