

Colorectal Anastomotic Leakage: A Review of Predictability Factors, Early Detection and Appropriate Management

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Abstract

Objective: The purpose of this review article is to provide an insight to the recent recommendations in the field of colorectal surgery to yield a better outcome following colorectal anastomosis. **Background:** Anastomotic leak following colorectal resection surgery is associated with high rates of morbidity, mortality, and escalated healthcare expenditures. Knowledge about the factors predisposing patients to anastomotic leak is vital to its early detection and decision making for surgery. Early detection of the complications and its methodical management is vital for patient survival. **Methodology:** A literature search on colorectal surgery was carried out using PubMed, COCHRANE library and MEDLINE. **Results:** Current practice however should comprise pre-operative risk assessment and its optimization, subsequent adaptation of appropriate operative technique when necessary, intraoperative testing of the integrity of the anastomosis, use of diverting stoma in specific situations, avoid unnecessary use of pelvic drains and avoid preoperative bowel preparation. Absolute vigilance is a must for early detection of an anastomotic leak. Appropriate investigations and post-operative clinical scoring systems acts as a guide to help us salvage the situation. **Conclusion:** Anastomotic leaks still occur despite advancements made in preoperative optimization of the patient, surgical techniques, equipments, and post-operative management. Many attempts are being made to enhance the healthcare systems in regards to dealing

with the anastomotic leaks and other colorectal surgery complications. Additionally future studies should aim at identification of other factors that may lead to anastomotic leak.

Keywords: Colorectal anastomosis technique; colorectal anastomotic leak; defunctioning stoma; Charlson Comorbidity Index; Colon Leakage Score (CLS); leak test; bowel preparation; drains in colorectal surgery; Dutch Leakage (DULK) Score.

Introduction

Despite many advances in colorectal surgery, the aim to achieve an uneventful healing of the intestinal anastomosis still remains a farfetched dream.

The prevalence of anastomotic leak has been reported to be between 0.5% and 21% after colon and rectal resections [1-3].

The incidence of clinically significant anastomotic leak after colorectal surgeries is between 1% and 12% overall and is particularly high in low colorectal resections up to 14% [5-8].

Most incidents of anastomotic leaks are difficult to predict, since they manifest with short notice as fever and sepsis [4].

Anastomotic leaks can lead to life threatening complications like - infection, fistula or abscess formation and peritonitis [9].

In cases of malignancy, presence of anastomotic leaks is also associated with increased rates of local cancer recurrence and decreased five year survival [10].

The rates of morbidity and mortality significantly

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increase after AL, with the rate ranging in between 12% and 27% [11-13].

Multiple reoperations and stoma creation are often necessary to control the leak, which significantly increases health risks and health care costs up to 5 times that of patients with no leak [14].

Despite a great numbers of studies on the rate of anastomotic leak, risk factors, and preventive techniques; a uniform definition of an "anastomotic leak" is still missing. Additionally, the incidence has not decreased.

However, comparison of rates between medical institutions remains difficult and depends on the use of standard definitions and methods of measurement.

Minor leaks are silent without any systemic manifestations and can only be diagnosed using radiologic studies [15].

Major leaks present with systemic symptoms as fever, hemodynamic instability, sepsis, and peritonitis requiring additional surgery.

Knowing about the factors predisposing to anastomotic leak is the key to its early detection and anticipating postoperative complications, surgical intervention and managing preoperative risk factors.

Methodology

A literature search on colorectal surgery was carried out using PubMed, COCHRANE library and MEDLINE.

Evaluating Certain Risk Factors of Anastomotic Leak

1. Preoperative Considerations

Identification of significant preoperative risk factors guides the proposed treatment and allows modification of risk.

Preoperative alteration of lifestyle and/or treatment may not always be possible, particularly in the emergency setting.

However, consideration of risk factors is relevant in the decision making process with regard to whether an anastomosis is a safe option, and whether a defunctioning (or permanent) stoma should be considered.

Factors like poor general nutritional status (albumin <3.5 gm% or weight loss >5kg/3 months),

degree of immunosuppression, (chemotherapy, high dose steroid therapy), general medical condition (DM, COPD, IHD, CKD etc.) [18].

Other independent significant factors that can contribute to higher leak rates include leukocytosis, sepsis, technically challenging anastomosis, bowel obstruction and peritonitis [22-23].

Recent colorectal studies have used Charlson Comorbidity Index (CCI) to measure the influence of various preoperative comorbidities on some postsurgical outcomes [16,63].

