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Impact of fast-track care program in laparoscopic rectal cancer surgery: a cohort-comparative study

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Abstract

Background Fast-track care programs after surgery improve recovery and decrease the length of hospital stay and postoperative morbidity in colonic cancer. However, the true impact of these programs on morbidity rates after rectal cancer surgery remains unclear. We aimed to assess the feasibility and impact of the fast-track program on postoperative outcomes after restorative laparoscopic rectal cancer resection and temporary loop ileostomy.

Methods This single-center observational study assessed data of patients undergoing elective rectal cancer surgery during a defined period before (standard group) and after the introduction of a fast-track program (fast-track group) from a prospectively maintained database. The primary endpoint was postoperative 90-day morbidity. Secondary endpoints were 30-day morbidity, fast-track program compliance, length of hospital stay, and readmission rate.

Results Overall, 336 patients ($n=176$, standard group; $n=160$, fast-track group) were assessed; there was no significant between-group difference in the patients' baseline characteristics (age, sex, body mass index, comorbidities, or neoadjuvant treatment). The protocol compliance rate was 91.4% in the fast-track group. The 90-day morbidity and mean total length of hospital stay were significantly lower in the fast-track group than in the standard group (34% vs 49%, respectively, $p<0.01$ and 8.96 days vs 10.2 days, $p<0.01$, respectively). There was no difference in readmission rates. Multivariate analysis revealed the fast-track program to be the only predictive factor of postoperative morbidity.

Conclusion Fast-track programs can be safely implemented following rectal cancer surgery to reduce the overall morbidity rate and length of hospital stay without adversely increasing the readmission rate.

Keywords Enhanced recovery after surgery · Rectal cancer · Compliance

The implementation of the enhanced recovery after surgery (ERAS) program or fast-track (FT) perioperative care program has been a major advance in clinical practice. This multimodal approach promotes postoperative recovery by reducing surgical stress and lead to a reduction in morbidity and, consequently, the length of hospital stay (LOS) in colorectal surgery [1, 2]. Despite the abundant and high-quality literature dedicated to FT care programs in colorectal surgery that have been published in recent years, the feasibility and impact of these programs when applied to rectal cancer excision remain controversial [3]. Indeed, previous studies were often characterized by non-optimal or imprecise adherence to the FT care program, and most studies grouped rectal resections with colonic resections in the overall analysis of the FT protocol [4–7] or secondarily treated patients undergoing rectal resection as a subgroup [8, 9]; these factors have precluded any conclusions with regard to these patients.

Rectal resections are associated with a higher rate of complications, longer LOS, and specific complications than colonic resection [10]. In particular, a temporary ileostomy is recommended for all infra-peritoneal anastomosis, which subsequently leads to specific complications [11]. Moreover, pelvic sepsis or bleeding and urinary retention are common sequelae of rectal resections. Therefore, pelvic drainage is frequently used, and the urinary catheter will need to be maintained in situ for several days. These two measures go against the principles of the FT care programs which advocate the avoidance or early removal of any catheter in

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order to reduce surgical stress. To delineate those differences, distinguished recommendations have been established with regard to the ERAS colon and rectum protocol [12, 13]. Therefore, the outcomes with these specific recommendations for rectal surgery must be evaluated in specific studies.

The aim of this study was to specifically assess the impact of the FT care program on patients who were undergoing restorative rectal cancer surgery with total mesorectal excision (TME) and loop ileostomy. The primary objective was to determine the 90-day postoperative morbidity; the secondary objective was to determine the 30-day morbidity, total LOS, rate of readmission, and compliance with the FT care program.

Materials and methods

Study design

This retrospective, observational cohort study evaluated data from a prospectively maintained institutional database to identify patients with rectal cancer who underwent surgical treatment.

Patients

We screened 450 patients who underwent laparoscopic rectal cancer surgery with infra-peritoneal colorectal or coloanal anastomosis as treatment for mid- and low rectal cancer (< 10 cm from the anal verge) between January 2014 and December 2019. At our institution, a systematic loop ileostomy is required for restorative TME. We excluded patients who needed emergency surgery and were scheduled for total proctocolectomy, abdominoperineal excision, or extended resection for T4 tumor or recurrent disease. However, age, comorbidity, and frailty were not included in the exclusion criteria. A total of 336 consecutive patients underwent elective restorative rectal cancer resection at the Institut Paoli-Calmettes during the study period and were included in the final analysis dataset.

