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ORIGINAL ARTICLE

Ileostomy versus colostomy: impact on functional outcomes after total mesorectal excision for rectal cancer

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Abstract

Aim: Even if a defunctioning stoma mitigates the serious consequences of anastomotic leakage after total mesorectal excision (TME) for rectal cancer, the presence of a temporary stoma or having a stoma for a prolonged period of time may also be a determining factor for further morbidities and poor bowel function. The aim of this study was to evaluate the impact of diverting stomas on clinical and functional outcomes after TME, comparing ileostomy or colostomy effects.

Methods: All consecutive patients who underwent TME for rectal cancer between March 2017 and December 2020 in three Italian referral centres were enrolled in the present study. For every patient sex, age, stage of the tumour, neoadjuvant therapy, surgical technique, anastomotic technique, the presence of a diverting stoma, perioperative complications and functional postoperative status were recorded. Considering the diverting stoma, the kind of stoma, length of time before closure and stoma related complications were evaluated.

Results: During the study period 416 consecutive patients (63% men) were included. Preoperative neoadjuvant therapy was performed in 79%. A minimally invasive approach was performed in >95% of patients. Temporary stoma was performed during the operation in 387 patients (93%) (ileostomy 71%, colostomy 21%). The stoma was closed in 84% of patients. The median time from surgery to stoma closure was 145 days. No difference was found between ileostomy and colostomy in overall morbidity after stoma creation and closure. Moreover, increased postoperative functional disturbance seemed to be significantly proportional to the attending time for closure for ileostomy.

Conclusion: The presence of a defunctioning stoma seems to have a negative impact on functional bowel activity, especially for delayed closure for ileostomy. This should be considered when the kind of stoma (ileostomy vs. colostomy) is selected for each patient.

KEYWORDS
Anterior resection, Colostomy, LARS, Low anterior resection syndome, Ileostomy, totan mesorectal excision

BACKGROUND

Low anterior resection with total mesorectal excision (TME) is the currently accepted standard surgical technique for middle and lower rectal cancers. Recent advances in surgical techniques and neoadjuvant therapy have reduced the tumour recurrence rate after resection and, at the same time, provided a better chance to preserve the anal canal and the sphincters in lower rectal tumours. However, there is a growing awareness that anatomical preservation of the sphincter does not always mean preservation of anorectal function [1]. In fact, patients having sphincter-preserving operations may experience relevant functional symptoms affecting their quality of life, and the question of whether quality of life is better for patients after anterior resection or after abdominoperineal excision/Hartmann operation with permanent stoma has yet to be answered [2]. Furthermore, to improve the chances of undergoing safe sphincter-saving procedures and to avoid or mitigate anastomotic complications a protective diverting stoma is often necessary, especially in the case of a very low tumour, advanced tumour or previous radiotherapy [3].

Unfortunately, the presence of an ileostomy, beside neoadjuvant therapy, low tumour height and anastomotic leak, has proven to be a risk factor for the development of low anterior resection syndrome (LARS) [4, 5]. Moreover, even if ileostomy is commonly used for defunctioning a colorectal anastomosis, its superiority over colostomy remains controversial [6] and rarely explored from a functional point of view or from a patient's quality of life impact or functional status outcome. Therefore, the aim of this study was to evaluate the impact of a diverting stoma on functional outcomes after TME for rectal cancer, comparing ileostomy or colostomy effects.

What does this paper add to the literature?

This is the first paper that compares functional results of colostomy and ileostomy after low anterior resection. These results may help in choosing the best solution for every single patient after anterior resection.

MATERIALS AND METHODS

All the consecutive patients with middle (5–10 cm) and low (<5 cm) rectal cancer who underwent TME between March 2017 and December 2020 in three Italian referral centres for rectal cancer (Careggi University Hospital, Florence; Cisanello University Hospital, Pisa; University of Campania 'Luigi Vanvitelli', Naples) were prospectively enrolled in a database and retrospectively evaluated in the present study.

Patients were excluded in the case of partial mesorectal excision, colonic resection, not oncological diseases, abdominoperineal resection, Hartmann procedure or emergency surgery. For every patient sex, age, stage of the tumour, neoadjuvant therapy, surgical technique (open, laparoscopic, robotic), anastomotic technique, the presence of a diverting stoma and perioperative complications were recorded.

