Drain vs No Drain After Colorectal Surgery

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Abstract In colorectal surgery, drains are expected to prevent hematoma, fluid collection, or abscess formation, to act as an indicator of postoperative complication, or to minimize the severity of complication-related symptoms. Routine drainage has not been advocated by meta-analyses as they failed to demonstrate any benefit in reducing anastomotic leak rate, minimizing symptoms, or serving as a warning function. Moreover, some reports even showed that drain itself is an independent risk factor of anastomosis. The introduction of total mesorectal excision (TME) for rectal cancer surgery has given further concern to this controversial issue, that the use of drain decreased anastomotic failure rate and the need for surgical re-intervention. While controversy still remains, the choice of using drain is left to the individual surgeon's preference in daily practice. Therefore, surgeons should be well acquainted with purpose of drainage (prophylaxis, information, or treatment), characteristics (materials), clinical application of drain (type of drainage system, timing of removal), surgical outcomes after using drain (incidence of postoperative complication), and drain-related complications. If drains are used, careful observation with proper use is crucial for the management. It is important that the duration of drainage should not be inadequately extended. Any complications

directly associated with the use of drain should be avoided. New concepts of drain have been proposed as diagnostic tool using biomarkers, and as preventive device against anastomotic leak. This article overviews the available, published data on the use of drain in colorectal surgery.

Keywords Colorectal surgery · Colorectal cancer · Drain · Drainage · Anastomotic leak · Risk factor

Introduction

What can colorectal surgeons expect for using surgical drain in colorectal surgery? One believes that accumulation of large amount of fluid or blood may lead to subsequent abscess, particularly in the extraperitoneal space where fluids are not absorbable due to the lack of peritoneum. Hence, drains are expected to evacuate potentially contaminated or known contaminated fluid [1], so that prophylactic drain may minimize the severity of related symptoms. One believes that drains can track the integrity of the anastomosis, and it can alert clinicians to the early diagnosis of anastomotic complication when a bowel content, pus or excessive fluid comes out through the drains [1, 2]. One can rely on the role of drain that can detect intraabdominal or intraperitoneal hemorrhage in the early postoperative period [1].

Clinical significance of prophylactic drainage in colorectal surgery has been arguable for years concerning its role in prevention and detection of anastomotic leak. Anastomotic leak result in delayed wound healing, prolonged hospital stay, diminished quality of life, impaired long-term anorectal function [3], and more importantly, it has been proven to be associated with increased overall and cancer-specific mortality and

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increased overall and local recurrence rate in patients who underwent rectal cancer surgery [4–6]. Previous meta-analyses have proven that there is no apparent evidence that justifies prophylactic drainage in reducing the frequency or detecting anastomotic leak in colorectal surgery [7, 8]. This concept has been advocated by subsequently published, large-scale retrospective studies [9, 10]. However, introduction of total mesorectal excision (TME) for rectal cancer surgery has prompted further concern with this issue because of the increased incidence of anastomotic leakage with 10 to 20% [11–15]. The Dutch TME trial [15] demonstrated some supportive data of using pelvic drainage in decreasing anastomotic failure rate and the need for surgical re-intervention.

Despite these conflicting evidences, there might be many surgeons who give preference to the use of drains in colorectal surgery. There might be some inconsistency between the data shown in the literature and what colorectal surgeons actually do in the operative theatre. To answer the continuing question whether to drain or not to drain in colorectal surgery, this article highlights the current evidence regarding the use of drain in terms of its significance in prevention and management of anastomotic leak, potential benefits and problems, and novel indications.

Drain as Prophylaxis

Use of Drain and the Incidence of Anastomotic Leak

A meta-analysis examined 4 randomized controlled trials with pooled data of 223 drained and 188 non-drained patients [7]. The odds ratio (drained group vs. non-drained group) was 1.4 (95%CI; 0.6 to 3.3) for mortality, 1.5 (95%CI; 0.7 to 3.1) for clinical leak, 1.0 (95%CI; 0.5 to 2.3) for radiological leak, 1.7 (95%CI; 0.9 to 3.3) for wound infection and 0.8 (95%CI; 0.4 to 1.6) for respiratory complications. These results favor non-drained group except respiratory complications. A subsequent meta-analysis included 717 drained and 673 non-drained patients [8], showing similar results but with slight significance compared with the previous analysis. The odds ratio (drained group vs. non-drained group) was 1.4 (95%CI; 0.8 to 2.5) for clinical leak, 1.4 (95%CI; 0.9 to 2.3) for wound infection and 0.8 (95%CI; 0.5 to 1.3) for respiratory complications. These 2 meta-analyses came to a same conclusion, that there was no significant benefit of routine drainage in reducing the incidence of anastomotic leak or other surgical complications. Yeh et al. [9] also concluded that routine drainage was not justified and should be discouraged. They found that the incidence of anastomotic leak was significantly higher when they used irrigation-suction drain (odds ratio=9.1, 95%CI; 1.2 to 72), while

statistically insignificant when they used silastic penrose drain. Although the non-randomized study design limits the credibility of their message, extensive discussions involving many surgeons worldwide have been made after the publication. In contrast, the Dutch TME trial revealed that the presence of drain was strongly associated with a lower leak rate (9.6%) compared with those without drain (23.5%) and this significance resulted in the relative risk of 2.5 (95%CI; 1.6 to 4.1) by the multivariate analysis, favoring the use of pelvic drain in reducing the anastomotic leak rate [15]. Besides, since this study provided supportive data to the clinical decision to construct covering stoma when performing TME, the main interest of the trials on TME has been shifted to whether to create defunctioning stoma or not at the time of initial surgery [16].