The type of care was not randomly allocated. A standardized enhanced recovery protocol for mini-invasive rectal resection was implemented at our institution in January 2017 and applied systematically thereafter (160 patients; FT group). Standard care was delivered from January 2014 to December 2016 (176 patients; standard group). The institutional criteria for the indications for medical oncological adjuvant treatment remained unaltered during the entire study period. Informed consent was preoperatively obtained from all patients. This study was conducted in accordance with the most recent version of the Declaration of Helsinki, and the study protocol was approved by the Institutional ethics committee of the Paoli-Calmettes Institute (NCT02869503).

Outcomes

The primary study endpoint was 90-day postoperative morbidity. Complications were graded in accordance with the Clavien–Dindo classification [14]. The secondary endpoints included 30-day postoperative morbidity, FT care program compliance, the total LOS, and the readmission rate.

Data collection and follow-up

The preoperative parameters (age, sex, body mass index [BMI], American Society of Anesthesiologists (ASA) score, comorbidities, and history of abdominal surgery), intraoperative data (main procedure, laparoscopic or robotic approach, duration, and combined procedures), and postoperative parameters until postoperative day 90 were prospectively recorded for the FT group and retrospectively determined from the electronic health records for the standard group.

The nutritional status was assessed from the estimated weight loss and BMI calculation. A patient was considered malnourished if they presented with a BMI ≤ 21 kg/m^2 or a recent weight loss of more than 10% of body weight. Stoma-related complications included mechanical bowel obstruction directly caused by stoma creation (defined by findings on imaging of a transitional zone between the flat and dilated small intestine immediately above the ileostomy), prolapse, invagination, abscess, and electrolyte imbalances. Anastomosis complications included bleeding, dehiscence, and leakage. Postoperative ileus (POI) was diagnosed by the appearance of the following clinical signs from the second postoperative day: nausea/vomiting, inability to tolerate solid food, no passage of gas or stool for 24 h, and abdominal distension.

After hospital discharge, the FT patients were required to maintain a diary with daily entries in coordination with their home nurse to record all signs that were potentially indicative of a postoperative complication and the diary contained a dedicated emergency telephone number for the hospital. Moreover, the hospital nurse coordinator organized telephone interviews on days 1, 7, and 30 after discharge to record all medical problems and to ensure patient satisfaction with the return to their home and the nursing care. Weekly laboratory investigations were conducted to assess the ionic tolerance of the ileostomy. The standard group only received emergency telephone numbers. Both of the study groups underwent medical assessment and follow-up at 7 to 10 days and 90 days after discharge. We considered any hospitalization within 30 days from a previous discharge as a readmission. The total LOS included the initial LOS after surgery and the LOS upon readmission.

Enhanced recovery after surgery protocol

A year after the implementation of a post-colon cancer surgery FT care program, the institutional multidisciplinary committee, including surgeons, anesthetists, nursing staff, and dieticians, met to develop a new protocol after rectal cancer surgery. This standardized clinical algorithm included 22 perioperative standard care elements in accordance with the ERAS guidelines (Table 1) [13]. The overall compliance to each item was assessed and expressed as a percentage. Good compliance was defined as a ≥ 80% score per criterion and/or per patient.

Discharge was considered from Postoperative Day 4, if deemed clinically safe and was approved by the patient. The discharge criteria were similar for both study groups: adequate pain control with non-opioid oral analgesics, normal food intake, no signs of infection (no fever, normal or decreasing white blood cell count, no tachycardia > 120/min), and return to the preoperative mobility level.

For the stoma, we standardized patient education before and during hospitalization as well as specific discharge criteria as follows: proper functioning of the ileostomy and learning to properly care for the stoma and to ensure that the pouching system was correctly fitted. Each patient had to empty the pouch three times on their own before they were discharged, as previously recommended [15].