The overall CCI score was significantly higher in patients with leak and patients with CCI of 3 or more were 3.5 times more likely to develop a leak than those with CCI of less than 3 [18].

Another remarkable contribution in the objective testing of the risk of anastomotic leaks was by Dekker et al. (2011), who developed and tested the Colon Leakage Score (CLS).

Multiple risk factors were collected and points were assigned to the patients per risk factor.

This scoring tool is unique in its ability to detect patients at risk of developing anastomotic leaks preoperatively and objectively assess the need for diverting ileostomy or nonrestorative surgery [17].

2. Role of Drugs

Schrock et al. (1973) found that administration of corticosteroids did not increase significantly incidence of clinical anastomosis leakage (retrospective study) [19].

From experimental study Furst et al. (1994) reported that steroids do have an adverse effect on colonic anastomotic healing [20].

Therefore it requires further clinical as well as experimental investigations to analyze a definite relationship.

Hence, caution should be shown while using steroids in patients scheduled for lower gastrointestinal surgery with anastomosis [55].

Neostigmine which reverses the effect of the curare-type relaxants might evoke active contraction of the intestine after completion of the anastomosis and subsequently might result in its disruption.

Current evidence suggests, that neostigmine should be avoided during colorectal surgery even with combination with atropine [21].

Halothane anaesthesia, however, abolished this

neostigmine adverse effect.

3. Anastomotic Technique

The technique used to fashion a colorectal anastomosis is largely based on surgeon preference. In order to achieve an adequate colonic anastomosis with a low rate of postoperative anastomotic leak or stricture formation, certain basic surgical principles must be met [24].

First, the technique utilized for the anastomosis must assure an adequate lumen.

Second, an adequate blood supply must be maintained for both the proximal and distal colon after resection.

Finally, the anastomosis must be performed so that there is no tension to pull it apart (i.e., the surgeon must assure adequate mobilization of the proximal and distal colon).

a) Conventional suturing by absorbable or non-absorbable suture, interrupted or continuous, double or single layered technique can be used. We should take deeper muscularis and minimal mucosa during anastomosis.

Good approximation all layers of bowel wall is important.

b) For stapled anastomosis – Use the largest caliber of stapler the anastomosis can accommodate.

After placing of the purse-string the excessive bulk of tissue should not appear around shaft.

The purse-string can be snagged up close to the shaft.

Reinforce the purse-string if one is concerned about the possibility of a gap.

Repair any identified defect.

Till date, no single technique, single layer suture, double layer suture or stapling has ever been definitely demonstrated to be superior in preventing anastomotic leaks [25-26].

4. Role of Leak Test

Once anastomosis is performed the pelvic cavity is filled with saline, intestinal clamp is applied proximal to the anastomosis and 50-100 ml of air is slowly and gently injected through the anus.

No bubbles mean anastomotic tightness.

If bubbles appear additional suture on the anastomotic line needs to be taken.

In the group of patients to whom intraoperative

air test was performed by Bielecki K. et al. 23% cases of air leak was observed and additional stitches placed to secure anastomosis.

On 10th postoperative day the radiological leak in 7.5% of cases was showed and overall mortality in this group was 2%.

In contrast, in group of patients to whom intraoperative air test was not performed, postoperative radiological leak was found in 23.5% of cases with 10% mortality [62].

In patients with high ligation of the inferior mesenteric artery while resection of the left colon there is 3.8 times higher chance of leak, than those who underwent low ligation [18].

This finding most likely represents the extent of the surgical procedure in patients with left-sided surgery with more extensive lymphovascular dissection.

Creating a tension-free low rectal orocoloanal anastomosis with a good blood supply is often not possible without performing a high ligation of the inferior mesenteric vessels.

Therefore, the choice of high ligation of the inferior mesenteric artery may be influenced by a variety of factors including: level of anastomosis (how much reach is needed to the rectum), degree of atherosclerosis in the mesentery, or whether or not there are intact marginal vessels in mesentery of colon.

5. Whether Stapled Anastomosis is More Tight and Reliable than Conventional Hand-Sewn Anastomosis?

In earlier studies the reported leak rates after stapled and hand-sewn anastomosis were 8% and 27% respectively [28].

A Cochrane database systemic review of the RCT's comparing stapled versus hand sewn anastomotic technique was published in 2012.

The evidence found was insufficient to demonstrate any superiority of stapled over hand sewn techniques in colorectal anastomosis surgery, regardless of the level of anastomosis, even with the expanding advances of surgical technology [29].

