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Standardized Algorithms for Management of Anastomotic Leaks and Related Abdominal and Pelvic Abscesses After Colorectal Surgery

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Abstract

Background The risk factors and incidence of anastomotic leak following colorectal surgery are well reported in the literature. However, the management of the multiple clinical scenarios that may be encountered has not been standardized.

Methods The medical literature from 1973 to 2007 was reviewed using PubMed for papers relating to anastomotic leaks and abdominal abscess, with a specific emphasis on predisposing factors, prevention strategies, and treatment approaches. A six-round modified Delphi research method was utilized to find consensus among a group of expert colorectal surgeons and interventional radiologists regarding standardized management algorithms for anastomotic leaks.

Results Management scenarios were divided into those for intraperitoneal anastomoses, extraperitoneal (low pelvic) anastomoses, and anastomoses with proximal diverting stomas. Management options were then based on the clinical presentation and radiographic findings and organized into three interconnected algorithms.

Conclusions This process was a useful first step toward establishing guidelines for the management of anastomotic leak.

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Introduction

In 1991 the United Kingdom Surgical Infection Study Group defined anastomotic leak as the "leak of luminal contents from a surgical join between two hollow viscera" [1]. Many experts divide anastomotic leak into two categories based on presentation: subclinical and clinical anastomotic leak. Subclinical anastomotic leaks are leaks detected radiographically in patients with no abdominal signs or symptoms. These types of leak are most commonly recognized in patients prior to take down of a protective, diverting colostomy or ileostomy. Clinical anastomotic leakage is accompanied by signs of peritonitis or abscess, septicemia, and fecal or purulent discharge from the wound, drain, or anus [1, 2]. Not surprisingly, the incidence of anastomotic leak following colorectal surgery varies among institutions and by anatomic location of the anastomosis. Table 1 illustrates selected published patient series with the following incidences: colorectal or coloanal anastomotic leak 1% to 19%; colocolic leak 0% to 2%; ileocolic leak 0.02% to 4.0%; and ileoileal leak $\sim$ 1%.

The anatomic location of the anastomosis determines whether the leak is intraperitoneal or extraperitoneal, which affects how a patient with anastomotic leak initially presents. Probably due to the large exposed peritoneal surface, intraperitoneal anastomotic leaks often present with classic signs of peritonitis [3]. Extraperitoneal anastomotic leaks, by definition, lack an innervated peritoneal surface and therefore may develop insidiously without

Table 1 Anastomotic leak rates in various anatomic locations following colorectal surgery

Study	Year	No. of patients	Anastomotic leak (no. of patients)				
			Colo-rectal/coloanal	Colocolic	Ileocolic	Ileorectal	Ileoileal
Schrock et al. [34]	1973	1932	34 (2%)	32 (2%)	22 (1%)	—	—
Heald and Leicester [17]	1981	52	10 (19%)	—	—	—	—
Brennan et al. [35]	1982	100	8 (8%)	—	—	—	—
McGinn et al. [36]	1985	118	9 (8%)	—	—	—	—
Beard et al. [37]	1990	143	13 (9%)	—	—	—	—
Mealy et al. [38]	1992	114	6 (5%)	—	—	—	—
Kracht et al. [39]	1993	454	—	—	17 (4%)	—	—
Redmond et al. [40]	1993	111	3 (3%)	—	—	—	—
Karanjia et al. [41]	1994	276	24 (9%)	—	—	—	—
Santos et al. [42]	1994	149	11 (7%)	—	—	—	—
Fingerhut et al. [43]	1995	113	8 (7%)	—	—	—	—
Sagar et al. [44]	1995	100	7 (7%)	—	—	—	—
Hansen et al. [45]	1996	615	9 (2%)	—	—	—	—
Mann et al. [46]	1996	370	11 (3%)	—	—	—	—
Golub et al. [9]	1997	813	4 (1%)	11 (1%)	5 (1%)	8 (1%)	
Vignali et al. [47]	1997	1014	29 (3%)	—	—	—	—
Dehni et al. [48]	1998	258	26 (10%)	—	—	—	—
Petersen et al. [49]	1998	467	41 (9%)	—	—	—	—
Rullier et al. [50]	1998	403	57 (14%)	—	—	—	—
Watson et al. [51]	1999	477	8 (2%)	0	1 (0.2%)	0	—
Merkel et al. [12]	2001	814	89 (11%)	—	—	—	—
Marijnen et al. [52]	2002	1414	54 (4%)	—	—	—	—
Marusch et al. [53]	2002	482	51 (11%)	—	—	—	—
Bell et al. [15]	2003	403	51 (13%)	—	—	—	—
Branagan et al. [11]	2005	1834	40 (2%)	31 (2%)	—	—	
Wong and Eu [54]	2005	1066	41 (4%)	—	—	—	—
Platell et al. [55]	2007	1562	29 (9.5%)	0	6 (1.4%)	1 (3.1%)	3 (0.8%)

peritoneal signs [4]. Indeed, the first sign of this type of anastomotic leak may be unexplained cardiorespiratory or urinary symptoms during the early postoperative period. Extraperitoneal anastomotic leak may form abscesses, which can rupture into a lumen (sometimes with complete spontaneous resolution) or may spread into the peritoneal cavity causing generalized peritonitis [4]. Anastomotic leak may be detected or confirmed with a radiographic study, although a low rectal anastomotic leak is sometimes detected with careful digital rectal palpation. Objective radiologic detection of anastomotic leak can be obtained using a water-soluble contrast enema or computed tomography (CT) of the abdomen and pelvis with oral, rectal, and/or intravenous contrast.