Statistical analysis

All statistical analyses were performed at the significance level $\alpha = 0.05$ using the SPSS® version 25 software (SPSS, Inc., Chicago, IL). Data were summarized for categorical variables as frequencies (%) after analysis by the Fisher exact test. Data were expressed as means ± standard deviations (SD), medians, and ranges and compared with the Mann–Whitney *U* test. Multivariate Cox models were developed and included age, ASA score, malnutrition, preoperative CRT, and sex as independent covariates. The associated hazard ratios (HR) were estimated with Wald's bilateral

Table 1 ERAS protocol and compliance

	Standard group ($n = 176$)		FT group ($n = 160$)		*p* Value
	N	%	*N*	%	
Compliance with ERAS protocol					
Median number of item/patient	11	(7–14)	20	(18–22)	< 0.001
Rate	48	(33–64)	91	(84–99)	
Specific information	2	1.2	156	98	< 0.001
Immunonutrition	176	100	160	100	< 0.001
No premedication	52	30	142	89	< 0.001
Limited fasting	71	40	158	99	< 0.001
Carbohydrate loading	18	10	154	96	< 0.001
Mini-invasive procedure	176	100	160	100	1
Antibiotic prophylaxis	176	100	160	100	1
Corticosteroid	60	34	160	100	< 0.001
IV Lidocaine or epidural	58	33	160	100	< 0.001
TAP block	94	53	151	94	< 0.001
Zero fluid balanced	15	8.5	140	88	< 0.001
PONV prophylaxis	75	43	144	90	< 0.001
Prevention of hypothermia	176	100	160	100	1
Preventive opioid-sparing Per os multimodal analgesia	107	61	158	99	< 0.001
Early removal of urinary drainage	91	52	132	82	< 0.001
Early discontinuation of IV fluid infusion	15	8.5	123	77	< 0.001
TED prophylaxis	176	100	160	100	1
Early mobilization out of bed on POD 1	115	65	157	98	< 0.001
Chewing gum	58	33	155	97	< 0.001
Early removal of pelvic drainage	17	9.7	51	32	< 0.001
Free diet on POD 1	40	23	144	90	< 0.001
Avoidance of nasogastric tube	175	99	158	98.75	1

PONV postoperative nausea and vomiting

confidence intervals. There were no missing data and no patients were lost to follow-up within 90 days of surgery.

Results

Patient characteristics

As shown in Table 2, there were no statistically significant differences between the study groups with regard to age, sex, BMI, comorbidities, or neoadjuvant treatment. Most of the patients underwent a transabdominal laparoscopic or robotic approach with stapled anastomosis. For lower-third locations, transanal endoscopic TME and coloanal anastomosis were used. There were no significant differences in the type of surgical approach between the two study groups. The operative time was significantly lower in the FT group (359 min vs 389 min, $p < 0.01$). A supplementary table summarizes oncological data in the 2 groups.

Table 2 Demographic and clinical data

	Standard group ($n = 176$)		FT group ($n = 160$)		p Value
	N	%	*N*	%	
Gender					
Male	118	67.0	108	67.5	0.9
Female	58	33.0	52	32.5	
Age (years)*	64.9	(28.0–92.0)	63.6	(31–95.0)	0.22
ASA score					
1–2	150	85	132	83	0.79
3–4	26	15	28	18	
Comorbidity					
Heart disease	84	49.4	62	38.8	0.1
Vascular	16	9.1	15	9.4	1
Respiratory	35	19.9	45	28.1	0.09
Diabetes	22	12	15	9.4	0.39
BMI (kg/m^2)*	25.3	(17–35)	24.9	(15–40)	0.36
Malnutrition	20	11.4	28	17.5	0.12
Previous abdominal surgery	84	48	63	39	0.12
Surgical approach					0.49
Robotic	48	27.3	49	30.6	
Laparoscopy	95	54	82	51.3	
TaTME	33	18.7	29	18.1	
Anastomosis technique					
Stappled	117	66.5	109	68.1	0.81
Hand-sewn	59	33.5	51	31.9	
Operative time (min)*	385	(287–483)	359	(280–438)	< 0.01
Conversion to open	9	5.1	4	2.5	0.21
30-D postoperative morbidity	84	47.7	51	31.8	< 0.01
90-D postoperative morbidity	96	54.5	61	38.1	< 0.01
Clavien–Dindo I	51	29	35	22	
Clavien–Dindo II	15	8.5	10	6.2	
Clavien–Dindo III	14	8	16	10	
Clavien–Dindo IV	16	9.1	0	0	
Primary LOS (days)*	10.2	(6–40)	8.96	(4–32)	0.01
Total LOS (days)*	11.2	(6–40)	9.76	(4–42)	0.015
Reoperation	14	8	12	7.5	0.86
Readmission	16	8.5	14	8.8	0.21
Non-scheduled consultation	8	4.6	3	1.9	0.17
Stoma closure delay (days)*	92.8	(9–422)	75.6	(6–322)	0.02