In double-stapled technique and other intersecting staple lines may have a higher predisposition to the leaks than single-stapled or hand-sewn anastomosis [30].

6. Laparoscopy Versus Open Anastomosis

Laparoscopic or laparoscopically assisted approach to colorectal surgery is not associated

with a higher risk of anastomotic leaks.

Morbidity and mortality rates with this method approximate those seen with conventional colorectal surgery [31,36].

The advantages obtained with the laparoscopic technique, with no significant differences in severe complications, indicate that this approach is preferable to the traditional technique [32].

7. Role of Diversion

Some surgeons prefer to create a defunctioning stoma in order to prevent fecal contamination of an anastomosis and to reduce the consequences of an anastomotic leak.

There is no evidence that protective stoma prevents the anastomotic leak.

In case a leak does take a place in patient having a diverting stoma, the septic complications resulting from the anastomotic dehiscence are significantly reduced.

Wessex (Grabham) colorectal audit showed that a defunctioning colostomy reduced the frequency of anastomotic leak from 11.4% to 6.5% [37].

Reoperation was needed more frequently where there was no protective stoma (7.3% vs. 3.0%).

Postoperative mortality was greater following a leak, where no diversion was performed (10.4% vs. 4.1%).

Therefore a diverting colostomy decreases both the frequency and consequences of anastomotic leakage following anterior resection.

Gastinger et al. conducted a prospective multicentre study between January 2000 and December 2001 where 881 (32.3 per cent) of 2729 patients received a protective stoma after low anterior resection.

Overall anastomotic leak rates were similar in patients with or without a stoma (14.5 versus 14.2 per cent respectively).

The incidence of leaks that required surgical intervention was significantly lower in those with a protective stoma (3.6 versus 10.1 per cent; $p < 0.001$), as was the mortality rate (0.9 versus 2.0 per cent; $p = 0.037$) [38].

Logistic regression analysis showed that provision of a protective stoma was the most powerful independent variable for avoiding an anastomotic leak that required surgical correction.

Hence, more experienced surgeons prefer a defunctioning stoma for low rectal anastomosis.

A diverting stoma should be considered in any high risk anastomosis like coloanal, colorectal < 6 cm from the anal verge or in any patient with severe malnutrition, significant immunosuppression or purulent peritonitis or pelvic sepsis.

Special considerations should be made for patients with gross comorbidities having compromised physiological reserve necessary to tolerate an anastomotic leak if that happens.

8. Role of Peritoneum and of the Omentum

Surgeons have attempted several intraoperative techniques in hopes of lowering anastomotic leak rates.

One is "omentoplasty" which involves wrapping the anastomosis with omentum. This was prospectively studied by the French Associations for Surgical Research [33].

In their randomized study of 705 patients, omentoplasty did not decrease the anastomotic leak rate or the clinical severity of anastomotic leaks compared to the patients without omentoplasty.

However, several surgeons do this maneuver whenever the integrity of an anastomosis is in doubt.

9. Does Preoperative Radio (Chemo)Therapy Increase Anastomotic Leakage?

Neo-adjuvant chemotherapy does not seem to increase anastomotic leak rate following restorative proctocolectomy, possibly because of the tendency of most surgeons to cover it with a proximal stoma.

Earlier RCTs, in fact, recommends protecting stoma in patients with neoadjuvant short course radiation for rectal cancer as it reduces the need for a surgical intervention should an anastomotic leak occurs.

Changjiang Qin et al. conducted a meta-analysis where 7 randomized controlled trials with 3375 patients were included. 1660 patients forming the group undergoing preoperative radiotherapy or chemoradiotherapy versus 1715 patients undergoing operation without preoperative radiotherapy or chemoradiotherapy.

The meta-analyses found that pR(C)T was not an independent risk factor for anastomotic leakage (OR 1.02, 95% CI 0.80–1.30).

Subgroups analysis was performed and the result was not altered.

Current evidence demonstrates that pR(C)T did not increase the risk of postoperative anastomotic

leak after rectal cancer resection in patients [34].

Hananel and Gordon in their experimental study demonstrated the 5-fluorouracil and leucovorin introduced in several regimens have no effect on the colonic anastomosis healing.

Surgery, at least in experimental animals, can be performed safely during and shortly after chemotherapy [35].