Anastomotic leak may lead to many serious problems for the patient, as it is associated with increased patient morbidity and mortality [5, 6], longer hospital stays, and higher total costs of hospitalization [7]. Braga and colleagues [8] noted that 60% of the extra costs from anastomotic leak were due to additional hospital length of stay, and 40% of the cost was from resources used to diagnose and treat the anastomotic leak. Colonic anastomotic leak is associated with a significant increase in postoperative mortality [9–11]. In addition, in patients with colorectal cancer, rectal anastomotic leak may be associated with an increase in locoregional recurrence and decreased survival [11–14]. Some authors have suggested that this association between leak and recurrence may be due to the stimulation of locally shed colorectal cancer cells or micrometastases by cytokines released during inflammation [15]. Quality of life may also be impaired following anastomotic leak of low rectal anastomoses, as anastomotic leak may result in decreased neorectal capacity, tenesmus, and anastomotic stricture [16]. This reduction in function is probably related to consequent scarring and fibrosis of the neorectal reservoir [17].

Despite the many problems associated with anastomotic leak, little information has been published in the medical literature describing evidence-based treatment strategies to manage anastomotic leaks when they do occur. Given the

fairly low incidence of anastomotic leak at large colorectal surgery centers, the development of such treatment strategies would require large multicenter trials. Therefore, this study uses a novel consensus-gathering method with colorectal and interventional radiology experts to identify areas of current agreement and disagreement as groundwork on which to base future experimental studies.

Methodology

Creation of anastomotic leak management algorithms

The medical literature from 1973 to 2007 was reviewed using PubMed with the search terms "anastomotic leak" limited to humans only. All studies that did not include anastomoses commonly found during colorectal surgery were excluded. Based on this literature review, algorithmic management options were created for three potential anastomotic leak scenarios: intraperitoneal anastomotic leak; extraperitoneal anastomotic leak; and patients with diversion and anastomotic leak.

Delphi technique

The Delphi technique was used to modify the anastomotic leak management algorithms from the medical literature to more closely resemble what treatment strategies are used in actual clinical practice. This technique is named after the Delphi oracle in ancient Greece, which was believed to prophesy a person's future; it has been used in many venues including public policy, educational assessment, and social science research [18–21] but is novel in the surgical literature. The Delphi technique is distinct from other forms of survey research in its use of an expert panel and the emphasis on generating consensus [22]; it is a useful adjunct in the creation of evidence-based guidelines [23].

A modified Delphi technique was conducted via electronic mail with a group of colorectal and interventional radiology panelists. Panelists were selected as recognized international experts in their respective field based on prior publications and presentations at national/international meetings. A representative sample of experts from several regions of the world was selected to ensure a diversity of opinion when revising the anastomotic leak algorithms. Three preliminary rounds with colorectal surgeons in three countries ($n = 6$) were conducted initially, followed by three more subsequent rounds with a larger expert panel of colorectal surgeons ($n = 34$) and interventional radiologists ($n = 3$) for a total consensus expert panel of 43 physicians. The smaller pool of colorectal surgery experts was used initially to identify areas of common agreement and areas of more controversial treatment strategies. After each Delphi round, the anastomotic leak algorithms were revised based on a general consensus. In instances where complete agreement could not be achieved, alternative options for management are described in the results section. This process was stopped after six Delphi rounds as no further new treatment strategies were proposed and there was general consensus on the most recently revised anastomotic leak algorithms.

Results

Intraperitoneal anastomotic leak

Intraperitoneal anastomotic leak with generalized peritonitis, high-grade sepsis

Patients with clinical generalized peritonitis or high-grade sepsis (sepsis with either organ dysfunction or hypotension) require immediate surgical intervention after appropriate rapid resuscitation (Fig. 1, A1). The procedure performed depends largely on the intraoperative findings.

There is no consensus on how to define a *major anastomotic defect*. Some of the experts in this study tended to classify major defects by size (>1 cm), whereas others used the circumference of the anastomosis (more than one-third). Others classified major and minor defects by overall clinical presentation. This issue warrants future investigation and standardization.

If there is a major anastomotic defect (Fig. 1, A1.1), extensive peritoneal soiling, or evidence of ischemia at the anastomosis, the patient should undergo anastomotic resection with formation of an end stoma. For sigmoid or rectal anastomotic leak, the safest option is a Hartmann's procedure as, apart from the rare possibility of stump blowout, this choice minimizes the possibility of further abdominal catastrophe [24]. An alternative approach for this type of anastomotic leak suggested through the Delphi process is to exteriorize both ends of the anastomosis, "maturing" them as a Mikulicz-type double-barreled stoma; however, this option is frequently impossible as it requires a fully mobilized anastomosis without any tension and is rarely performed nowadays.

Occasionally, some surgeons during the Delphi process mentioned that they may resect the previous anastomosis (or even attempt sutured repair) and perform a reanastomosis with proximal diversion. This technique may decrease the morbidity of subsequent restoration of gastrointestinal continuity but exposes the patient to the possibility of further anastomotic leak. It is typically performed in patients who are not septic, hypotensive, or