Total mesorectal excision was considered as the complete removal of the rectum, together with the surrounding lymphovascular fatty tissue (mesorectum), by dissection along the visceral pelvic fascia and the level of anastomosis about 5 cm or less from the dentate line.

The height of the tumour from the anorectal junction was assessed by digital rectal examination and rigid proctosigmoidoscopy. Moreover, thorax and abdomen computed tomography scan and pelvic magnetic resonance imaging (MRI) and/or endoscopic ultrasound (EUS) were performed for staging. The cancer stage was defined according to the American Joint Commission on Cancer Tumour Node Metastasis classification system.

Neoadjuvant radiochemotherapy was performed in Stage II (T3–4, node-negative disease with tumour penetration through the muscle wall) or Stage III (node-positive disease without distant metastasis) rectal cancer. A neoadjuvant protocol was routinely followed: radiotherapy was given of 1.8–2 Gy daily in 25–28 fractions for at least 5 weeks to reach 45 Gy plus a 9 Gy boost in some patients; chemotherapy was given with continuous intravenous infusion of 5-fluorouracil (200–225 mg/m^2/day) 5 days a week. After at least 6 weeks from the end of the treatment, a local restaging with MRI or EUS was performed; after at least 8 weeks patients underwent surgery.

Colostomy (transverse colostomy) or ileostomy was performed according to the local routine or surgeon's preference. In selected patients no stoma or a ghost ileostomy was performed. Patients were considered for no stoma/ghost ileostomy for body mass index <25, age <70, no severe comorbidities (American Society of Anesthesiologists [ASA] score <3), no ultra low rectal cancer requiring intersphincteric resection or coloanal anastomosis, no previous neoadjuvant radiotherapy, complete staple ring and negative hydropneumatic test (no bubbles) during intra-operative evaluation.

Considering a diverting stoma, the type of stoma, length of time before closure and stoma related complications (stoma prolapse, skin peristomal lesions, dehydration, parastomal hernia, surgical wound infection after stoma closure, incisional hernia) were evaluated. The need for conversion of a ghost ileostomy to diverting ileostomy due to anastomotic leak was also recorded.

After surgery all the patients underwent an internal protocol of prevention of LARS. All patients at the time of discharge were provided with educational and informative material regarding potential postoperative functional disturbances and were trained for pelvic floor muscle exercises (Kegel exercises). For each patient with a diverting stoma (ileostomy or colostomy) the integrity of the anastomosis was documented by endoscopy or barium enema within 30 days from the surgery.

Between 30 and 60 days after surgery (if no stoma) or after the stoma closure and after 12 months all patients underwent a clinical and functional evaluation with LARS score. All patient data were updated during the study period by structured telephone interview if necessary.

The LARS score is a validated questionnaire that assesses five issues: incontinence for flatus, incontinence for liquid stools, frequency, clustering (the number of times the patient has a bowel movement within 1 h from the last bowel movement) and urgency. The total scores are used to place patients in one of three categories: no LARS (0–20), minor LARS (21–29) and major LARS (30–42) [7].

Statistical analysis

Data were prospectively recorded in a dedicated database; all patients gave written informed consent. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS 17). Quantitative data were given as median (range). Comparisons of categorical variables were performed using the chi-squared test. Comparisons between two groups were analysed according to the Mann–Whitney *U* test. For comparison of more than two groups, the Kruskal–Wallis one-way ANOVA test was used. A difference was considered statistically significant for *p* values <0.05.

RESULTS

During the study period 416 consecutive patients underwent TME for rectal cancer and were included in the present study for analysis (Table 1).

Of these, 262 were men (63%). The mean age of the patients was 67 years. Preoperative neoadjuvant therapy was performed in 329 patients (79%). Surgery was performed laparoscopically in 207 (50%) patients, robot-assisted in 196 patients (45%) and with open laparotomy in 13 patients (four early conversion to open surgery for adhesions). Anastomosis was performed mechanically with a stapler according to the Knight–Griffen technique in 344 cases (82.5%) and coloanal anastomosis in 72 cases.