10. Role of Mechanical Bowel Preparation

The importance of efficient mechanical bowel preparation in preventing infectious complications and anastomotic dehiscence after colorectal surgery has been a dogma among surgeons for more than a century (Halsted 1887; Thornton 1997).

This rigidity of concept was based more on observational data than on solid evidence.

Several well designed prospective randomized trials have shown that preoperative bowel cleaning does not prevent anastomotic leakage or wound infection in patients undergoing open or laparoscopic colorectal surgery [39,40,41].

As shown by Cochrane database systemic review 2005, inadequate mechanical bowel preparation leads to liquid bowel contents and increases the rate of intraoperative spillage which may increase the rate of postoperative infectious complications [42,43].

Some surgeons consider that bowel preparation might decrease operating time by improving bowel handling during anastomosis and might help in intestinal palpation necessary for identification of a lesion [44].

Therefore bowel preparation is not routinely recommended.

11. Role of Pelvic Drains

Role is still controversial.

Prevention of collection of fluids or hematoma in the pelvis minimizes the risk of Anastomotic Leak.

Recent large RCTs and meta-analysis, has not shown any benefit nor any harm.

A systematic review and meta-analysis of randomized controlled trials by D R Urbach et al. using four randomized controlled trials, including a total of 414 patients, compared the routine use of drainage of colonic and/or rectal anastomoses to no drainage.

Use of a drain did not significantly affect the rate of any of the outcomes examined, although

the power of this analysis to exclude any difference was low. Comparison of pooled results revealed an odds ratio for clinical leak of 1.5 favoring the control (no drain) group.

They concluded that any significant benefit of routine drainage of colon and rectal anastomosis in reducing the rate of anastomotic leakage and other surgical complications can be excluded with more confidence based on the pooled data than from the individual trials alone [45].

Recent report from Dutch TME trial, a large randomized control study comparing TME with and without preoperative radiation, demonstrated by multivariate analysis that lack of pelvic drainage was an independent risk factor for anastomotic leakage after TME [46].

The reported leakage rate was 9.6% in patients with pelvic drainage, which was much lower than 23.5% in those without a pelvic drain [47].

12. Role of Epidural Analgesia

Earlier case reports showed a risk of early anastomotic leakage in patients receiving epidural analgesia with local anesthetic agents.

There was data documenting a stimulatory effect of epidural block on gastrointestinal motility, leading to more leaks.

Review of controlled, randomized clinical trials aiming to investigate postoperative complications in which continuous postoperative epidural local anesthetic was administered in patients scheduled for colorectal surgery with an anastomosis by Holte K et al. showed that there is no statistically significant evidence to indicate an increased risk of anastomotic breakdown [48].

However, relatively few patients have been included in randomized trials, indicating a need for more studies to secure valid conclusions.

How to Manage a Colo-Rectal Anastomotic Leak?

Müller (1994), gave a definition of anastomotic leak;

1. Fecal fistulas to the skin or vagina
2. Fever > 38°C or septicemia
3. Radiological or endoscopic signs of anastomotic leakage
4. An intraperitoneal abscess or peritonitis in the presence of an anastomotic leak [49].

It is typically discovered around 5 to 7 days after surgery and hind sight usually reveals earlier signs that should make the surgeon more suspicious

of a leak include fever, leukocytosis, localised or generalised tenderness, generalised ileus with abdominal distension and tachycardia.

It is usually necessary to obtain objective tests of anastomotic integrity because of the early non-specific clinical signs.

Complimentary radiologic studies such as computed tomography (CT scan) or contrast water-soluble enemas can be used to confirm the diagnosis.

CT scan is superior to the latter in showing abscess formation in the pelvis [51].

The presence of a collection of fluid and gas adjacent to the colonic suture/staples indicates an anastomotic leak.

If suspicions persist, the leak can be more illustrated with intestinal opacification and using fluoroscopic imaging.

Conventional contrast enemas pursued with a supplementary CT examination at the same time that might show an intestinal wall defect with communication of the intraluminal and extraluminal compartments [52].

Anastomotic leaks may be divided into those which are clinically significant and those which are not.

Anastomotic leaks can also be classified as; Free or Contained leak.

Free leak are characterized by symptoms of fever, tachycardia, leucocytosis, diffuse peritonitis, feculent fluid may present through the incision or the pelvic drain, hypotension and other signs of sepsis.

Whereas contained leaks are more benign in their natural history and is contained in a small cavity around the anastomotic site [50].

To achieve an uniform guideline for the detection and management of colorectal anastomotic leaks M. den Dulk et al., combined the clinical features into a clinical scoring system, the Dutch Leakage (DULK) Score.

