REVIEW ARTICLE

To Drain or Not to Drain after Colorectal Cancer Surgery

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Abstract Prophylactic drainage of abdominal cavity after GI surgery has been widely practiced. The most important signal function of prophylactic drain is to detect early complications. But the same drains could be the cause of some of the complications. Although there is a considerable theoretical and practical evidences in favor of drainage, the dispute about "to drain or not to drain" the peritoneal cavity after elective colorectal surgery remains open. Unfortunately, the principle of drainage is not based on any scientific data. During the last three decades, surgeons have made efforts to investigate the value of prophylactic drainage after colorectal surgery. However, the results of trials are contradictory due to lack of quality and/or statistical power and therefore do not provide an answer to the clinical question. A systematic review of studies suggests that there is insufficient evidence for routine use of drain after colorectal surgery. Despite evidence-based data questioning prophylactic drainage of abdominal cavity in many instances, most surgeons around the world continue to use drains on a routine basis until now. There are strong evidences in literature in favor of no apparent benefit of drainage for supra-peritoneal anastomoses;

however, there is still controversies regarding drainage of infra-peritoneal rectal anastomoses.

Introduction

Drainage of body cavities has been practiced in medicine since long time. Historical reports of drainage of chest empyema and ascites go back to Hippocratic era [1]. Prophylactic drainage of the peritoneal cavity after gastrointestinal (GI) surgery has been widely practiced since the mid-1800s. The dictum of Lawson Tait, a 19th-century surgeon, "When in doubt, drain," is well known to all surgical trainees. The most important signal function of prophylactic drain is to detect early complications, such as postoperative hemorrhage and anastomotic leakage [2].

Sims was the first surgeon to use prophylactic drains after gynecologic operations in the last quarter of the nineteeth century [3]. Since that time, surgeons have routinely used prophylactic drainage of the peritoneal cavity after abdominal surgery. The great surgeon, Theodor Billroth, was also convinced that prophylactic drainage saved many lives after GI surgery [4].

Drain vs No Drain

It has been demonstrated that use of drains limits the risk of an anastomotic leakage but, in some cases, the same drains could be the cause of some of the complications. Prophylactic drainage is thought to [5, 6]

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(A) Decrease the rate of anastomotic leakage by evacuating seroma and blood that once infected, can lead to abscess formation and opening of the abscess into the anastomosis
(B) Decrease the severity of these complications by earlier diagnosis
(C) Facilitate the diagnosis of intra-peritoneal hemorrhage

However, surgically placed drains are not without risk. They have been associated with increased rates of infection, abdominal pain, decreased pulmonary function, prolonged hospital stay and organ damage, etc [7–14]. There are surgeons who believe that drainage of peritoneal cavity is impossible, and therefore, prophylactic drainage is useless [15, 16]. The surgeons who are opposed to drainage believe that it [17–22]

(A) Actually stimulates the formation of serous fluid
(B) Can lead to infection from outside
(C) Increases the rate of leakage by preventing the mobilization of omentum and adjacent organs, obstructing their sealing action on suture line or even creating leakage by mechanical erosion of the anastomoses
(D) Is walled off quickly

Although there is a considerable theoretical and practical evidences in favor of drainage, the dispute about "to drain or not to drain" the peritoneal cavity after elective colorectal surgery remains open [23]. Anastomotic dehiscence is a serious complication leading to major mortality and morbidity of colorectal surgery [24]. In order to treat or prevent anastomotic dehiscence, some surgeons routinely use drains. Others use drains only when in doubt, and some never use drains [5, 18, 25].

Unfortunately, the principle of drainage is not based on any scientific data. During the last three decades, surgeons have made efforts to investigate the value of prophylactic drainage after abdominal surgery in controlled randomized clinical trials (RCTs) [26].

There is no doubt that once anastomotic leakage has occurred, drains should be used for therapeutic purpose. However, on prophylactic use, no such agreement exists [27, 28]. Pelvic drains are even more commonly used because of higher leakage rates in pelvic anastomosis [29–31].

Several reviews, trials and retrospective studies on the issue whether to drain or not to drain colorectal anastomoses were published. In particular, a number of randomized clinical trials on the same issue were carried out. However, the results of these trials are contradictory due to lack of quality and/or statistical power and therefore do not provide an answer to the clinical question [28].

In a recently conducted Spanish study, "Drains" were not used by 46 % in right colon surgery; 22 % in left colon surgery, and 3.1 % in rectal surgery. Drains were considered very useful by 16 % in colon surgery and by 52 % in rectal surgery [32].