ASA American Society of Anesthesiologists; *BMI* body mass index, *TaTME* transanal endoscopic total mesorectal excision; *LOS* length of stay

*Expressed as median (range)

Outcomes

A significant decrease in the overall complication rate in the FT group was observed (33.8% vs 48.9%, $p < 0.01$) up to 90 days after discharge (Table 3). The significant decrease in global morbidity is mirrored by the decrease in both severe and non-severe complications, as described in Table 3. The rate of anastomosis complications was lower in the FT group (6.2% vs 13.1%, $p = 0.04$), with a shorter delay to stoma closure (92.8 days vs 75.6 days, $p = 0.02$). Excluding stoma-related obstruction, there were no statistically significant differences in the incidence of POI (11.4% in the standard group vs 15% in the FT group, $p = 0.32$). No differences were found in the urinary complication rate between the two groups.

Based on the multivariate analysis in the entire population, the only predictive factor of postoperative morbidity was the FT care program (Table 4).

Length of hospital stay

The LOS was significantly shorter in the FT group. The mean primary LOS decreased from 10.2 days in the standard group to 8.96 in the FT group ($p = 0.01$). In addition, the mean total LOS decreased from 11.2 days in the standard group to 9.8 days in the FT group ($p < 0.015$). There were no differences in the non-scheduled consultation and readmission rates between the two study groups.

Protocol compliance

The overall compliance rate in the FT group was 94%. The compliance rate in the standard group, as recorded from the retrospective data, was 48%. The items of the new program are described in Table 1. The target of 80% was reached for all protocol items, with the exception of early termination of intravenous therapy and pelvic drainage.

Discussion

The present study demonstrates that FT care program implementation after surgery for rectal cancer is a feasible and safe therapeutic option, even when it requires diverting stoma. We observed an overall decrease in the morbidity rate and LOS, without an increase in the readmission rate. The literature on the implementation of FT care programs in rectal surgery is limited, as the published studies include both rectal and colonic surgery cases. The studies that have assessed a rehabilitation program for rectal surgery alone were small, retrospective, case series, and two randomized studies, although none of their results allowed any formal and definitive conclusions [16, 17].

Feng et al. reported a significant decrease in the postoperative LOS and overall morbidity rate in the FT group, but the patient selection was tightly controlled in order to only include patients without a temporary stoma [16]. Similarly, small, retrospective case series have suggested a reduction of LOS by 3–4 days, with no impact on morbidity after rectal cancer surgery [7, 18–20]. These studies included patients who underwent an abdominoperineal excision [3, 18–20]. Huibers et al. [18] reported that abdominoperineal excision was not an independent predictor of prolonged LOS on multivariate analysis, although this was likely attributable to the small population. Given that the flap closure and perineal healing can slow mobilization and necessitate prolonged urinary and abdominal drainage, we recommend that abdominoperineal excision should be assessed separately. Furthermore, the studies included heterogeneous groups of patients undergoing open or laparoscopic surgery and 30–80% of patients had an ileostomy, thereby creating a potential bias [7, 18–20].

Indeed, a stoma requires additional postoperative care and can be a factor that prevents early discharge and acts as a source of postoperative complications. This study included a wider range of patients without medical exclusion criteria, and we conducted a systematic ileostomy for any extraperitoneal anastomosis, which enabled us to evaluate the most homogeneous population for perioperative care. Finally, the only study that included only patients who required a defunctioning ileostomy described a significant increase in postoperative morbidity during the rehabilitation and this was directly related to an increased rate of POI and acute urinary retention [17]. The authors concluded that these two specific complications represent an obstacle to the implementation of a fast-track protocol after rectal surgery. Nonetheless, the protocol used in this study does not include a large number of ERAS recommendations, such as limited fasting, opioid-sparing multimodal analgesia, optimal fluid balance, or nausea prevention. Moreover, the authors did not specify either protocol compliance or their definition of ileus.

