

## Pelvic drain after low anterior resection of the rectum: pros and cons

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### Abstract

Low anterior resection, unlike other large bowel resections with anastomosis, is characterized by a high incidence of postoperative complications, repeated surgical interventions, accompanied by high mortality. To reduce these indicators, the creation of a protective stoma and drainage of the pelvis has become widespread. However, the efficiency of pelvic drainage after low anterior resection remains unclear and controversial. This literature review is devoted to the relevance of the problem of efficiency and analysis of studies on this issue. Most randomized trials have not proven the effectiveness of drainage in colorectal surgery, but in these studies, as a rule, little or no attention was paid to draining the small pelvis after total mesorectal excision. This work analyzes the studies of supporters and opponents of pelvic drainage after low anterior resection of the rectum and provides arguments for and against drainage of the pelvic cavity. Although there are randomized trials showing no benefit of pelvic drainage, many clinics use pelvic drain after low anterior resection. The personal experience of the surgeon and the occurrence of intraoperative complications such as bleeding, contamination, technical difficulties in colorectal anastomosis formation has an important role to play in this. A lower rate of repeated operation in the use of pelvic drainage suggests the possibility of conservative treatment.

**Keywords:** total mesorectal excision, colorectal anastomosis, anastomotic leakage, low anterior resection, pelvic drain.

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**Introduction.** Over the past decades, approaches to the treatment of rectal cancer have changed significantly with the introduction of total mesorectal excision (TME) and neoadjuvant chemoradiation therapy, which contributed to an increase in the proportion of sphincter-preserving surgeries [1–4]. Moreover, many authors noted a high frequency (20%) of postoperative complications, such as failure of sutures of the colorectal anastomosis (FSCA) and purulent-septic complications in the pelvic region [5–7]. In contrast to other colon resections with the formation of an anastomosis, low anterior rectal resection is characterized by a high frequency of postoperative complications, repeated surgical interventions, and high mortality. To reduce these indicators, the formation of preventive intestinal stomas (PIS) and drainage of the small pelvis are widespread [8–11].

The pelvic cavity can be drained in three ways: passive drainage, active drainage, and drainage with irrigation. The first two are most widely used,

while drainage with irrigation is seldom used, as it does not provide satisfactory results [12–14].

According to some authors, pelvic drainage should have three beneficial effects: (1) evacuation of accumulated postoperative fluids (blood, serous fluid, etc.), (2) early detection of FSCA, (3) prevention of repeated surgery due to the timely evacuation of pathological fluids [15]. In the presacral space, which is devoid of the peritoneal cover, fluid absorption and anastomotic healing are known to occur more slowly than in the peritoneal region [12]. However, the question of efficiency of pelvic drainage after low anterior rectal resections remains unclear and controversial [11, 16–23].

**This work aimed** to analyze studies supporting and opposing pelvic drainage after low anterior rectal resection.

**Against drainage of the pelvic cavity.** Most of the randomized studies have not proven the efficiency of drainage in colorectal surgery; however, a few studies have investigated the efficiency

of pelvic drainage after TME [24–31]. Studies that have investigated the efficiency of small pelvic drainage after low anterior resections are presented herein.

Menagem et al. conducted a meta-analysis based on three randomized trials involving 660 patients after low anterior resection (with pelvic drainage,  $n = 330$ ; without drainage,  $n = 330$ ). The overall mortality rate was 0.7% (2/267) in patients with pelvic drainage and 1.9% (5/261) in those without drainage ( $p = 0.900$ ). The incidence of FSCA was 14.8% (49/330) in the group with drainage and 16.7% (55/330) in the group without drainage ( $p = 0.370$ ). The incidence of postoperative parietic intestinal obstruction was significantly higher in patients with drainage than in those without drainage [50/267, 18.7% versus 33/261, 12.6%, odds ratio (OR) 1.61, 95% confidence interval (CI) 1.00–2.60;  $p = 0.050$ ].

The authors concluded that the prophylactic use of pelvic drainage after a low colorectal anastomosis does not affect the incidence of FSCA and postoperative mortality. However, it significantly increases the incidence of postoperative parietic intestinal obstruction. The majority of patients received protection of the anastomosis with PIS formation [32].