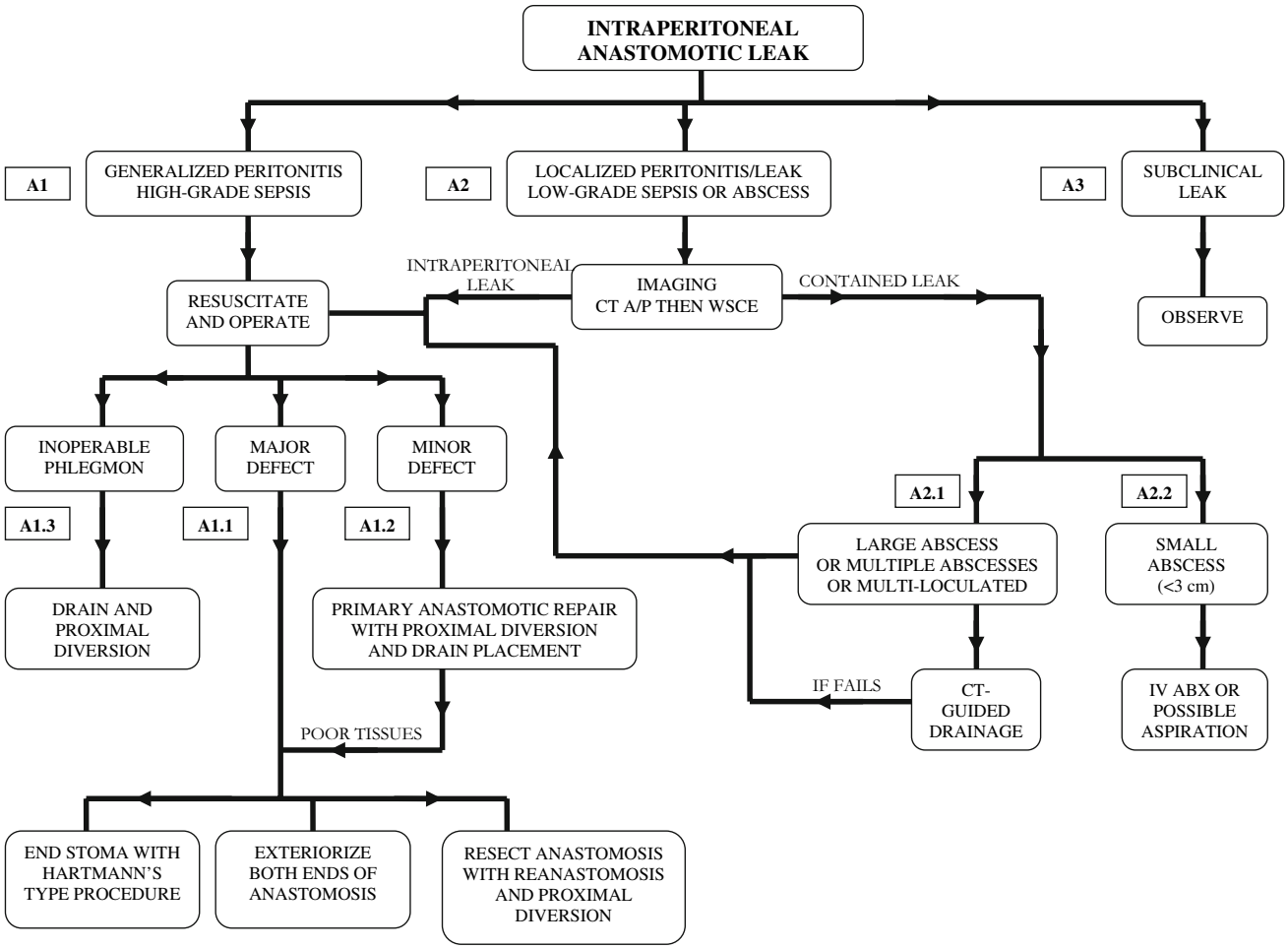

Fig. 1 Recommendations for the management of intraperitoneal anastomotic leak with references to the pertinent sections of this article for more information. KEY: IV ABX=intravenous antibiotics; CT=computed tomographic; WSCE=water soluble contrast enema; CT A/P=computed tomographic scan of the abdomen and pelvis

malnourished (either undernourished or morbidly obese) and who do not have inflammatory bowel disease. Again, both bowel ends must allow for a tension-free repeat anastomosis, and multiple drains should be placed to avoid possible abdominal or pelvic fluid collections.

There is also no consensus on how to define a *minor defect*. Some of the experts in this study tended to classify by size (<1 cm) and others by circumference of the anastomosis (less than one-third). If a minor defect is discovered, one should choose an operation that has the lowest chance for morbidity and the highest chance for success to avoid one complication leading to another. In a patient who is hemodynamically stable and has a reasonable nutritional state, a primary sutured anastomotic repair with proximal diversion may be performed with perianastomotic drains (Fig. 1, A1.2). This presumes that the tissues of the bowel are of adequate quality to hold interrupted sutures, which is not always the case. If technically possible, an omental flap may be added to protect and/or seal the anastomosis. If the anastomotic integrity is questionable, or if the tissues do not appear to hold sutures well, the leak should be managed as a major defect. Primary repair without proximal diversion is rarely performed.

When anastomotic repair is performed, some experts have suggested that the bowel distal to the defunctioning stoma should be irrigated with copious warmed saline solution through a catheter placed in the distal limb of the stoma. This technique may reduce persistent or continued contamination in case of recurrent leak; however, there is no published information on this practice, and there is no consensus within this group of experts as to whether this practice is necessary.

Fibrin glue has been studied for the management of upper gastrointestinal anastomotic leaks [25, 26], but most of the experts thought that further research must be done before any recommendations can be made. Future research may find a benefit for this technology. Other options, such as fibrin plugs and the use of intraluminal stents, in the

management of anastomotic leaks following colorectal surgery also deserve investigation.

If the patient has a large *phlegmon*, one that the surgeon believes exposes the patient to great risk by exploring the inflammatory mass, it may be deemed inoperable and can be managed by insertion of drains into any abscess cavity or the perianastomotic area (Fig. 1, A1.3). As the leak may not readily be identifiable, one may do more harm than good dissecting through the inflammatory mass, possibly converting a small anastomotic leak into a major disruption. It should be noted that there is no consensus within this group as to the use of loop colostomy or ileostomy as a diverting ostomy in these cases.

Less commonly, a high ileostomy or jejunostomy is required owing to extensive distal inflammatory changes. In such cases, the ileum may be extensively involved with the inflammatory reaction, and so few loops of bowel are suitable for a stoma. The stoma may therefore need to be in the more proximal ileum and rarely in the jejunum. These high stomas predispose the patient to a high-volume ostomy output and the need for total parenteral nutrition.

Regardless of which diversion procedure is chosen, the abdomen should be lavaged with saline; and in some cases, the surgeon may consider the use of irrigating drains with continuous irrigation for 24 to 48 hours. Others consider a planned "relook" laparotomy as part of the management of severe intraabdominal sepsis. In these very difficult cases, surgeons should not reoperate for at least 3 to 6 months to reduce the risk of creating multiple enterocutaneous fistulas. Exceptions to this would include suspected intestinal ischemia or life-threatening sepsis or bleeding. Fortunately, these situations occur infrequently.