Type of Drain and Timing of Removal

The type of pelvic drains used are indeed heterogeneous among the published literature, including irrigation-suction or suction drain [17], closed-suction drain alone [18–20], choice of irrigation-suction, silastic penrose, or Jackson-pratt drain [9], closed-silastic with gravity drainage [2], or not even clearly described [10, 14, 15]. Moreover, the timing of drain removal after surgery is also variables such as at least 24 h [17], 3 days [20], 5 days at the latest [18], 7 days [2, 19], or not clearly documented [9, 10, 14, 15]. Anastomotic leak can occur during immediate postoperative period, however a recent review describes that there are two peaks when making the diagnosis of anastomotic leak; when diagnosed clinically, the median postoperative day of 7 days and when diagnosed radiographically the median days of 16 days [21]. On the other hand, another systematic review revealed that the timing of anastomotic assessment by contrast radiography ranges 4 to 14 days after surgery in the majority of reports [22]. These facts implies that if surgeons expect the role of drain in yielding information about the anastomosis and/or active drainage of abscess, drain should not be removed in the early postoperative period.

Drain as Information

Early Indicator of Anastomotic Leak

Although surgeons can expect that drain serves as an eye into the anastomosis [23], the anticipated warning function of prophylactic drain has been questioned. Urbach et al. [7] showed in their meta-analysis that only 1 of 20 drains contained pus or enteric content at the time of diagnosis, resulting in a quite low sensitivity of 5% in detecting anastomotic leak. Contrary to that analysis, the authors

presented acceptable sensitivity of pelvic drain in detecting anastomotic leak [2]. In 13 of 21 patients with leak, changes in drain content were the initial indicator of anastomotic leak. Other diagnostic indicators include fever in 6, radiograph alone in 1 patient. The remaining one patient had substantially delayed diagnosis of leak when developed ureteral-colonic fistula. Finally, changes in the drain content indicating anastomotic leak were observed in 15 (71%) patients, and 11 of whom remained asymptomatic. This difference in sensitivity is partly owing to the timing of drain removal as described above, the longer duration of placement, the higher detection of anastomotic leak. The another contributing factor may be the closed-passive drainage system we used, which can reduce the risk of luminal obstruction compared with active suction drainage used in most of the previous series.

Drain as Treatment

Therapeutic Use of Drain in Management of Anastomotic Leak

When anastomotic leak occurs after colorectal resection, individualized management including administration of broad spectrum antibiotics, bowel rest, drainage of abscess, surgical revision, or fecal diversion are necessary [21]. Anastomotic leak with minimal clinical symptoms may possibly be managed by drainage alone or with re-anastomosis, particularly after right-sided colorectal resection. For most of the anastomotic leaks after low rectal surgery, fecal diversion is required to salvage progressive septic status. If diverting stoma was not created at the initial surgery, then secondary surgery is unavoidably needed in an emergent or urgent clinical setting. However, stoma creation itself does not resolve intraperitoneal or extraperitoneal abscess resulting from anastomotic leak. Appropriate drainage is indispensable for ‘control’ of the abscess. If an existing drain was suitably placed in the vicinity of the anastomosis at the initial surgery, and is still left in place at the time of diagnosis of leak, additional drainage may not be necessary. Otherwise, surgical or radiological drainage is required. It is preferably performed with CT-guided approach [24, 25] and its success rate has been reportedly around 80% [26, 27]. In selected cases, anastomotic leak after rectal surgery with subclinical symptoms can be managed by non-surgical, conservative therapy by drainage alone with a success rate of 48% [2] (Fig. 1).

The route of drain can turn into a fecal fistula during the postoperative period [23], and this process is a fundamental principle of non-surgical, conservative treatment for anastomotic leak (Fig. 2). However, the obvious disadvantage of

Fig. 1 Minor anastomotic leak. A narrow, meandered extravasation of contrast solution around the anastomosis is observed. A small amount of contrast flows into the tip of drain located in the presacral space, indicating this drainage is effective

this non-surgical, conservative treatment is durable drainage, the reported length of drain placement is a median of 52 days (range 32 to 169 days) [2].

Drain as An Independent Risk Factor of Anastomotic Leak?

Risk factors of anastomotic leak in colorectal surgery have been extensively analyzed in the literature. Identified risk factors include male gender [12, 13], tumor location and the level of anastomosis [11–13, 28], steroid use [21], smoking [13, 21], intraoperative adverse events [28], the lack of stoma [11, 14, 15], preoperative chemoradiotherapy or radiotherapy [12, 28], severe bleeding [28], higher American Society of Anesthesiologists grade [21, 29], and emergency surgery [29].