But randomized controlled trials have questioned the routine use of abdominal drain in elective surgery. The available literature from Pubmed, Medline, and Cochrane database was reviewed with major emphasis on RCTs and meta-analysis

Randomized Controlled Trails

Several well-constructed, prospective studies failed to show any benefit from surgically placed closed suction drainage [13, 14]. After a variety of intra-abdominal procedures, such as colorectal resection [12, 33, 34], there appears to be no statistical difference in the rate of complications between patients who are drained and those who are not, suggesting at the best that routine placement of intraperitoneal drains is unnecessary.

Till now, eight RCTs on abdominal/pelvic drainage versus no drainage after colorectal surgery have been published. Six of eight RCTs had included specific population of patients based on the level of the anastomoses [12, 34–38], whereas two RCTs were composed of a heterogeneous population [33, 39] (Table 1). Two trials included only cancer patients [35, 37]; in six trials, benign disease patients were also included. But these trials have predominantly cancer patients (61 to 77 %). Six trials [12, 33–37] studied only elective surgery, whereas two other also included emergency procedures [38, 39]. However, emergency procedures were in the minority, and patients were equally represented in the drained and nondrained group in both studies.

All studies revealed a similar pattern of postoperative complications in both groups of patients (Table 2). The major outcome, anastomotic leakage detected clinically or radiologically ranged from 1 to 23 %, but not statistically significant between drainage and no drainage groups. A multicenter study by Merad et al. [12] for suprapromontory anastomoses showed slight difference in favor of drainage group, but they concluded that it might be due to many high-risk patients (i.e., those with ascites) in non-drainage group. Two studies have noted higher rate of wound infection in drained group [12, 34], but other four studies showed lesser wound infection in nondrained group. Overall, the difference in two groups was not statistically significant in any of the studies. The differences in mortality among the groups were unrelated to the anastomotic leakage in majority, and overall, it was not statistically significant between the two groups.

Meta-analysis

The first meta-analysis was published by Urbach et al. in 1999 [28]. It included four RCTs with pooled data from 223 drained and 188 non-drained patients. The 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.

Table 1 Showing level of evidence and level of anastomoses in different RCTs

Study (Ref)	Level of evidence	Level of anastomoses
Hoffman, 1986 [36]	IIb	Supraperitoneal
Johnson, 1989 [39]	IIb	Colocolic, colorectal, ileocolic, ileoanal, coloanal
Hagmueller, 1990 [35]	IIb	Colocolic, colorectal, ileocolic,
Sagar, 1993 [33]	Ib	Colocolic, colorectal, ileocolic, ileoanal, ileorectal
Sagar, 1995 [38]	IIb	Pelvic (colorectal, coloanal, ileoanal, ileorectal)
Merad, 1998 [12]	Ib	Suprapromontory (colocolic, colorectal, ileocolic)
Merad, 1999 [34]	Ib	Pelvic (colorectal, coloanal)
Brown, 2001 [37]	IIb	Infraperitoneal (colorectal, coloanal)

Comparison of pooled results revealed an odds ratio for clinical leak of 1.5 favoring no drain group. Of the 20 observed leaks among all four studies that occurred in a patient with a drain in place, only in one case (5 %) did pus or enteric content actually appear in the effluent of the existing drain. The overall quality of the studies was poor, so Urbach et al. recommended additional well-designed randomized controlled trials to reinforce this conclusion.

Jesus et al. [40] also published a systematic review and meta-analysis of drainage or no drainage in elective colorectal anastomoses in 2004. The primary objective of this systematic review was to determine if prophylactic drainage after anastomosis in elective colorectal surgery prevents clinical anastomotic leakage. The secondary objectives were to perform a subgroup-analysis according to level of anastomoses and compare drainage to non-drainage regimes in terms of length of hospital stay, radiological anastomotic leakage, and infectious complications.

