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ORIGINAL ARTICLE

The use of intra-abdominal drain in minimally invasive right colectomy: a propensity score matched analysis on postoperative outcomes

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Abstract

Purpose No evidences supporting or not the use of intra-abdominal drain (AD) in minimally invasive right colectomies have been published. This study aims to assess the outcomes on its use after robotic or laparoscopic right colectomies.

Methods This is a multicenter propensity score matched study including patients who underwent minimally invasive right colectomy with (AD group) or without (no-AD group) the use of AD between February 1, 2007, and January 31, 2018. AD patients were matched to no-AD patients in a 1:1 ratio. Main outcomes were postoperative morbidity and mortality and anastomotic leak.

Results A total of 653 patients were included. Of 149 (22.8%) no-AD patients, 124 could be matched. The rate of postoperative complications (AD $n = 26$, 21% vs. no-AD $n = 26$, 21%; $p = 1.000$), mortality (AD $n = 2$, 1.6% vs. no-AD $n = 1$, 0.8%; $p = 1.000$), anastomotic leak (AD $n = 2$, 1.6% vs. no-AD $n = 5$, 4.0%; $p = 0.453$), and wound infection (AD $n = 9$, 7.3% vs. no-AD $n = 6$, 4.8%; $p = 0.581$) did not significantly differ between the groups. Time to oral feeding was significantly shorter in the no-AD group [2 (1–3) vs. 3 (2–3), $p = 0.0001$]. The median length of hospital stay was 8 (IQR 7–9) in the AD group while it was 6 (IQR 5–9) in the no-AD group ($p = 0.010$).

Conclusions In conclusion, the use of AD after minimally invasive right colectomies has no influence on postoperative morbidity and mortality rates.

Keywords Robotic surgery · Minimally invasive right colectomy · Laparoscopy · Outcomes · Drain · Drainage · ERAS

Introduction

Current Enhanced Recovery After Surgery (ERAS) guidelines do not recommend the use of intra-abdominal drain (AD) after right hemicolectomy [1, 2]. However, there is no recent literature supporting (or not) the use of AD, and the majority of the published studies dealt with its use after colorectal anastomoses.

Furthermore, no reports have evaluated the impact of the use of AD in the minimally invasive surgery era, as most of the papers on this topic were published more than 20 years ago [3–8].

As a possible consequence of this lack of evidence, current studies on AD after either robotic or laparoscopic right colectomies show that several surgeons still routinely place the intra-abdominal drain during these procedures [9–16].

With this paper, we aim to analyze a large series of minimally invasive right hemicolectomies to understand whether the use of the intraabdominal drain could be justified and whether its placement could affect the outcomes.

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Material and methods

This study was conducted according to the Strengthening the Reporting of Cohort Studies in Surgery (STROCSS) [17].

Study design and patients

In this retrospective cohort study, all consecutive patients who underwent minimally invasive right colectomy (robotic or laparoscopic) in three Italian high-volume centers between February 1, 2007, and January 31, 2018, were included. Patients were grouped according to the use of intraabdominal drain: AD or no-AD.

This institutional review board–approved study was conducted in accordance with the ethical standards and with the Helsinki Declaration of 1964 and later versions.

Variables and definitions

Baseline characteristics collected included sex, age, American Society of Anesthesiologists (ASA) score, body mass index (BMI), and indication for surgery (neoplasm vs. benign). Operative variables collected included operative time, type of anastomosis, conversion to open surgery and additional resection. Primary outcomes were the rates of postoperative complications and mortality. Secondary outcomes were the rate of anastomotic leak, abdominal abscess, wound infection, postoperative hemorrhage, and re-admissions within 90 days from discharge. Time to first flatus, time to oral feeding, and length of hospital stay were also recorded. Complications, which were graded as proposed by Clavien et al. [18], were recorded up to 90 days after the procedure. Anastomotic leak, abdominal abscess, wound infection, and postoperative hemorrhage were defined as reported elsewhere [19]. In particular, the anastomotic leak was defined as a defect of the intestinal wall at the anastomotic site at imaging. A Penrose drain was used in all procedure in the AD group.