Intraperitoneal anastomotic leak with localized peritonitis/low-grade sepsis/localized abscess

If the patient has signs of localized peritonitis (Fig. 1, A2), low-grade sepsis (systemic inflammatory response syndrome and documented infection), or abscess, a diagnostic imaging workup is completed. This workup likely includes a triple-phase CT scan of the abdomen and pelvis with oral, rectal, and intravenous contrast. Some experts in this study avoid the use of oral contrast as it is associated with a risk of diarrhea. A CT scan is often performed in preference to a water-soluble contrast enema (WSCE) or luminal contrast study alone, as CT-guided drainage may be a treatment option if a localized collection is discovered. The surgeon should inform the radiologist of the site and configuration of the anastomosis, and the radiologist should use diluted water-soluble contrast (2–3%) solution to prevent artifact from obscuring the anastomotic leak. The rectal contrast should be delivered via a soft, small-bore catheter instead of the typical rigid rectal contrast enema tip. For very low rectal anastomoses, the rectal contrast should be injected by syringe with as little pressure as possible. In the unusual situation of visualizing a free intraperitoneal leak, the patient should be operated on as outlined in section A1. It is also possible that an anastomotic leak may still be present despite a normal CT scan with contrast and a normal WSCE, but this probably occurs infrequently [27]. In patients with a diverting stoma, some authors prefer to inject water-soluble contrast from above through the stoma to avoid further potential disruption of the anastomosis.

If a *large abscess* (>3 cm), *multiple abscesses*, or a *multiloculated abscess* are observed on triple-phase CT imaging, treatment will depend on the overall clinical condition of the patient and the assessed feasibility of CT guided drainage after consultation with available interventional radiologists (Fig. 1, A2.1) [2]. Patients should be managed operatively, as described earlier, if an interventional radiologist is not available, the abscess is in an inaccessible anatomic location, the CT-guided drainage is incomplete, or the patient experiences no improvement, persistent sepsis, or deteriorating clinical status. In these patients, a WSCE may be considered to delineate the area of anastomotic leak prior to surgery. This additional imaging technique is not required if a multidetector row CT scan has been obtained with acquisition parameters that allow creation of multiplanar reformatted or three-dimensional images. Intraoperative assessment of the anastomosis can be difficult because of local inflammation of the surrounding tissues. The inflammation may lead to anastomotic friability, and great care is required so there is no disruption of an intact anastomosis during intraoperative assessment. If it is unclear whether the anastomosis is intact, it may be useful to perform an air test, Betadine instillation, or endoscopic evaluation intraoperatively for further assessment. Treatment should then be based on operative findings as detailed earlier in this section. Patients who are clinically stable may be made NPO and treated with broad-spectrum intravenous antibiotics effective against gram-negative and anaerobic organisms, with repeat imaging to see if the abscess becomes more amenable to drainage as the abscess cavities evolve and "mature."

If a *small abscess* (<3 cm) is observed on CT imaging, broad-spectrum intravenous antibiotics are recommended, and aspiration of the abscess is performed if possible, as these collections are often too small for insertion of a drain (Fig. 1, A2.2). Many of these small abscesses respond to broad-spectrum intravenous antibiotics alone, such as a second- or third-generation cephalosporin [28]. If the abscess can be aspirated via CT guidance, some recommend gentle irrigation of the abscess cavity with a small amount of saline several times until the returning fluid is clear. At the end of the procedure in selected cases, some

inject fibrinolytic agents such as urokinase into the cavity to enhance drainage [29, 30]. Patients with a small abscess following colorectal anastomotic leak may also require bowel rest, with consideration for total parenteral nutrition (TPN) if this situation persists. In most cases, though, enteral feeding and broad-spectrum intravenous antibiotic therapy against gram-negative and anaerobic organisms are sufficient.

Intraperitoneal anastomotic subclinical leak

Finally, if a subclinical intraperitoneal anastomotic leak is detected (Fig. 1, A3), observation only is recommended as almost all of these leaks resolve with time. If the patient develops a clinical leak, treatment may proceed as described above.

Extraperitoneal anastomotic leak

Figure 2 illustrates the recommendations for management of an extraperitoneal anastomotic leak. Patients with extraperitoneal anastomotic leak and generalized peritonitis or high-grade sepsis should be managed as patients with an intraperitoneal anastomotic leak, as described above. One difference in the management of extraperitoneal anastomosis leak is that after a Hartmann's type end colostomy is performed, the short rectal remnant may be too inflamed, or too short, to staple or suture closed. In this case, abdominal and/or transanal drains may be placed to drain any effluent from the defunctioned rectum and anus. Patients with localized peritonitis and low-grade sepsis, or those who present with a subclinical leak should be managed as patients with an intraperitoneal anastomotic leak as described in the sections above.

Management of an extraperitoneal anastomotic leak differs from that of an intraperitoneal anastomotic leak only in patients who present with an abscess cavity. If the patient is symptomatic, creation of a diverting stoma should be considered. Otherwise, management generally depends on the anatomic location of the abscess and leak.

Extraperitoneal anastomotic leak in the low pelvis low pelvic anastomotic leaks

(Fig. 2, B1) are generally posterior and related to coloanal, low colorectal, or ileoanal anastomoses. If the anastomotic leak is situated in a posterior position in the low pelvis, management options depend on whether the abscess is contained or in continuity with the anastomotic leak. Anterior leaks can be managed similarly to posterior leaks unless associated with intraperitoneal sepsis. There is also a greater risk of adjacent organ injury when managing anterior leaks.

By definition, a *contained abscess* (Fig. 2, B1.1) is not in continuity with the anastomosis. The use of broad-spectrum parenteral antibiotics in patients with contained abscesses is not well represented in the medical literature. Patients with small abscesses (<3 cm) may have resolution of the abscess with intravenous antibiotic therapy alone [28, 31]. Abscesses $\geq$ 3 cm may be candidates for CT-guided drainage of the abscess cavity via a transabdominal, transvaginal, transanal, or transrectal pathway [31]. These paths may be inaccessible for low pelvic locations, necessitating consideration of a transsciatic or transgluteal approach to encourage closure of the anastomotic defect. However, this approach has been associated with sciatic neuritis and local dissemination of the abscess into the gluteal region if the catheter lumen becomes occluded. If image-guided drainage fails or is not anatomically feasible, examination under anesthesia (EUA) may also permit transrectal or transanastomotic drainage. If it is unclear whether the abscess is in continuity with the anastomotic leak, it is recommended that one assume that the abscess is in continuity and proceed with EUA or luminal contrast imaging before drainage.