In summary, they identified nine RCTs comparing prophylactic anastomotic drainage with non drainage in colorectal surgery. Three of nine RCTs were excluded: one because of inadequate allocation concealment [39] and other two because of emergency surgery patients inclusion [33, 38]. Six RCTs were analyzed with 1140 patients. Of the six RCTs, four studies were published in English [12, 34, 36, 37] and two in German [35, 41]. Of the 1140 patients who were enrolled, 573 were allocated for drainage and 567 for no drainage. The outcome measures were mortality (3 vs 4 %), clinical anastomotic dehiscence (2 vs 1 %), radiological anastomotic

Table 2 Summary of outcomes of different RCTs

Study (ref)	Arm	End points events (n/N)					
		Clinical Leakage	Peto OR (95 % CI)	Wound Infection	Peto OR (95 % CI)	Mortality	Peto OR (95 % CI)
Hoffman, [36]	Drain	1/28	1.15 (0.07, 18.88)	4/28	2.41 (0.45, 12.86)	0/28	0.15
	No drain	1/32		2/32		2/32	(0.01, 2.45)
Johnson, [39]	Drain	6/49	1.18 (0.36, 3.93)	10/49	1.20 (0.46, 3.15)	2/49	2.31
	No drain	6/57		10/57		1/57	(0.23, 22.87)
Hagmueller, [35]	Drain	1/60	6.58 (0.13, 333.8)	2/60	1.74 (0.18, 17.16)	1/60	0.88
	No drain	0/53		1/53		1/53	(0.05, 14.36)
Sagar, [33]	Drain	8/94	1.45 (0.40, 5.23)	9/94	1.61 (0.42, 5.98)	9/94	3.25
	No drain	3/51		3/51		1/51	(0.85, 12.41)
Sagar, [38]	Drain	5/52	2.29 (0.50, 10.58)	3/52	12.7 (0.21, 75.9)	3/52	0.92 (0.18, 4.76)
	No drain	2/48		0/48		3/48	
Merad, [12]	Drain	1/156	0.53 (0.05, 5.11)	6/156	0.88 (0.29, 2.67)	7/156	0.80
	No drain	2/161		7/161		9/161	(0.29, 2.17)
Merad, [34]	Drain	6/247	1.95 (0.52, 7.29)	10/247	0.70 (0.31, 1.59)	8/247	0.79
	No drain	3/245		14/245		10/245	(0.31, 2.02)
Brown, [37]	Drain	2/31	0.90 (0.12, 6.74)	5/31	1.57 (0.36, 6.92)	1/31	0.90
	No drain	2/28		3/28		1/28	(0.05, 14.82)

The odds ratio represents the odds of an adverse event occurring in the non drain group compared with the drain group. Odds ratios >1 favor the non drain group, and the point estimate of the odds ratio is considered statistically significant at the $p < 0.05$ level only if the 95 % confidence interval (95 % CI) does not include the vertical bar at 1. The 95 % CIs always include 1, indicating that there were no statistically significant differences between two groups for any outcome.

n no. of events, *N* total no. of patients in study, *OR* odds ratio, *CI* confidence interval

Table 3 Summary of outcome measures of three meta-analysis

Study	Arm	Outcome measures							
		Clinical leak		Radiological leak		Wound infection		Mortality	
		n/N	OR (95 % CI)	n/N	OR (95 % CI)	n/N	OR (95 % CI)	n/N	OR (95 % CI)
Urbach [28]	Drain	20/223	1.47	17/174	1.01	26/223	1.70	14/223	1.38
	No drain	12/188	(0.71, 3.06)	11/131	(0.45, 2.26)	15/188	(0.87, 3.3)	8/188	(0.57, 3.31)
Jesus [40]	Drain	11/522	1.55	16/522	1.33	29/573	1.03	18/573	0.71
	No drain	7/519	(0.61, 3.95)	19/519	(0.29, 5.98)	28/567	(0.6, 1.76)	25/567	(0.73, 3.95)
Petrowosky [42]	Drain	30/717	1.3	NA		46/717	1.41	NA	
	No drain	16/673	(0.77, 2.49)			30/673	(0.87, 2.29)		

n no. of events, *N* total no. of patients, *OR* odds ratio, *CI* confidence interval, *NA* not analyzed

dehiscence (3 vs 4 %), wound infection (5 vs 5 %), re-intervention (6 vs 5 %), and extra-abdominal complications (7 vs 6 %) (Table 3). None of these differences in outcome were statistically significant. They concluded that there is insufficient evidence to suggest routine drainage after colorectal anastomoses to prevent anastomotic and other complications.

Petrowsky et al. [42] performed a new meta-analysis of eight RCTs with pooled data from 717 drained and 673 non-drained patients. This meta-analysis confirmed the results of a previously published meta-analysis by Urbach et al. [28]. Although, a slight advantage for non-drained patients in respect to clinical leakage and wound infections was documented, but statistically not significant. They stated that available RCTs and our own meta-analysis point out that the use of routine prophylactic drainage provides no benefit after uncomplicated major colon and rectal surgeries. There was a trend favoring a no-drainage policy regarding wound infection and the incidence of clinically apparent anastomotic leakage. From this analysis, there is no evidence that justifies routine drainage of colon and rectal anastomoses after uncomplicated surgery.