Matching and statistical analysis

To minimize the impact of treatment allocation bias, patients in AD group were matched to patients in no-AD group using propensity scores. Multivariable logistic regression was performed to estimate the propensity for drain placement for all patients, regardless of the actual treatment received. Propensity scores were based on preoperative (age, sex, BMI, ASA score, and indication for surgery) and operative (type of approach, type of anastomosis, operative time, conversion to open surgery, and additional resection) variables following the principles recommended by Austin et al. [20]. Nearest neighbor matching was performed in a 1:1 ratio without replacement, and a caliper width of 0.2 standard deviation (SD) was specified.

Before matching, continuous variables were presented as median and interquartile (IQR) range and were compared using the Mann-Whitney *U* test. Categorical data were presented as frequencies with percentages and were compared using the chi-square or Fisher's exact test, as appropriate. After matching, the Wilcoxon signed rank test was used to compare continuous data while McNemar's test was used for categorical variables.

Results

Total cohort

A total of 653 patients (504 AD vs 149 no-AD) were included in the study. Patients' preoperative characteristics are shown in Table 1. The two groups significantly differed in terms of sex (female, AD225, 44.8% vs no-AD 82, 55.0%; $p = 0.031$) BMI (≥ 30, AD 50, 9.9% vs no-AD 24, 16.1%; $p = 0.040$) and indication for surgery (neoplasm, AD 427, 84.7 vs no-AD141, 94.6; $p = 0.001$). Operative outcomes are presented in Table 2. The rate of robotic right colectomy (60.4% vs 46.2%, $p = 0.003$) and intracorporeal anastomosis (53.0% vs. 88.6%, $p < 0.0001$) were higher in the AD group. An additional resection was more often performed in the AD group (13.1% vs 8%, $p = 0.008$). Median operative time was significantly longer in AD group [210 (165–270) vs. 180 (149–226), $p < 0.0001$].The drain was kept in place for a median duration of 5 days (IQR 4–6). The diagnosis of anastomotic leak was made after a median of 4 (IQR 4–8.5) days in the AD group versus 5 (IQR 3–5) in the no-AD group ($p = 0.161$). Among those patients who were diagnosed with anastomotic leak, only two cases of in-hospital mortality were recorded in the no-AD group ($p = 0.07$) versus 0 in the AD group. Anastomotic leaks with a Clavien-Dindo grade ≤ 2 were found only in the AD group ($n = 2$, $p = 1.000$).

All postoperative outcomes are shown in Table 3. Median time to first flatus was shorter in no-AD group [2 (2–3) vs. 3 (2–3), $p = 0.0001$]. No-AD was associated with shorter postoperative hospital stay compared with AD [8 (7–10) vs. 6 (5–8) days, $p < 0.0001$].

Matched cohort

After matching, there were no significant differences in the variables included in the propensity score (Tables 1 and 2). Postoperative complications and mortality did not significantly differ between the groups (Table 3). There was a tendency toward significance in the difference in time to first flatus which was shorter in the no-AD group [2 (2–3) vs. 3 (2–3), $p = 0.059$]. Time to oral feeding was significantly shorter in the no-AD group [2 (1–3) vs. 3 (2–3), $p = 0.0001$]. The median length of hospital stay was 8 (IQR 7–9) in the AD group while it was 6 (IQR 5–9) in the no-AD group ($p = 0.010$).

Table 1 Baseline characteristics

Variables *n* (%)		Total cohort			Matched cohort		
		Drain (*n* = 504)	No drain (*n* = 149)	*p*	Drain (*n* = 124)	No drain *n* = 124)	*p*
Age	≥ 65	348 (69.0)	101 (67.8)	0.763	83 (66.9)	85 (68.5)	0.894
	< 65	156 (30.9)	48 (32.2)		41 (33.1)	39 (31.4)	
Sex	F	225 (44.8)	82 (55.0)	0.031	65 (52.4)	66 (53.2)	1.000
	M	279 (55.3)	67 (45.0)		59 (47.6)	58 (46.8)	
BMI	≥ 30	50 (9.9)	24 (16.1)	0.040	13 (10.5)	19 (15.3)	0.362
	< 30	454 (90.1)	125 (83.9)		111 (89.5)	105 (84.7)	
ASA score	> 2	117 (23.2)	30 (20.1)	0.503	23 (18.5)	27 (21.8)	0.644
	≤ 2	387 (76.8)	119 (79.9)		101 (81.4)	97 (78.2)	
Neoplasm	Yes	427 (84.7)	141 (94.6)	0.001	109 (87.9)	116 (93.5)	0.167
	No	77 (15.3)	8 (5.3)		25 (20.7)	8 (6.4)	