If the *abscess is in continuity with the anastomotic leak* (Fig. 2, B1.2) and the anastomosis is low enough to be accessed transanally, EUA permits effective transanal drainage of the abscess with minimal risk of fistula development. There are several options for transanal drainage, with no consensus as to which technique is optimal. Some experts in this study favor making a wide opening in the anastomosis with a finger or surgical instrument to allow drainage. Others make a small opening and insert a mushroom-tipped or other type catheter, which is sutured in place and exits through the anal canal. The drain is then left in place for several weeks, with or without irrigation through the catheter. Before the drain is removed, repeat EUA or imaging should be considered to ensure resolution of the collection and absence of an anastomotic stricture. However, some experts in this study were concerned that placing a drain through an anastomotic leak may actually prevent the anastomotic defect from healing, particularly in patients without diversion. The optimal form of such transanal management has not been determined and warrants further research.

Extraperitoneal anastomotic leak with upper pelvis collection

If the anastomotic leak is situated high in the pelvis (Fig. 2, B2), management options are identical to those offered above, as if it were in the lower abdomen.

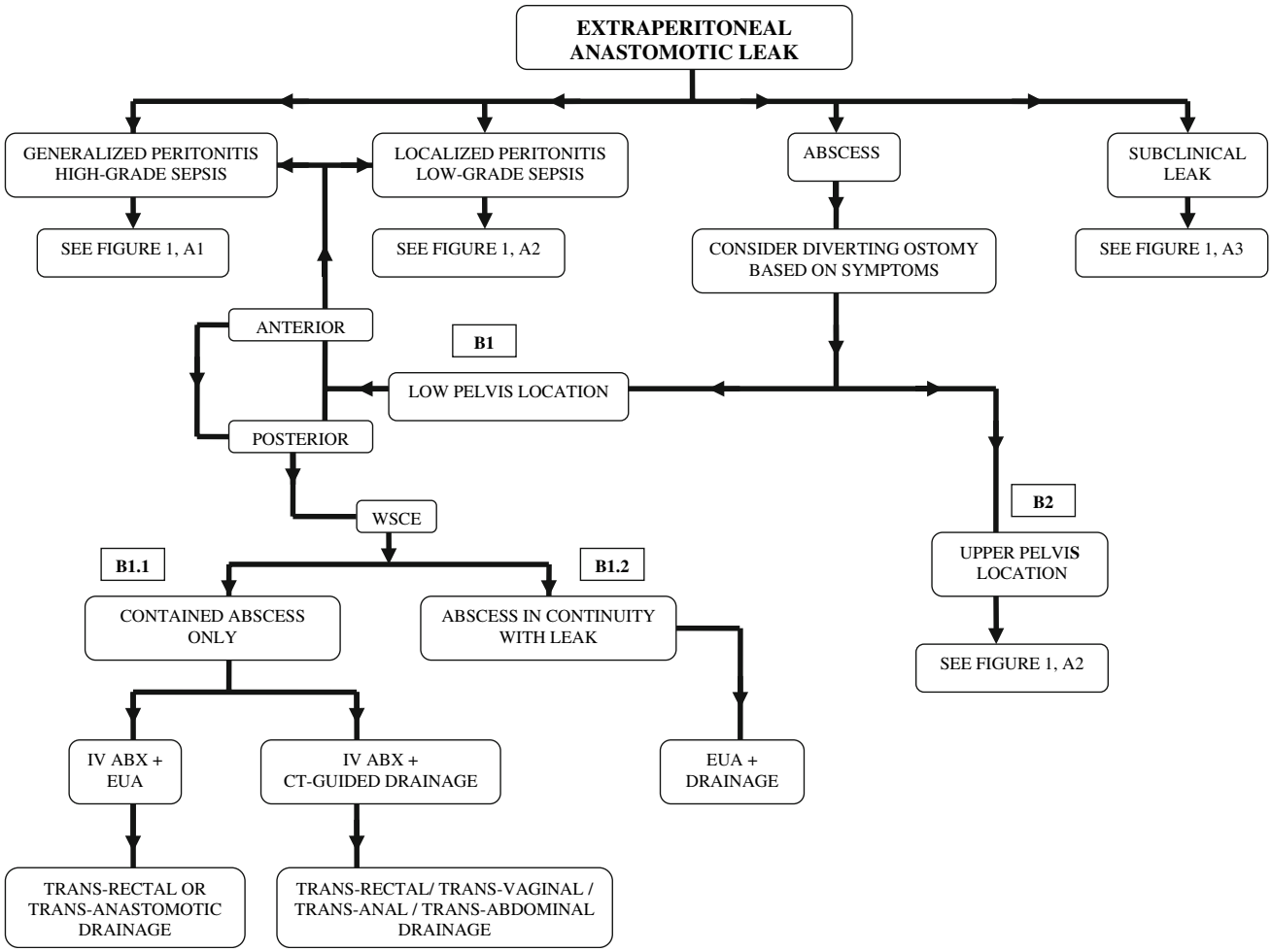

Fig. 2 Recommendations for the management of extraperitoneal anastomotic leak with references to the pertinent sections of this article for more information. KEY: IV ABX=intravenous antibiotics; CT=computed tomographic; WSCE=water soluble contrast enema; EUA=exam under anesthesia

Patients with diversion and anastomotic leak

Figure 3 contains recommendations for the management of an anastomotic leak in a patient who already has a diversion. This algorithm is similar to that for intraperitoneal anastomotic leak and extraperitoneal anastomotic leak in patients who present with peritonitis (Fig. 1, A1), sepsis (Fig. 1, A2), or abscess (Fig. 1, A2; Fig. 2, B1, B2), respectively. However, an important difference is the recommendations for the management of a subclinical leak, which is often a late radiologic finding in these patients. Management generally depends on the anatomic location of the anastomotic leak.