In fact, no study has specified a compliance rate with their established protocol. The present study is the first to describe not only the overall protocol compliance but also the feasibility of each of its items. We describe a median conformance of 91% per patient in this study. This high conformance emphasizes the strength of the present study to assess the impact of the FT care program on patient outcomes after rectal cancer surgery in comparison to previous retrospective observational studies [7, 18]. An FT care program had already been implemented in the study center for 1 year after that for colon cancer surgery, with a significant impact on recovery [21]; this limited the learning curve and facilitated

Table 3 Postoperative morbidity

	Standard group ($n=176$)		FT group ($n=160$)		p Value
	N	%	*N*	%	
Clavien I–II	58	32.9	38	23.75	0.07
Stoma-related morbidity	17	9.7	5	3.1	0.02
Mechanic intestinal obstruction	2	1.1	0		
Renal failure or ionic disturbance	11	6.2	4	2.5	
Other: Ostomy system dysfunction	2	1.1	1	0.6	
Prolapse	2	1.1	0		
Anastomosis morbidity	6	3.4	3	1.9	0.5
Bleeding	3	1.7	1	0.6	
Fistula/pelvic abscess	3	1.7	2	1.2	
Paralytic ileus	33	18.75	24	15	0.38
Positioning-related morbidity	6	3.4	2	1.25	0.28
Rhabdomyolysis	2	1.1	2	1.25	
Paresthesia/brachial plexus	4	2.3	0	0	
Urinary complications	18	10.2	8	5.6	0.12
AUR	13	7.4	6	3.75	
UTI	10	6.3	4	2.5	
Macroscopic hematuria	2	1.1	0		
Cardiovascular	8	4.5	1	0.6	0.04
Cardiac decompensation	3	1.7	0		
Atrial fibrillation	5	2.8	1	0.6	
Pulmonary	4	2.3	3	1.9	1
COPD decompensation	1	0.6	0		
Pneumonia/Atelectasis	1	0.6	2	1.25	
DVT/embolus	2	1.1	1	0.6	
Other					
Transfusion	4	2.3	1	0.6	
Lymphangitis/CVC infection	3	1.7	1	0.6	
Isolated fever	1	0.6	3	1.9	
Anal pain	3	1.7	1	0.6	
Delirium	3	1.7	0		
Uncontrolled diabetes	1	0.6	0		
Wound infection	3	1.7	1	0.6	
Chyloperitoneum	1	0.6	0		
Clavien III–IV	28	15.9	16	10	0.14
Stoma-related morbidity					
Mechanic intestinal obstruction	6	3.4	1	0.6	0.12
Anastomosis morbidity	17	1.1	7	4.4	0.09
Bleeding	2	9.7	1	0.6	
Fistula/pelvic abscess	15	8.5	6	3.75	

Table 3 (Continued)

	Standard group ($n=176$)		FT group ($n=160$)		p Value
	N	%	*N*	%	
Other					
Deep hemorrhage	2		3		
Bladder injury	1	1.1	0	1.9	
Intestinal volvulus	1	0.6	3	1.9	
Small intestine injury	0	0.6	1	0.6	
Wound abscess	0	0.6	1	0.6	
DVT/embolus	1		0		

AUR acute urinary retention; *UTI* urinary tract infection; *COPD* chronic obstructive pulmonary disease; *DVT* deep vein thrombosis; *CVC* central venous catheter

Table 4 Multivariate analysis of clinicopathological factors associated with postoperative morbidity

Variables	OR	p Value
ERAS protocol	0.52 [0.33–0.81]	< 0.01
Age	0.99 [0.98–1.02]	0.86
ASA score	1.67 [0.89–3.17]	0.11
Malnutrition	1.37 [0.71–2.64]	0.34
Preoperative CRT	0.97 [0.61–1.51]	0.88
Sex	1.48 [0.91–2.44]	0.12
Tobacco	1.06 [0.67–1.69]	0.80
Surgical approach	0.88 [0.54–1.43]	0.62

ASA American Society of Anaesthesiologists; *BMI* body mass index; *CRT* chemoradiation

the achievement of optimal compliance very quickly. As suggested by Gustafson et al. [22], we believe that optimal compliance enabled, for the first time, the observation of a significant decrease in overall morbidity (54 vs 39.4%, $p<0.01$) after rectal cancer surgery in patients who required an ileostomy.