In GRECCAR 5, a large randomized study, the treatment outcomes of 469 patients after low anterior rectal resection, namely, 233 patients with pelvic drainage and 236 without it, were analyzed. The incidence of purulent-septic complications in the pelvic region was 17.1% (80/469), almost identical in both groups, namely, 16.1% in patients with drainage versus 18.0% in those without drainage ( $p = 0.580$ ). No differences were found in postoperative surgical complications (18.7% versus 25.3%;  $p = 0.83$ ), frequency of repeated surgeries (16.6% versus 21.0%;  $p = 0.22$ ), duration of hospitalization (12.2 days versus 12.2 days;  $p = 0.99$ ), and frequency of stoma elimination (80.1% versus 77.3%;  $p = 0.53$ ) between the groups. The absence of PIS was the only independent factor in pelvic sepsis (OR 1.757, 95% CI 1.078–2.864;  $p = 0.024$ ). The authors concluded that the use of pelvic drainage after low resection in rectal cancer is not beneficial to the patients [33].

Matsuda et al. examined the efficiency of pelvic drainage in 200 patients after laparoscopic low anterior resection with PIS formation. Pelvic abscesses developed in 14 (12.7%) of 110 patients with pelvic drainage and in 9 (10.0%) of 90 patients without drainage ( $p = 0.548$ ). No differences were also noted in the incidence of FSCA, time to diagnosis of pelvic sepsis, and type of treatment. The authors concluded that the prophylactic use of

pelvic drainage after laparoscopic low anterior rectal resection with PIS formation does not reduce the incidence of pelvic sepsis; thus, regular pelvic drainage is not recommended [34].

In a meta-analysis that included 1803 patients who received surgical treatment of colorectal cancer (low and high anastomoses), Zhang et al. revealed no significant differences in the incidence of FSCA in patients with and without pelvic drainage ( $n = 1803$ , OR 1.14, 95% CI 0.80–1.62;  $p = 0.47$ ). Similar results were obtained among patients with low colorectal anastomoses ( $n = 291$ , OR 0.99, 95% CI 0.54–1.83;  $p = 0.98$ ). In addition, no differences were found in the incidence of clinical and radiological FSCA. The authors also did not reveal significant differences in the incidence of postoperative complications, mortality, and repeated surgeries. According to the authors, prophylactic drainage of the small pelvis is not beneficial to patients with any intraperitoneal anastomosis, including low anastomosis [35].

Table 1 presents randomized studies that did not confirm the efficiency of pelvic cavity drainage [17, 19, 33, 34, 36]. Antagonists of pelvic drainage have reported complications such as intestinal perforation, vascular damage from pressure ulcers or excessive suction when using aspiration drains, creation of potential “entry gates” for infection, damage to organs and blood vessels, and pain during drainage removal [37–40].

**For drainage of the pelvic cavity.** Despite the above convincing results, some studies have supported the need for drainage of the pelvic cavity.

In a large randomized multicenter study, including 924 patients, Peters et al. proved the efficiency of pelvic drainage after anterior rectal resection with TME. In the postoperative period, FSCA was detected in 107 (11.6%) of 924 patients; i.e., a significantly lower incidence of FSCA was noted, with 76 (9.6%) of 792 patients in the group with pelvic drainage, compared with 31 (23.5%) of 132 patients in the group without drainage ( $p < 0.001$ ).

In addition, repeated surgical interventions for FSCA were significantly less frequently needed in patients with pelvic drainage than in those without drainage (56 of 76 versus 30 of 31 patients, respectively;  $p = 0.006$ ). The authors suggested that a large presacral and retrosacral space is formed after TME, where hematoma and/or seroma can develop. This is an excellent environment for infectious agents to spread, penetrate the anastomosis, and cause edge separation; pelvic drainage can prevent this process [11].