The criticism of this meta- analysis is some heterogeneity in anastomotic population, drain type, and duration of drainage. The large variability of drainage duration among the RCTs (3–7 days) may indicate the need for future RCTs that are focused on drainage duration, especially on short-term drainage (24–48 h), which has not been investigated yet.

Results of all three meta-analysis are summarized in Table 3.

Infra-peritoneal Anastomoses

There are strong evidences in literature in favor of no apparent benefit of drainage for supra-peritoneal anastomosis; there are still controversies regarding drainage of infra-peritoneal rectal anastomosis.

Brown et al. [34] did a prospective randomized study of drains in infra-peritoneal rectal anastomoses. All patients with rectal cancer resection with infra-peritoneal anastomoses were randomized to drainage or no drainage group. They analyzed

Table 4 Summary of studies by level of anastomosis and overall anastomotic dehiscence (6 trials, 1138 patients)

Study or subgroup	Drainage (n/N)	No. drainage (n/N)	OR (95 % CI)
Extra-peritoneal			
Brown 2001[37]	3/31	3/31	0.50 (0.11, 2.21)
Merad 1999 [34]	8/63	8/63	1.11 (0.39, 3.14)
Subtotal (95 % CI)	11/94	13/97	0.85 (0.36, 2.00)
Intra-peritoneal			
Hagmuller 1990 [35]	4/60	1/53	3.07 (0.51, 18.34)
Mennigen 1989 [44]	1/51	1/48	0.94 (0.06, 15.27)
Merad 1998 [12]	3/161	1/156	2.66 (0.37, 19.06)
Merad 1999 [26]	9/184	7/176	1.24 (0.46, 3.37)
Subtotal (95 % CI)	19/484	13/466	1.44 (0.71, 2.93)
Total (95 % CI)	30/578	26/563	1.16 (0.68, 2.01)

n no. of events, *N* total no. of patients in study, *OR* odds ratio, *CI* confidence interval

59 patients. There were 10 % leak in the drain group and 18 % in the no-drain group (*p*=ns). There were 2 (7 %) patients in each group with a clinical leak. There were no specific drain complications, and the incidences of other complications were similar in both the groups. In conclusion, this study supports the contention that there is no difference in morbidity with or without a drain for infra-peritoneal anastomosis.

A prospective study by Yeh et al. 2005 [43] for pelvic drainage and other risk factors for leakage after elective anterior resection in rectal cancer, found irrigation suction drain as an independent risk factor for anastomotic leakage. However, use of a drain and type of drainage were at the surgeon's preference. Total 978 patients were included. They concluded that routine use of pelvic drainage is not justified and should be discouraged. In cases, pelvic drainage is required such as difficult operations or to prevent pelvic hematoma, pelvic drainage other than irrigation-suction should be considered.

The most recent study is published by Tsujinaka et al. [44], who performed a study particularly for pelvic drainage after anterior resection. One hundred and ninety-six patients who underwent elective anterior resection (for rectal cancer) from 2001 to 2006 were included. Pelvic drainage was established in all patients using a silastic drain in a closed, gravitational method. Anastomotic leaks occurred in 21 (10.7 %) patients and changes in drain content suggesting an anastomotic leak were observed in 15 (71.4 %) patients, 11 of whom remained asymptomatic. Anastomotic leaks were resolved by conservative treatment with the existing drain in 10 (47.6 %) patients, and the other 11 (52.4 %) required further surgical interventions. They concluded that pelvic drainage may act as an early detector of anastomotic leaks and reduce the need for reoperation in selected patients undergoing rectal cancer surgery.

Summary of RCTs by level of anastomosis and overall anastomotic dehiscence are tabled in Table 4.

Conclusion

There is strong and sufficient level I evidence to suggest that routine use of prophylactic drainage does not offer any additional benefit after supra-peritoneal colorectal cancer surgery. However, some risk factors justify the selective use of drains when there is an increased risk of postoperative morbidity in certain conditions.

In contrast, there is conflicting data regarding use of drains in infra-peritoneal rectal surgery. So, the use of drains in these circumstances should be decided by patient condition and operative factors and surgeons' preference till the time new evidence comes.

Considering the higher leakage rate of extra-peritoneal anastomoses described in the literature, a randomized controlled trial comparing drainage versus non-drainage for extra-peritoneal anastomoses is suggested.

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