Discussion

The use of intraabdominal drain does not affect the rate of postoperative complications and mortality. Similar findings were also found in a 20-year old metanalysis by Urbach et al. [8]. The authors, examining 411 patients (223 drained versus 188 on-drained) from four randomized controlled trial found no differences in mortality, clinical, and radiological leak, wound infections and respiratory complications between the two groups. In 2004, those results were confirmed by a pooled analysis on 1334 patients from seven prospective studies by Petrowski et al. [21]. It must be highlighted that these metanalyses, which are commonly cited as the best available evidences on the use of drain in colorectal surgery, were characterized by cohorts with extremely heterogeneous types of colorectal resections and anastomoses, making their results difficult to interpret. In addition, those studies were performed before the minimally invasive surgery era in colorectal surgery. Our study tried to overcome the biases of the previous reports being the first to investigate on the role of drainage in the homogeneous population of minimally invasive right colectomies.

In the present study, the drain did not prevent/favor the occurrence of an anastomotic leak, and no significant differences were seen between the groups in both the total and the matched cohort. Still, it seems that AD might have a role in the early diagnosis of anastomotic leak: in our study, it was found that patients the AD group were diagnosed with anastomotic leak 1 day earlier than those in the no-AD group. This difference was not significant at statistical analysis, but we believe that this may be found with larger samples. Unfortunately, the largest studies investigating on the risk factors for anastomotic leak following right colectomy [22, 23] did not provide data on the use of drain and on its influence on the severity of the complications. In the present cohort, two anastomotic leaks (the only two with Clavien-Dindo grade below 2) were treated with the AD, and they do not require interventions. Furthermore, we found a trend toward significance the anastomotic leak-related mortality rate between the two groups (AD 0% versus no-AD 33%, $p = 0.07$). In our opinion, these results highlighted the need of additional studies, which deal specifically with minimally invasive right colectomies, to

Table 2 Operative outcomes

Variables		Total cohort			Matched cohort		
		Drain (*n* = 504)	No drain (*n* = 149)	p	Drain (*n* = 124)	No drain (n = 124)	p
Robotic –n- (%)		233 (46.2)	90 (60.4)	0.003	77 (62.1)	82 (66.1)	0.583
Laparoscopic –n- (%)		271 (53.8)	59 (39.6)		47 (37.9)	42 (33.9)	
Operative time (min) – median – (IQR)		210 (165–270)	180 (149–226)	<0.0001	200 (90–425)	200 (90–500)	0.104
Intracorporeal anastomosis –n- (%)	Yes	267 (53.0)	132 (88.6)	<0.0001	103 (83.1)	107 (86.3)	0.388
	No	237 (47.0)	17 (11.4)		21 (16.9)	17 (13.7)	
Conversion to open surgery –n- (%)	Yes	13 (2.6)	3 (2.0)	1.000	2 (1.6)	3 (2.4)	1.000
	No	491 (97.4)	146 (98.0)		122 (98.4)	121 (97.6)	
Additional resection –n- (%)	Yes	66 (13.1)	8 (5.3)	0.008	10 (8.1)	8 (6.4)	0.790
	No	438 (86.9)	141 (94.6)		114 (91.9)	116 (93.5)	
Number of lymph nodes harvested (n) – median – (IQR)		23 (16–29)	23 (16–26)	0.064	21 (16–28)	22 (16–26)	0.517