In a trial based on the treatment outcomes of 196 patients with drainage of the small pelvis, Tsujinaka et al. concluded that pelvic drainage allows

**Table 1.** General characteristics of the studies.

Indicators	Sagar et al. (1995)		Brown et al. (2001)		Zhang et al (2011)		Denost et al. (2017)		Matsuda et al. (2018)	
	D <sup>+1</sup>	D <sup>-2</sup>	D <sup>+</sup>	D <sup>-</sup>	D <sup>+</sup>	D <sup>-</sup>	D <sup>+</sup>	D <sup>-</sup>	D <sup>+</sup>	D <sup>-</sup>
Patients, n	52	48	31	28	50	50	236	233	110	90
Anastomosis level	Low	Low	Low	Low	Low/high	Low/high	Low	Low	Low	Low
CASF <sup>4</sup> , %	7 (13.5)	5 (10.4)	3 (9.7)	5 (17.8)	2 (4)	1 (2)	38 (16.1)	42 (18)	24 (21.8)	19 (21.1)
Repeated surgeries	1 (1.9)	2 (4.2)	ND	ND	1 (2)	0	39 (16.5)	49 (21)	ND	ND
Prolongation of drainage, days	7	–	3	–	7	–	4	–	3	–
Hospitalization, days	13	11	7	7.5	ND	ND	12.2	12.2	ND	ND

Note: <sup>1</sup>D<sup>+</sup>, patients with pelvic drainage; <sup>2</sup>D<sup>-</sup>, patients without pelvic drainage; <sup>3</sup>ND, no data; <sup>4</sup>CASF, colorectal anastomosis suture failure.

for an earlier diagnosis of FSCA and reduces the incidence of repeated surgical interventions. Of the 21 patients who developed FSCA in the postoperative period, 15 cases were resolved conservatively by prolonging the pelvic drainage for an average of 52 days [15].

Rondelli et al. conducted a meta-analysis of three clinical randomized and five non-randomized studies on the efficiency of pelvic drainage, based on data from 2277 patients. In randomized trials, no difference was found in the incidence of FSCA in patients with and without pelvic drainage (OR 0.98; 95% CI 0.49–1.99;  $I^2 = 0\%$ ). Moreover, a meta-analysis of five other studies (1986 patients) revealed a lower incidence of FSCA in patients with pelvic drainage than in those without drainage (OR 0.42, 95% CI 0.28–0.62;  $I^2 = 3\%$ ). A significantly lower repeated intervention rate was noted in the group with drainage than in the group without drainage (OR 0.29; 95% CI 0.18–0.46;  $I^2 = 0\%$ ).

The authors mentioned that the contradictory data of various studies on drainage efficiency are affected by three factors when analyzing and solving this problem, namely, type of drainage (passive drainage, active drainage, or drainage with irrigation), indications for its installation, and timing of its removal. The choice of each of these factors is often at the discretion of the surgeon; thus, it may differ not only between studies but within the same study population. Accordingly, it is very difficult to achieve homogeneity in this aspect [16].

**Conclusion.** The review of the literature shows that the efficiency of drainage of the pelvic cavity is controversial. The contradictory results of various studies are mainly due to the difficulty of achieving a homogeneous sample in terms of the type and number of drainages, method of their installation, and period of prolongation. In many studies, the drainage was removed on postoperative

days 2–4, while on average, FSCA occurred on day 7. Thus, it is impossible to determine how pelvic drainage would affect further approach, although the authors reported no difference in the frequency of repeated surgeries.

Although some randomized trials did not reveal the benefits of pelvic drainage, many clinics and centers use pelvic drainage after low anterior rectal resection with TME. This is importantly influenced by the surgeon's personal experience and occurrence of intraoperative complications such as bleeding, intraoperative contamination, and technical difficulties in the formation of a colorectal anastomosis and PIS.

The lower repeated surgery rate when using pelvic drains indicates the possibility of conservative treatment (which appears to be preferable to repeated surgical interventions), because effective drainage controls leakage from the anastomosis and promotes healing of the anastomosis. Even if repeated surgery is unavoidable, the installed pelvic drainage enables to delay it.

Currently, the issue of pelvic drainage after low anterior resection with TME has not been resolved.

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## REFERENCES

1. Groningen J.T., Hagen P., Tollenaar R.A., Tuynman J.B., Marang-van de Mheen P.J., Doornebosch P.G., Graaf E.J. Evaluation of a completion total mesorectal excision in patients after local excision of rectal cancer: A word of caution. *J. National Comprehensive Cancer Network*. 2018; 16 (7): 822–828. DOI: 10.6004/jnccn.2018.7026.