Yeh et al. [9] concluded that drain itself was an independent risk factor of anastomotic leak. Irrigation-suction, silastic penrose, or Jackson-pratt drain was utilized in that study, only irrigation-suction drain was found to be associated with increased risk of anastomotic leak. Another single-institutional study analyzing over 1,500 patients revealed that the use of abdominal drain was one of the significant factors of anastomotic leak in the univariate analysis [10]. However, their observations may be inevitably biased, because the decision to place drains intraoperatively was left to the surgeons' discretion, the increased incidence of anastomotic leak may have been the reflection of precarious or incomplete anastomosis, as previous literature has pointed out [21, 30]. In a Swedish randomized controlled study focused on the efficacy of defunctioning stoma on reducing the anastomotic leak rate in patients undergoing low anterior resection, the use of

Fig. 2 Contrast enema: fecal fistula and the healing process. **a** At the time of diagnosis of leak. The contrast massively flows into the drain. **b** 4 weeks after diagnosis of leak. The contrast does not flow into the

drain. **c** 6 weeks after diagnosis of leak. The bowel continuity has been completely restored and the drain was removed successfully

pelvic drain were at the choice of individual surgeon. Interestingly, the proportion of having pelvic drainage was 97% (227 of 234) of the recruited patients. This implicates that surgeons may still have some hesitations for not indicating pelvic drainage in patients with low anastomosis, and that the use of drain may not dramatically affect the incidence of anastomotic leak when compared with the presence of diverting stoma in low rectal cancer surgery.

Drain-Related Complications

There are few, but significant complications specifically associated with the use of drain including drain-site wound infection (up to 2.5%) [2, 31, 32], pain [31], bleeding [31, 32], small bowel evisceration [32–34], bowel injury (0.1–0.5%) [2, 18], and herniation of omentum (up to 1.0%) [2]. Although the rarity of detailed literature describing drain-related complications other than case reports limits to appreciate the actual incidence, it seems to be uncommon to develop these complications by the available data. Suggested predisposing risk factors include general debility, steroid administration, increased abdominal pressure, and stab wound incision for drain exceeding 10 mm in diameter [32, 34]. Some of these complications may require surgical interventions and it is indeed drawback of the use of drain.

Moreover, an old experimental study showed that the long drainage period led to the increased incidence of fistulae, bowel obstruction, and injury of the adjacent structures [35]. As previously described, non-surgical, conservative treatment necessitates long-lasting drain placement with a median of 52 days (range 32 to 169 days) [2]. This long-term treatment may result in prolonged hospital stay, increased medical costs, and diminished quality of life. Great care must be taken in order to avoid any drain-related complications. Drain must be placed to the appropriate

anatomic location to achieve effective drainage, and it may be useful to take abdominal radiographs immediately after surgery in order to verify the position of the drain [2]. Herniation of visceral organs may be intervened by smaller incision for the stab wound (less than 10 mm) or by the use of smaller bore drainage system [32, 34]. There is no doubt that a careful observation with proper use is crucial for the management of drain, and certainly, the duration of drainage should not be inadequately extended.

Novel Innovations

New Concepts of Drain for Detection and Prevention of Anastomotic Leak

To enable an early diagnosis of anastomotic complications before causing clinical symptoms, some biomarkers have been proposed as objective diagnostic parameters [36]. Biomarkers are collected from the fluid through the drain located near the site of interest. Potential biomarkers include immune (interleukin-1, 6 and 10, tumor necrosis factor- α) parameters, tissue repair (matrix metalloproteinase-1, 2, 9 and 13) parameters, parameters of ischemia (glucose, lactate, glycerol), and microbiological (lipopolysaccharides, pH, pCO₂, and pO₂) parameters [36]. As changes in the value of these markers are considered to be the reflection of physiological, pathogenic or a pharmacologic response in the vicinity of the anastomosis, the drain has more pivotal role in periodical fluid collection rather than visual monitoring of drain content.

The C-seal is a thin-walled tubular drain, with an approximate diameter of 4 cm and a length of 25 cm. It is applied with a circular stapler and stapled to the anastomosis, covering the luminal side of the anastomosis and preventing

direct contact of bowel contents. The C-seal gradually degrades and is expelled from the body together with bowel contents after 10 to 14 days. The C-seal does not preclude anastomotic dehiscence, however, it prevents extravasation of bowel contents into the peritoneal cavity. A phase II study testing the C-seal has been currently recruiting [37].

Conclusions

As supported by many reports, routine drainage is not necessary in colon surgery or rectal surgery with intraperitoneal anastomosis, though it can be used as ‘information drain’ when considerable oozing is anticipated after complicated surgical procedure. However, based on the available literature, the authors believe that there has not been sufficient evidence to deny the use of drain in rectal cancer surgery performing TME. To answer this question, large-scale, well-designed randomized controlled trials focused on the effectiveness of pelvic drain against anastomotic leak are still warranted.

Conflict of interest The authors state that there is no conflict of interest.

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