The morbidity rate appears high in the standard group, although it is in agreement with the rates reported in previous studies [18–20]. We postoperatively recorded any adverse event until 90 days (in case of readmission and systematic follow-up for outpatient evaluation) and observed a decrease in both severe and non-severe morbidity rates. Remarkably, we observed a decrease in anastomotic morbidity (13% in the standard group vs 6.2% in the FT group, $p=0.04$). The non-significant decrease in the number of anastomotic bleeds in the FT group (2 patients vs 5 patients) is probably explained by the lower rate of patients on antiplatelet agents and/or anticoagulants in the FT group (14% vs 22%, p 0.09). For anastomotic fistulas, all surgical procedures were performed by surgeons experienced in laparoscopic and robotic colorectal surgery, thereby eliminating the effects of a learning curve. No changes in surgical technique were observed between the 2 groups, including no ICG testing. Both of the study groups were comparable with regard to comorbidities, preoperative treatment, or nutritional status. It can be assumed that the standardization of the care pathway associated with increased information and involvement of the patient in their care has led to better detection of risk factors for poor healing and better care from the preoperative phase (smoking cessation, physical preparation, cardiological assessment, and geriatric assessment). Another possible explanation was reported by a Chinese-randomized study, which found similar results as in this study with regard to a significant decrease in anastomotic complications in the fast-track group than in the conventional group after colorectal surgery [23]. Those authors suggested that nutritional support (limited fasting, carbohydrates, and early feeding) contributed to improved rehabilitative effects because of improved immune function and homeostasis. However, specifically designed studies are needed to validate this hypothesis. Nonetheless, early feeding did not lead to an increase in the POI rate in the present study (18.75% vs 15% in the standard and FT group, respectively, $p=0.38$). In this analysis, we separated mechanical and functional occlusions, which represent two very distinct issues. The mechanical obstruction rate was significantly lower in the FT group (4.5% vs 0.6%, $p=0.04$) and more generally involved stoma-related complications (3.7% vs 13.1%, $p=0.03$).

In line with ERAS principles, we reconsidered old paradigms and adopted new ideas in order to minimize stoma-related complications. Therefore, we stopped using stoma rods to prevent the retraction of loop stomas into the abdominal cavity. As suggested by Mohan et al. [24], there were no ostomy retractions, and we observed a significant decrease in mechanical occlusions. The absence of rods simplified ostomy care and accelerated patient autonomy. Furthermore, there were no electrolyte imbalances despite the early discontinuation of intravenous (IV) fluid infusion. However, early discontinuation of IV fluid infusion was achieved in only 77% of cases, mainly due to stoma dysfunction.

The second item that was improperly applied was short surgical drainage. We based our protocol on the GRECCAR 5 study data [25]. We considered that the only advantage of pelvic drainage was the prevention of a postoperative hematoma. Therefore, drain removal on the second postoperative day in the absence of bleeding was included in the new protocol, but this measure was only applied in 32% of the patients. This change in practice has been considerably more difficult for surgeons than relinquishing the stoma rod, because of the theoretical risk for postoperative fluid collection due to the large empty space that remains after TME that lacks a peritoneal surface as well as the fact that the edema of pelvic tissues after preoperative radiotherapy can lead to potential contamination and pelvic abscess formation. There is, however, no evidence to support this theory. The drainage time was significantly shorter in the FT group (5.0 vs 6.2 days, $p < 0.01$), without an increase in the anastomotic complications (5.0% vs 5.6%, $p = 1$), and compliance nearly doubled in the second part of the protocol implementation (41.2 vs 22.5%). These findings are encouraging although the data are insufficient for appropriate validation.

This study had some limitations. First, it was not a randomized study and, instead, was a retrospective comparative study. However, the compared group included consecutive cohorts of homogeneous patients, in terms of clinical characteristics and the surgical treatment, in order to limit the confounding factors. The implementation of the ERAS protocol required a radical change in institutional care practices. Therefore, it would have been very difficult or impossible to manage patient care in accordance with the two different protocols during the same period.

Second, this was a single-center study. The implementation of an ERAS program means the standardization of practices and requires significant compliance in terms of workforce and resource allocation. We believe that this process would not be an easy task within the same team. In a multicenter study, the imposition of the same protocol in several teams and several institutions despite different organizational issues and cultural barriers increased the risk of protocol deviations and led to lower compliance. The optimal compliance and a homogeneous study population facilitated the identification of significant data and definitive findings for the efficacy of the FT care program in patients who underwent surgery for rectal cancer.

Conclusion

The present study indicates that the FT care program reduced the overall morbidity rate and the length of hospital stay without adversely increasing the readmission rate in patients undergoing restorative rectal cancer surgery with a diverting stoma. FT care program is a safe and efficient perioperative care management and should be considered as the standard care in this indication.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00464-021-08811-5.

Declarations

Disclosures Hélène Meillat, Victor Serenon, Clément Brun, Cécile de Chaisemartin, Marion Faucher, and Bernard Lelong have no conflict of interest or financial ties to disclose.

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