Here the patients are scored every day.

Separate points are assigned to certain clinical manifestations and symptoms (i.e., fever, heart rate, respiratory rate, urinary output, and mental status), nutritional status (kind of intake), local findings (such as signs of ileus, gastric retention, fascial dehiscence) and laboratory findings (i.e., CRP level, kidney function test, leucocyte level).

After applying, the scoring system

retrospectively on a historical cohort, the score was used prospectively.

It was noted that patients with a higher score were more susceptible to anastomotic leaks so required intensive medical care or radiological evaluation.

This scoring system decreased the delay in detecting the anastomotic leak from 4 to 1.5 days, decreasing the false negative diagnostic imaging which is considered a major factor in the delay of diagnosis [53,54].

Routine measurement of C-reactive protein (CRP) postoperatively has been used for detecting the presence of any infectious complications after surgery and in particular anastomotic leaks.

Warschkow et al. in a meta-analysis showed that a cut-off of 135 mg/L on day 4 post surgery was resulting in a negative prediction value of 89% for infections and complications [56].

Treatment of Colorectal Anastomotic Leaks

For major leaks patient requires immediate intervention with resuscitation for hemodynamic instability, IV antibiotics, monitoring with central lines, urinary catheters, and arterial lines in an ICU.

Once stabilized, laparotomy with lavage and drainage is mandatory, followed by the formation of a de-functioning stoma.

In right sided colonic leaks, the anastomosis can be refashioned and then a drain is placed.

In left colonic leaks, based on the condition of the anastomosis, the surgeon has to take a decision.

If the anastomosis has a small clear defect, it is closed and a stoma is fashioned with adequate drainage of the abdominal cavity.

Primary repair may be attempted in very small colorectal leak, with a covering stoma and placed beneath the midline incision.

If the anastomosis has total dehiscence, the proximal end is brought out as a colostomy and the distal end is kept as a Hartman's stump.

Alternatively it can be brought out as a mucous fistula [57].

For leaks with localized collections, treatment is conservative with IV antibiotics, bowel rest and observation.

If the leak is contained in a large cavity, then the best approach is to do a percutaneous drainage under radiologic guidance with a success rate of 80% being documented [58].

If non-surgical drainage is not feasible, then laparotomy may be necessary [57].

Long-Term Functional Outcome Anastomotic Leakage

In patients with leak as the results of pelvic sepsis, fibrosis may develop which can eventually lead to narrowing of the distal bowel or can form a stricture [60].

Stricture formation in the site of the anastomosis is seen due to anastomotic leak, ischemia or due to cancer recurrence [61].

The stricture is repaired when there is luminal obstruction, need to reverse a proximal stoma, or defecatory symptoms.

Neorectal volume at distension pressures of 40 and 50 cm H₂O and compliance at sensation of filling urgency maximum tolerated volume were significantly reduced in patients with anastomotic leak.

The impaired anorectal function is measured by, increased urgency, increased frequency of bowel movements, increased incontinence score and impaired evacuation.

Anastomotic leak may increase the risk of locoregional neoplastic recurrence [59].

Conclusion

Colorectal anastomotic leaks are serious complications following surgery that alter the desired outcome and is a burden on patients, putting healthcare practitioners under pressure and dilemmas regarding its' appropriate management.

Surgeons should keep in mind the risk factors for colonic anastomotic leaks.

Colonic anastomotic leak can be avoided by the use of proper surgical technique.

In fashioning a colorectal anastomosis, some basic surgical techniques must be followed to limit the complications.

Presence of adequate blood supply to the anastomosis, minimal contamination, absence of tension in the anastomotic line and no distal obstruction.

The use of either sutures or staples to create a colorectal anastomosis do not significantly alter the anastomotic leak rate.

The use of preoperative mechanical bowel

preparation is decreasing as its' utility has been questioned by findings from several recently performed randomized prospective studies.

The anastomosis should be tested intraoperatively and if needed should be covered by a de-functioning stoma.

Even when excellent surgical technique is used, a small percentage of leaks are inevitable on account of the many known and unknown factors.

The clinicians must have a high index of suspicion to diagnose an anastomotic leak early to adequately salvage the situation.

Leakage scoring systems and clinical laboratory tests contribute strongly to the early detection of leaks.

Treatment is based on the patient's conditions and the magnitude of the leak.

Anastomotic leaks therefore remain a challenging complication which require further investigation and research.

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