2. Baik S.H., Kim N.K., Lim D.R., Hur H., Min B.S., Lee K.Y. Oncologic outcomes and perioperative clinicopathologic results after robot-assisted tumor-specific mesorectal excision for rectal cancer. *Ann. Surg. Oncol.* 2013; 20 (8): 2625–2632. DOI: 10.1245/s10434-013-2895-8.
3. Asli L.M., Johannesen T.B., Myklebust T.A., Moller B., Eriksen M.T., Guren M.G. Preoperative chemoradiotherapy for rectal cancer and impact on outcomes — A population-based study. *Radiotherapy and Oncol.* 2017; 123 (3): 446–453. DOI: 10.1016/j.radonc.2017.04.012.
4. Shin Y.S., Park J.H., Yoon S.M., Kim J.C., Yu C.S., Lim S.B., Choi E.K., Seung D.A., Sang-Wook L., Jong H.K. Total mesorectal excision versus local excision after preoperative chemoradiotherapy in rectal cancer with lymph node metastasis: A propensity score-matched analysis. *Intern. J. Radiation Oncol. Biol. Physics.* 2018; 101 (3): 630–639. DOI: 10.1016/j.ijrobp.2018.02.032.
5. McDermott F.D., Heeney A., Kelly M.E. Systematic review of preoperative, intraoperative and postoperative risk factors for colorectal anastomotic leaks. *Br. J. Surg.* 2015; 102 (5): 462–479. DOI: 10.1002/bjs.9697.
6. Kawada K., Takahashi R., Hida K., Sakai Y. Impact of transanal drainage tube on anastomotic leakage after laparoscopic low anterior resection. *Intern. J. Colorectal Dis.* 2018; 33 (3): 337–340. DOI: 10.1007/s00384-017-2952-z.
7. Hoshino N., Hida K., Sakai Y., Osada S., Idani H., Sato T., Saito N. Nomogram for predicting anastomotic leakage after low anterior resection for rectal cancer. *Intern. J. Colorectal Dis.* 2018; 33 (4): 411–418. DOI: 10.1007/s00384-018-2970-5.
8. Mrak K., Uranitsch S., Pedross F., Heuberger A., Klingler A., Jagoditsch M., Tschmelitsch J. Diverting ileostomy versus no diversion after low anterior resection for rectal cancer: A prospective, randomized, multicenter trial. *Surgery.* 2016; 159 (4): 1129–1139. DOI: 10.1016/j.surg.2015.11.006.
9. Shiomi A., Ito M., Maeda K., Kinugasa Y., Ota M., Yamaue H., Saito N. Effects of a diverting stoma on symptomatic anastomotic leakage after low anterior resection for rectal cancer: A propensity score matching analysis of 1,014 consecutive patients. *J. Am. Coll. Surg.* 2015; 220 (2): 186–194. DOI: 10.1016/j.jamcollsurg.2014.10.017.
10. Anderin K., Gustafsson U.O., Thorell A., Nygren J. The effect of diverting stoma on postoperative morbidity after low anterior resection for rectal cancer in patients treated within an ERAS program. *Eur. J. Surg. Oncol. (EJSO).* 2015; 41 (6): 724–730. DOI: 10.1016/j.ejso.2015.03.234.
11. Peters K.C., Tollenaar R.A., Marijnen C.A., Klein Kranenbarg E., Steup W.H., Wiggers T., Rutten H.J., van de Velde C.J. Dutch Colorectal Cancer G. Risk factors for anastomotic failure after total mesorectal excision of rectal cancer. *Br. J. Surg.* 2005; 92 (2): 211–216. DOI: 10.1002/bjs.4806.
12. Galandiuk S., Fazio V.W. Postoperative irrigation-suction drainage after pelvic colonic surgery. A prospective randomized trial. *Dis. Colon Rectum.* 1991; 34: 223–228. DOI: 10.1007/BF02090161.
13. Guerra F., Giuliani G., Coletta D., Boni M., Rondelli F., Bianchi P.P., Coratti A. A meta-analysis of randomized controlled trials on the use of suction drains following rectal surgery. *Digestive Surg.* 2018; 35: 482–490. DOI: 10.1159/000485139.
14. Numata M., Godai T., Shirai J., Watanabe K., Inagaki D., Hasegawa S., Yukawa N. A prospective randomized controlled trial of subcutaneous passive drainage for the prevention of superficial surgical site infections in open and laparoscopic colorectal surgery. *Intern. J. Colorectal Dis.* 2014; 29 (3): 353–358. DOI: 10.1007/s00384-013-1810-x.