A diverting stoma was performed in 387 patients (93%). Ileostomy was performed in 298 patients (71%) and colostomy in 89 (21%). In 29 cases (7%) no stoma or ghost ileostomy (17 patients) was performed. In these patients, 5 (17%) stomas were further performed for anastomotic leakage or other complications during hospitalization (four ghost ileostomies opened and one colostomy). Of 392 patients with a potentially reversible stoma, after a mean follow-up time of 32 months, 329 (84%) were closed (251 ileostomy and 78 colostomy). No statistically significant difference was found in the closure ratio between ileostomy and colostomy ($p = 0.05$).

TABLE 1 Participant and treatment characteristics.

	No stoma	Ileostomy	Colostomy	Total
	29 (7%)	298 (71%)	89 (21%)	416
Male	22 (76%)	193 (65%)	47 (53%)	262 (63%)
Female	7 (24%)	105 (35%)	42 (47%)	154 (37%)
Age	62.06	67.28	69.35	67.35
Tumour stage				
I	14 (49%)	55 (18%)	22 (25%)	91 (22%)
II	10 (34%)	100 (34%)	26 (29%)	136 (33%)
III	4 (14%)	114 (38%)	27 (30%)	145 (35%)
IV	1 (3%)	29 (10%)	14 (16%)	44 (11%)
Neoadjuvant therapy				
Yes	0	254 (85%)	75 (84%)	329 (79%)
No	29 (100%)	44 (15%)	14 (16%)	87 (21%)
Surgical technique				
Open (or early conversion)	1 (3%)	4 (1%)	8 (9%)	13 (3%)
Laparoscopic	13 (45%)	151 (51%)	43 (48%)	207 (50%)
Robotic	15 (52%)	143 (48%)	38 (43%)	186 (47%)
Anastomotic technique				
K-G stapled	22 (76%)	250 (84%)	72 (81%)	344 (83%)
Coloanal	7 (24%)	48 (16%)	17 (19%)	72 (17%)
Patients distribution (Centre)				
Florence Hospital	21 (12%)	84 (49%)	68 (39%)	173
Pisa Hospital	1 (7%)	138 (86%)	1 (7%)	140
Naples Hospital	7 (7%)	76 (74%)	20 (19%)	103

Abbreviation: K-G, Knight–Griffen.

The median time from surgery to stoma closure was 145 days (range 14–423): 143 days for ileostomy and 151 days for colostomy. No difference was found between ileostomy and colostomy in overall morbidity and post reversal morbidity. Stoma related complications are reported in Table 2. Stoma prolapse was significantly higher in the colostomy patients, while dehydration (requiring hospitalization) was significantly higher in the ileostomy patients. Considering skin irritation (requiring medications), wound infection, parastomal hernia, incisional hernia and other complications, no statistically significant differences were found.

Functional evaluation

After surgery, in patients without stoma the mean LARS score was 24, compatible with a minor LARS. On the other hand, in patients with ileostomy and colostomy increased postoperative functional disturbance is proportional to the attending time for closure, especially for ileostomy (Figure 1). The mean postoperative LARS score was 32.1 for ileostomy patients and 29.7 for colostomy patients. The LARS score after ileostomy was significantly worse compared to scores of patients without stoma ($p=0.04$). No significance was found in LARS of patients after colostomy compared with patients without stoma ($p=0.2$). Even if the LARS score trends over time were worse in patients with ileostomy than those with colostomy, colostomy patients' values tended to remain more stable regardless of time between surgery and closure; this difference was not statistically significant. The same results were confirmed after 1 year from stoma closure. In fact, in patients without stoma the mean LARS score was 19.1, compared to 24.7 ($p=0.1$) and 22.1 ($p=0.5$) for ileostomy and colostomy patients respectively, with no statistically significant differences. However, a statistically significant difference was found when ileostomy was closed after 90 days from surgery ($p=0.05$ between 90 and 180 days and $p=0.01$ after 180 days).

After 1 year from surgery, 196 patients (47%) needed further treatment for functional alterations such as pelvic floor rehabilitation (volumetric, biofeedback), transanal irrigation, tibial neurostimulation, sacral neuromodulation or other specialist evaluations (urologist, gynaecologist, gastroenterologist etc.) with need of chronic medical treatment. Of these, a stoma was never performed in nine patients (37%), 38 had a previous colostomy (48%) and 149 (59%) had a previous ileostomy.