Patient with diversion and intraperitoneal anastomotic leak

If the leak is subclinical, intraperitoneal (Fig. 3, C1), and too small for drainage in the patient with diversion, the experts in this study recommended observation, possibly with broad-spectrum intravenous antibiotics for 2 weeks, and reimaging in 6 to 8 weeks. If the leak does not resolve, the cycle of possible antibiotics for 2 weeks with reimaging in 6–8 additional weeks should be repeated as most of these leaks eventually resolve. Another option is to perform distal irrigations via the distal limb of the stoma two to four times per week. Some authors favor long-term oral antibiotics in patients with diversion and an irradiated pelvis.

In cases that have not resolved after 6 months, options include surgical revision of the anastomosis or proceeding with closure of the proximal diverting stoma, recognizing that there is a small chance that this may lead to recurrent sepsis. There is no information in the literature as to whether the length or size of any sinus predicts clinical outcome. Some suggest that endoscopy could also be utilized to dilate the adjacent anastomosis, cauterize the opening, or needle-knife the opening to increase drainage, although this has not been studied in detail. Prior to ostomy

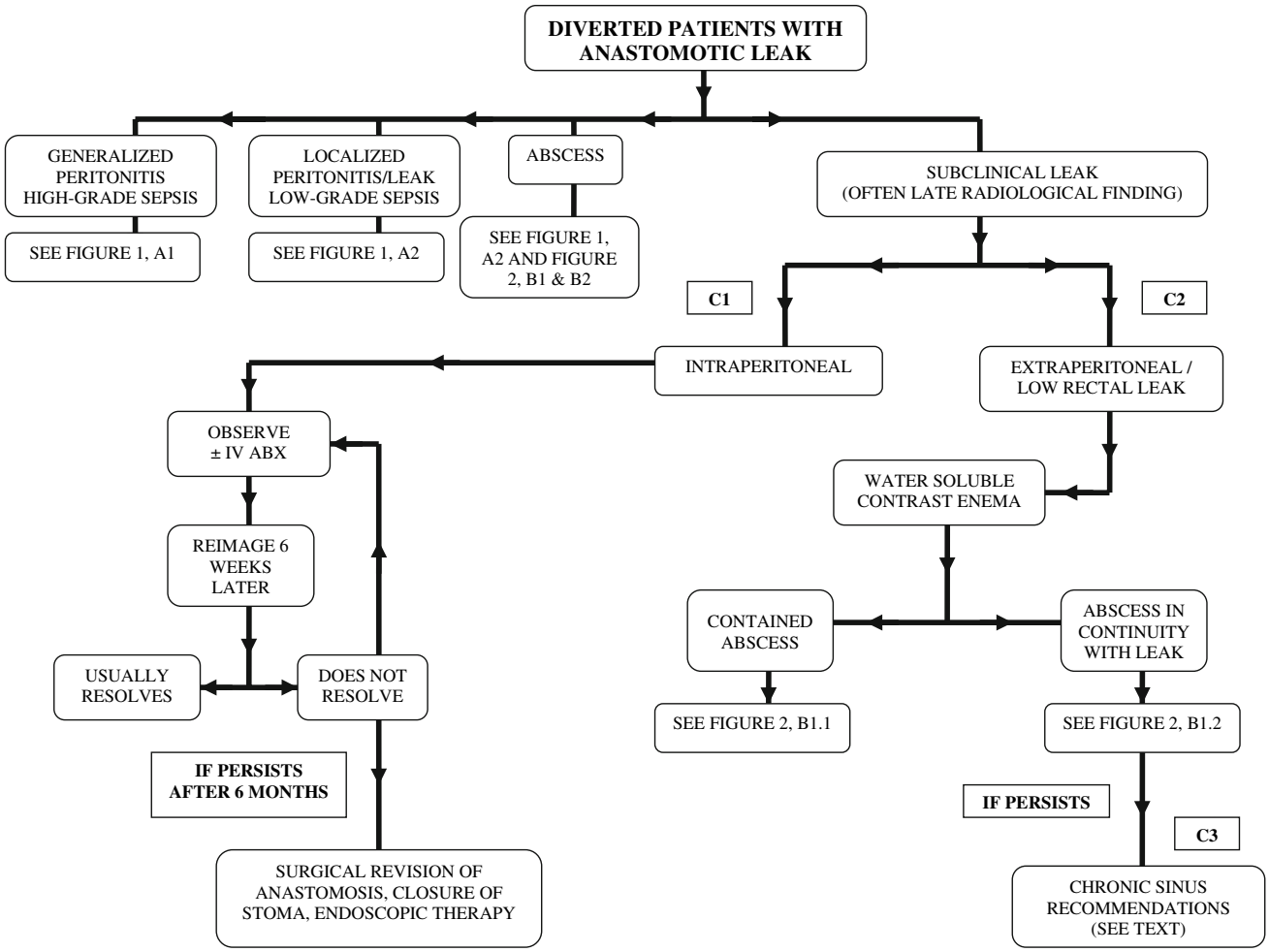

Fig. 3 Recommendations for the management of an anastomotic leak in a patient who is already diverted with references to the pertinent sections of this article for more information. KEY: IV ABX=intravenous antibiotics

closure, WSCE may help determine that the leak is not persistent and, more importantly, that no stricture has developed during the interim. If a diverted intraperitoneal anastomosis develops a leak with an abscess, treatment would be similar to that for a patient with no diversion, as discussed earlier.

Patient with diversion and an extraperitoneal anastomotic leak

Extraperitoneal anastomotic leaks are by definition in the mid to low rectum and usually are associated with a low colorectal, coloanal or ileoanal anastomosis (Fig. 3, C2). The management of this type of anastomotic leak depends on the size of the abscess and the clinical presentation associated with the condition. For a contained abscess or an abscess in continuity with the anastomotic leak, treatment is generally the same as described for low pelvic anastomotic leaks, described earlier.

Management of a chronic low-rectal anastomotic sinus

The management of chronic low-rectal anastomotic sinus (Fig. 3, C3) depends on the size of the sinus and the overall clinical status of the patient. If the patient is asymptomatic and the sinus cavity is small, as visualized on WSCE, the patient can be simply observed as such sinuses frequently resolve without intervention. If a small (<1 cm) sinus cavity persists after 3 months from the initial surgery, there is usually no contraindication to reverse the stoma.