15. Tsujinaka S., Kawamura Y.J., Konishi F., Maeda T., Mizokami K. Pelvic drainage for anterior resection revisited: use of drains in anastomotic leaks. *ANZ J. Surg.* 2008; 78: 461–465. DOI: 10.1111/j.1445-2197.2008.04535.x.
16. Rondelli F., Bugiantella W., Vedovati M.C., Balzarotti R., Avenia N., Mariani E., Agnelli G., Becattini C. To drain or not to drain extraperitoneal colorectal anastomosis? A systematic review and metaanalysis. *Colorectal Dis.* 2013; 16: O35–O42. DOI: 10.1111/codi.12491.
17. Sagar P.M., Hartley M.N., Mcfie J.B., Mancey-Jones P. Sedman, May J. Randomized trial of pelvic drainage after rectal resection. *Dis. Colon Rectum.* 1995; 38: 254–258. DOI: 10.1007/BF02055597.
18. Merad F., Hay J.M., Fingerhut A., Yahchouchi E., Laborde Y., Pélissier E., Msika S., Flamant Y. Is prophylactic pelvic drainage useful after elective rectal or anal anastomosis? A multicenter controlled randomized trial. French Association for Surgical Research. *Surgery.* 1999; 125: 529–535. DOI: 10.1016/S0039-6060(99)70205-9.
19. Brown S.R., Seow-Choen F., Eu K.W., Heah S.M., Tang C.L. A prospective randomized study of drains in infra-peritoneal rectal anastomoses. *Tech. Coloproctol.* 2001; 5: 89–92. DOI: 10.1007/s101510170005.
20. Lohsiriwat V. Pelvic drain after colorectal anastomosis: useful or useless. *Translational Cancer Res.* 2016; 5 (7): 1404–1407. DOI: 10.21037/tcr.2016.12.48.
21. An V., Chandra R., Lawrence M. Anastomotic failure in colorectal surgery: Where are we at? *Indian J. Surg.* 2018; 80 (2): 163–170. DOI: 10.1007/s12262-018-1745-0.
22. Emile S.H., El-Hamed A., Tito M. Routine drainage of colorectal anastomoses: an evidence-based review of the Current literature. *Gastroenterol. Res. Pract.* 2017; 2017: 6253898. DOI: 10.1155/2017/6253898.
23. Jesus E.C., Karliczek A., Matos D., Castro A.A., Atallah A.N. Prophylactic anastomotic drainage for colorectal surgery. *Cochrane Database Syst. Rev.* 2004; (4): CD002100. DOI: 10.1002/14651858.CD002100.pub2.
24. Karliczek A., Jesus E.C., Matos D., Castro A.A., Atallah A.N., Wiggers T. Drainage or nondrainage in elective colorectal anastomosis: A systematic review and meta-analysis. *Colorectal Dis.* 2006; 8: 259–265. DOI: 10.1111/j.1463-1318.2006.00999.x.
25. Petrowsky H., Demartines N., Rousson V., Clavien P.A. Evidence-based value of prophylactic drainage in gastrointestinal surgery: A systematic review and meta-analyses. *Ann. Surg.* 2004; 240: 1074–1084; discussion 1084–1085. DOI: 10.1097/01.sla.0000146149.17411.c5.
26. Podda M., Di Saverio S., Davies R.J., Atzeni J., Balestra F., Viridis F., Reccia I., Jayant K., Agresta F., Pisano A. Prophylactic intra-abdominal drainage following colorectal anastomoses. A systematic review and meta-analysis of randomized controlled trials. *Am. J. Surg.* 2020; 219 (1): 164–174. DOI: 10.1016/j.amjsurg.2019.05.006.
27. Urbach D.R., Kennedy E.D., Cohen M.M. Colon and rectal anastomoses do not require routine drainage: A systematic review and meta-analysis. *Ann. Surg.* 1999; 229: 174–180. DOI: 10.1097/0000658-199902000-00003.
28. Alfonsi P., Slim K., Chauvin M., Mariani P., Faucheron J.L., Fletcher D. French guidelines for enhanced recovery after elective colorectal surgery. *J. Visceral Surg.* 2014; 151 (1): 65–79. DOI: 10.1016/j.jvisurg.2013.10.006.
29. Ishizaki M., Matsui K., Kaibori M. Pros and cons of abdominal drain in digestive surgery. In: *Enhanced recovery after surgery.* 2018; 45–55. DOI: 10.1007/978-981-10-6796-9\_5.
30. Samaiya A. To drain or not to drain after colorectal cancer surgery. *Indian J. Surg.* 2015; 77 (3): 1363–1368. DOI: 10.1007/s12262-015-1259-y.