Table 3 Postoperative outcomes

Variables		Total cohort			Matched cohort		
		Drain (n = 504)	No drain (n = 149)	P	Drain (n = 124)	No drain (n = 124)	p
Postoperative complications –n- (%)	Yes	121 (24.0)	31 (20.8)	0.442	26 (21.0)	26 (21.0)	1.000
	No	383 (76.0)	118 (79.2)		98 (79.0)	98 (79.0)	
Postoperative mortality –n- (%)	Yes	3 (0.6)	2 (1.3)	0.321	2 (1.6)	1 (0.8)	1.000
	No	501 (99.4)	147 (98.7)		122 (98.4)	123 (99.2)	
Postoperative complications Clavien-Dindo>2 –n- (%)	Yes	37 (7.3)	11 (7.4)	1.000	10 (8.1)	9 (7.3)	1.000
	No	467 (92.6)	138 (92.6)		114 (92.9)	115 (92.7)	
Anastomotic leak –n- (%)	Yes	15 (3.0)	6 (4.0)	0.597	2 (1.6)	5 (4.0)	0.453
	No	489 (97.0)	143 (96.0)		122 (98.4)	119 (96.0)	
Wound infection –n- (%)	Yes	47 (9.3)	7 (4.0)	0.089	9 (7.3)	6 (4.8)	0.581
	No	457 (90.7)	142 (95.3)		115 (92.7)	118 (95.2)	
Abdominal abscess –n- (%)	Yes	8 (1.6)	3 (2.0)	0.720	1 (0.8)	2 (1.6)	1.000
	No	496 (98.4)	146 (98.0)		123 (99.2)	122 (98.4)	
Postoperative hemorrhage –n- (%)	Yes	19 (3.7)	11 (7.4)	0.067	4 (3.2)	11 (8.9)	0.092
	No	485 (96.3)	138 (92.6)		120 (96.8)	103 (83.1)	
Re-admissions ≤90 days –n- (%)	Yes	10 (2.0)	1 (0.7)	0.471	2 (1.6)	0 (0)	0.500
	No	494 (98.0)	148 (99.3)		122 (98.4)	124 (100)	
Time to first flatus (days) -median- (IQR)		3 (2–3)	2 (2–3)	0.0001	3 (2–3)	2 (2–3)	0.059
Oral feeding (days) –median- (IQR)		3 (2–4)	2 (1–2.5)	<0.0001	3 (2–3)	2 (1–3)	<0.0001
Hospital stay (days) –median- (IQR)		8 (7–10)	6 (5–8)	<0.0001	8 (7–9)	6 (5–9)	0.010

understand whether patients at high risk of anastomotic leak could benefit from the use of abdominal drain.

It has been reported that the use of drain was a factor associated with a higher rate of wound infections, especially in patients with diabetes [24]. Our results did not show any differences in such a rate between the two groups even in the post-match analysis; however, it must be highlighted that we could not retrieve any details about comorbidities, being the ASA score the sole marker of patients' preoperative conditions.

Time to first flatus, time to oral feeding, and hospital stay, which could have been altered by the type of anastomosis performed [25], were significantly shorter in the no-AD group even in the post-match analysis. These findings might be related to the presence of the abdominal drain; however, it must be considered that those outcomes may have also been influenced by variations in the protocols of postoperative care during the study period. As such, several studies showed that enhanced recovery protocols, which do not recommend the routine use of intraabdominal drain, are significantly correlated with improved outcomes and decreased hospital stay [26]. However, a shorter length of hospital stay in the no-AD group was also found in the studies by Hagmueller et al. (mean AD 14.9 vs no-AD 13.3 days) [3] and Sagar et al. (median 12 versus 13 days) [7], which were published much earlier than the introduction of enhanced recovery protocols. This might suggest that not using the intraabdominal drainage may improve functional outcomes and, thus, shorten the length hospital stay.

This study has a few limitations linked to its retrospective nature. First, we could not retrieve all perioperative data about the risk factors for anastomotic leak, and thus, we could not use them in the calculation of the propensity scores and, consequently, in the matching processes. Similarly, information about blood loss, which is an intraoperative factor affecting the decision of using AD, could not be found and, therefore, post-match grouping might have carried the biases linked to this missing variable. Third, the effect of learning curve was not considered in the analysis, and results should also be interpreted in light of this latter variable. Finally, no details about enhanced recovery protocols were reported, and they could have had an impact on postoperative outcomes.

In conclusion, the use of AD after minimally invasive right colectomies has no influence on postoperative morbidity rate. No-AD patients may have a faster recovery and an earlier hospital discharge.

Authors' contributions All authors contributed to the study conception and design. Data collection was performed by Francesca Pecchini, Giulia Vitali, Andrea Avanzolini, and Paolo Checcacci. Analyses were performed by Leonardo Solaini, Davide Cavaliere, Fouzia Mecheri, Federico Perna, and Alessandro Cucchetti. The first draft of the manuscript was written by Leonardo Solaini, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

This institutional review board–approved study was conducted in accordance with the ethical standards and with the Helsinki Declaration of 1964 and later versions.

This article does not contain any studies with animals performed by any of the authors.

Conflict of interest The authors declare that they have no conflict of interest.

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