If the patient is symptomatic or the sinus cavity is large, a mushroom-tipped catheter may be inserted through the defect with regular EUA every 3 to 4 weeks to allow the catheter to be gradually downsized. An alternative is to irrigate the abscess cavity with saline using a catheter placed through the defect. However, these catheters may not be well tolerated by patients, and there is no published evidence on the effectiveness of this practice in patients with chronic sinus from anastomotic leak. Fibrin glue may also be used to fill this cavity,

although there are no published data yet supporting this practice.

It is important to note that the cavity behind the distal rectum has the potential to be large with rigid boundaries (pelvic side walls, sacrum). Therefore, the abscess cavity often fails to shrink, even though it may be adequately drained. Some of the experts in this study suggested that one option to deal with this difficult problem is to divide and marsupialize the posterior wall of the neorectum or ileal pouch using scissors, electrocautery, laparoscopic cautery scissors, or an endoscopic gastrointestinal anastomosis stapler [32]. Great care must be taken to avoid injury to other structures that may form the wall of the cavity, such as the small intestine. This technique allows the cavity to granulate, and the stoma is then closed some weeks later. Another option is to perform a transanal anastomotic sleeve advancement. In selected cases of failed ileoanal anastomosis, this technique has been beneficial and may also be useful for selected coloanal anastomotic leaks [33]. Finally, if these less invasive options fail, a redo coloanal or ileoanal anastomosis with diverting stoma is a possible option.

Conclusions

A group of colorectal and interventional radiology experts have described their practices for the management of anastomotic leaks and abdominopelvic abscesses after colorectal surgery using a modified Delphi process. This process was a useful first step toward establishing guidelines for the management of this condition. Specific topics for further research that resulted from this study include determining the optimal management of drainage of low rectal and anastomotic leaks and standardizing definitions of major and minor anastomotic leaks. Ultimately, the results of this study can be used to develop future experimental trials to create evidence-based guidelines for the treatment of anastomotic leak.

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References

1. Peel AL, Taylor EW (1991) Proposed definitions for the audit of postoperative infection: A discussion paper. Surgical Infection Study Group. Ann R Coll Surg Engl 73:385–388
2. Schrock TR (2005) Anastomotic leak after colon and rectal resections. In Current Therapy in Colon and Rectal Surgery. 2nd edition. Fazio VW, Church JM, and Delaney CP eds. (Philadelphia, PA): Mosby, pp 525–528
3. Galandiuk S (2005) To drain or not to drain. Ann Surg 241:14–15
4. Alberts JCJ, Parvaiz A, Moran BJ (2003) Predicting risk and diminishing the consequences of anastomotic dehiscence following rectal resection. Colorectal Dis 5:478–482
5. Fielding LP, Stewart-Brown S, Blesovsky L et al (1980) Anastomotic integrity after operations for large-bowel cancer: A multicentre study. BMJ 281:411–414
6. Ansari MZ, Collopy BT, Hart WG et al (2000) In-hospital mortality and associated complications after bowel surgery in Victorian public hospitals. ANZ J Surg 70:6–10
7. Mäkelä JT, Kiviniemi H, Laitnen S (2003) Risk factors for anastomotic leak after left-sided colorectal resection with rectal anastomosis. Dis Colon Rectum 46:653–660
8. Braga M, Vignali A, Zuliani W et al (2005) Laparoscopic versus open colorectal surgery: cost-benefit analysis in a single-center randomized trial. Ann Surg 242:890–895, discussion 895–896
9. Golub R, Golub RW, Cantu R Jr et al (1997) A multivariate analysis of factors contributing to leakage of intestinal anastomoses. J Am Coll Surg 184:364–372
10. Alves A, Panis Y, Pocard M et al (1999) Management of anastomotic leak after non-diverted large bowel resection. J Am Coll Surg 189:554–559
11. Branagan G, Finnis D (2005) Prognosis after anastomotic leak in colorectal surgery. Dis Colon Rectum 48:1021–1026
12. Merkel S, Wang WY, Schmidt O et al (2001) Locoregional recurrence in patients with anastomotic leak after anterior resection for rectal carcinoma. Colorectal Dis 3:154–160