31. Wang Z., Chen J., Su K., Dong Z. Abdominal drainage versus no drainage post-gastrectomy for gastric cancer. *Cochrane Database Syst. Rev.* 2015; (5): CD008788. DOI: 10.1002/14651858.CD008788.pub3.
32. Menahem B., Vallois A., Alves A., Lubrano J. Prophylactic pelvic drainage after rectal resection with extra-peritoneal anastomosis: is it worthwhile? A meta-analysis of randomized controlled trials. *Intern. J. Colorectal Dis.* 2017; 32 (11): 1531–1538. DOI: 10.1007/s00384-017-2891-2898.
33. Denost Q., Rouanet P., Faucheron J.L., Panis Y., Meunier B., Cotte E., Meurette G., Kirzin S., Sabbagh C., Loriau J., Benoist S., Mariette C., Sielezneff I., Lelong B., Mauvais F., Romain B., Barussaud M.L., Germain C., Picat M.Q., Rullier E., Laurent C.; French Research Group of Rectal Cancer Surgery (GRECCAR). To drain or not to drain infraperitoneal anastomosis after rectal excision for cancer. *Ann. Surg.* 2017; 265 (3): 474–480. DOI: 10.1097/SLA.0000000000001991.
34. Matsuda K., Yokoyama S., Hotta T., Watanabe T., Tamura K., Iwamoto H., Mizumoto Y., Yamaue H. Pelvic drain after laparoscopic low anterior resection for rectal cancer in patients with diverting stoma. *Surg. Laparoscopy, Endoscopy & Percutaneous Techniques.* 2018; 28 (2): 82–85. DOI: 10.1097/SLE.0000000000000517.
35. Zhang H.Y., Zhao C.L., Xie J., Ye Y.W., Sun J.F., Ding Z.H., Ding L. To drain or not to drain in colorectal anastomosis: a meta-analysis. *Intern. J. Colorectal Dis.* 2016; 31 (5): 951–960. DOI: 10.1007/s00384-016-2509-6.
36. Zhang W., Luo B., Pang M.H., Li P. Prophylactic abdominal drainage in patients with colorectal anastomosis: a prospective study. *Chin. J. Dig. Surg.* 2011; 10 (6): 427–429.
37. Moloo H., Etzioni D.A. Intraoperative adjuncts in colorectal surgery. *Surg. Clin. North Am.* 2013; 93: 33–43. DOI: 10.1016/j.suc.2012.09.007.
38. Mujagic E., Zeindler J., Coslovsky M., Hoffmann H., Soysal S.D., Mechera R., Kraus R. The association of surgical drains with surgical site infections — A prospective observational study. *Am. J. Surg.* 2018; 217 (1): 17–23. DOI: 10.1016/j.amjsurg.2018.06.015.
39. Gilbert A., Ortega-Deballon P., Di Giacomo G., Cheynel N., Rat P., Facy O. Intraoperative drains move. *J. Visceral Surg.* 2018; 155 (2): 105–110. DOI: 10.1016/j.jvisc-surg.2017.10.001.
40. Raskin E.R., Madoff R.D. Complications of rectal cancer surgery. In: *Modern management of cancer of the rectum.* 2015; 447–459. DOI 10.1007/978-1-4471-6609-2\_29.