13. Chang SC, Lin JK, Yang SH et al (2003) Long-term outcome of anastomosis leak after curative resection for mid and low rectal cancer. Hepatgastroenterology 50:1898–1902
14. Walker KG, Bell SW, Rickard MJ et al (2004) Anastomotic leak is predictive of diminished survival after potentially curative resection for colorectal cancer. Ann Surg 240:255–259
15. Bell SW, Walker KG, Rickard MJ et al (2003) Anastomotic leak after curative anterior resection results in higher prevalence of local recurrence. Br J Surg 90:1261–1266
16. Nesbakken A, Nygaard K, Lunde OC (2001) Outcome and late functional results after anastomotic leak following mesorectal excision for rectal cancer. Br J Surg 88:400–404
17. Heald RJ, Leicester RJ (1981) The low stapled anastomosis. Br J Surg 68:333–337
18. Bellamy N, Anastassiades P, Watson-Buchanan W et al (1991) Rheumatoid arthritis antirheumatic drug trials. III. Setting the delta for clinical trials of antirheumatic drugs—results of a consensus development (Delphi) exercise. J Rheumatol 18:1908–1915
19. Clayton MJ (1997) Delphi: a technique to harness expert opinion for critical decision-making tasks in education. Educ Psychol 17:373–386
20. Critcher C, Gladstone B (1998) Utilizing the Delphi technique in policy discussion: a case study of a privatized utility in Britain. Public Admin 76:431–449
21. Jones J, Hunter D (1995) Consensus methods for medical and health services research. BMJ 311:376–380
22. de Villiers MR, de Villiers PJ, Kent AP (2005) The Delphi technique in health sciences education research. Med Teach 27:639–643
23. Roddy E, Zhang W, Doherty M et al (2006) Evidence-based clinical guidelines: a new system to better determine true strength of recommendation. J Eval Clin Pract 12:347–352
24. Oncel M, Remzi FH (2003) Perioperative complications in colorectal surgery. Clin Colon Rectal Surg 16:143–152
25. Truong S, Bohm G, Klinge U et al (2004) Results after endoscopic treatment of postoperative upper gastrointestinal fistulas and leaks using combined Vicryl plug and fibrin glue. Surg Endosc 18:1105–1108
26. Bonanomi G, Prince JM, McSteen F et al (2004) Sealing effect of fibrin glue on the healing of gastrointestinal anastomoses: implications for the endoscopic treatment of leaks. Surg Endosc 18:1620–1624
27. Nesbakken A, Nygaard K, Lunde OC et al (2005) Anastomotic leak following mesorectal excision for rectal cancer: true incidence and diagnostic challenges. Colorectal Dis 7:576–581
28. Kumar RR, Kim JT, Haukoos JS et al (2006) Factors affecting the successful management of intra-abdominal abscesses with antibiotics and the need for percutaneous drainage. Dis Colon Rectum 49:183–189
29. Haaga JR, Nakamoto D, Stellato T et al (2000) Intracavitary urokinase for enhancement of percutaneous abscess drainage: phase II trial. AJR Am J Roentgenol 174:1681–1685
30. Haaga JR, Nakamoto D (2004) Computed tomography-guided drainage of intra-abdominal infections. Curr Infect Dis Rep 6:105–114
31. Siewert B, Tye G, Kruskal J et al (2006) Impact of CT-guided drainage in the treatment of diverticular abscesses: size matters. AJR Am J Roentgenol 186:680–686
32. Whitlow CB, Opelka FG, Gathright JB Jr et al (1997) Treatment of colorectal and ileoanal anastomotic sinuses. Dis Colon Rectum 40:760–763
33. Fleshman JW, McLeod RS, Cohen Z et al (1988) Improved results following use of an advancement technique in the treatment of ileoanal anastomotic complications. Int J Colorectal Dis 3:161–165
34. Schrock TR, Deveney CW, Dunphy JE (1973) Factors contributing to leak of colonic anastomoses. Ann Surg 177:513–518
35. Brennan SS, Pickford IR, Evans M et al (1982) Staples or sutures for colonic anastomoses: a controlled clinical trial. Br J Surg 69:722–724
36. McGinn FP, Gartell PC, Clifford PC et al (1985) Staples or sutures for low colorectal anastomoses: a prospective randomized trial. Br J Surg 72:603–605
37. Beard JD, Nicholson ML, Sayers RD et al (1990) Intraoperative air testing of colorectal anastomosis: a prospective, randomized trial. Br J Surg 77:1095–1097
38. Mealy K, Burke P, Hyland J (1992) Anterior resection with a defunctioning colostomy: Questions of safety. Br J Surg 79:305–317
39. Kracht M, Hay JM, Fagniez PL et al (1993) Ileocolonic anastomosis after right hemicolectomy for carcinoma: stapled or hand-sewn? A prospective, multicenter, randomized trial. Int J Colorectal Dis 8:29–33
40. Redmond HP, Austin OM, Clery AP et al (1993) Safety of double-stapled anastomosis in low anterior resection. Br J Surg 80:924–927
41. Karanjia ND, Corder AP, Bearn P et al (1994) Leakage from stapled low anastomosis after total mesorectal excision for carcinoma of the rectum. Br J Surg 81:1224–1226
42. Santos JC Jr, Batista J, Sirimarco MT et al (1994) Prospective randomized trial of mechanical bowel preparation in patients undergoing elective colorectal surgery. Br J Surg 81:1673–1676
43. Fingerhut A, Hay JM, Elhadad A et al (1995) Supraperitoneal colorectal anastomosis: hand-sewn versus circular staples–a controlled clinical trial; French Associations for Surgical Research. Surgery 118:479–485
44. Sagar PM, Hartley MN, Macfie J et al (1995) Randomized trial of pelvic drainage after rectal resection. Dis Colon Rectum 38:254–258
45. Hansen O, Schwenk W, Hucke HP et al (1996) Colorectal stapled anastomoses. Experiences and results. Dis Colon Rectum 39:30–36
46. Mann B, Kleinschmidt S, Stremmel W (1996) Prospective study of hand-sutured anastomosis after colorectal resection. Br J Surg 83:29–31
47. Vignali A, Fazio VW, Lavery IC et al (1997) Factors associated with the occurrence of leaks in stapled rectal anastomoses: a review of 1,014 patients. J Am Coll Surg 185:105–113
48. Dehni N, Schlegel RD, Cunningham C et al (1998) Influence of a defunctioning stoma on leakage rates after low colorectal anastomosis and colonic J pouch-anal anastomosis. Br J Surg 85:1114–1117
49. Peterson S, Freitag M, Hellmich G et al (1998) Anastomotic leak: Impact on local recurrence and survival in surgery of colorectal cancer. Int J Colorectal Dis 13:160–163
50. Rullier E, Laurent C, Garrelon JL et al (1998) Risk factors for anastomotic leak after resection for rectal cancer. Br J Surg 85:355–358
51. Watson AJM, Krukowski ZH, Munro A (1999) Salvage of large bowel anastomotic leak. Br J Surg 86:499–500
52. Marijnen CA, Kapiteijn E, van de Velde CJ et al (2002) Acute side effects and complications after short-term preoperative radiotherapy combined with total mesorectal excision in primary rectal cancer. J Clin Oncol 20:817–825
53. Marusch F, Koch A, Schmidt U et al (2002) Value of a protective stoma in low anterior resections for rectal cancer. Dis Colon Rectum 45:1164–1171
54. Wong NY, Eu KW (2005) A defunctioning ileostomy does not prevent clinical anastomotic leak after a low anterior resection: a prospective, comparative study. Dis Colon Rectum 48:2076–2079
55. Platell C, Barwood N, Dorfmann G,et al (2007) The incidence of anastomotic leaks in patients undergoing colorectal surgery. Colorectal Dis 9:71–79