DISCUSSION

Our results confirm the well-known complications reported for colostomies and ileostomies. In fact, stoma prolapse was significantly higher in the colostomy patients, while dehydration (requiring hospitalization) was significantly higher in the ileostomy patients, and no statistically significant differences were found considering other complications (skin irritation, wound infection, parastomal or incisional hernia etc.).

In addition, differences in functional outcome between colostomy and ileostomy, or no ostomy, were explored, highlighting how in patients with ileostomy and colostomy increased postoperative functional disturbance is proportional to the attending time for closure, especially for patients with ileostomy. A statistically significant difference was found when ileostomy was closed after 90 days from surgery ($p=0.05$ between 90 and 180 days and $p=0.01$ after 180 days). Moreover, the LARS score after ileostomy was significantly worse compared to the scores of patients without stoma ($p=0.04$) while no significance was found in the LARS score after colostomy compared with patients without a stoma ($p=0.2$).

TABLE 2 Complications.

	Ileostomy, 302 patients	Colostomy, 90 patients	*p*	Total, 392 patients
Perioperative				
Prolapse	6 (2%)	7 (8%)	**0.03**	13 (3%)
Skin irritations	33 (11%)	5 (5.5%)	0.1	38 (10%)
Dehydration	19 (7%)	1 (1%)	**0.05**	20 (5%)
Parastomal hernia	9 (3%)	6 (7%)	0.1	15 (4%)
Retraction/stenosis	10 (3%)	4 (4%)	0.5	14 (4%)
Other (fistula, bleeding, necrosis etc.)	9 (3%)	4 (4%)	0.5	13 (3%)
Total	86	27	0.7	
Post reversal				
Wound infection	11 (4%)	6 (7%)	0.2	14 (4%)
Incisonal hernia	9 (3%)	4 (4%)	0.5	11 (3%)
Obstruction	2	1	0.6	3 (1%)
Anastomotic leak	2	2	0.2	4 (1%)
Total	24	13	0.09	

The bold values significance as $p<0.05$.

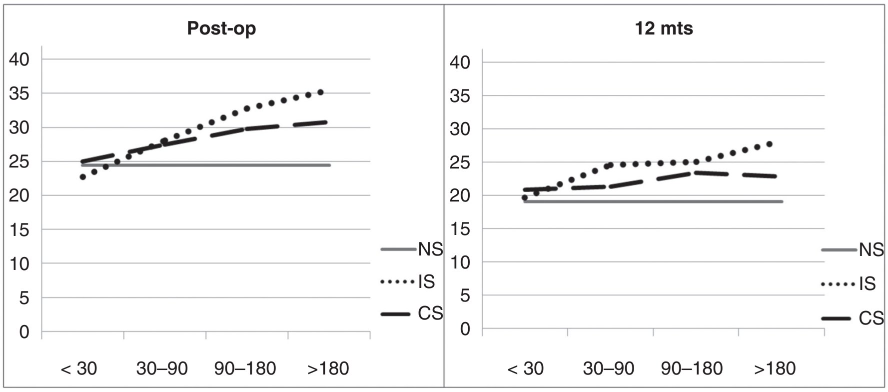

FIGURE 1 Postoperative and 12-month follow-up LARS score according to time between surgery and stoma closure. CS, colostomy; IS, ileostomy; mts, months; NS, no stoma.

Even if a diversion performed after TME is not only effective in reducing the severity of anastomotic leak consequences but also protective against anastomotic leak, decreasing both the risk of dehiscence and reoperation rate [8], it has been previously suggested that a protective stoma could worsen long-term functional outcomes [9–11].

Moreover, although ileostomy is generally more widely used than colostomy, due to the lower risk of complications (prolapse, parastomal hernia, wound infection or incisional hernia after closure) [12, 13], a recent meta-analysis suggests that there is no significant difference in overall morbidity after stoma creation and closure between ileostomy and colostomy. In fact, the morbidity rates following the creation of ileostomy were decreased but at the cost of a higher risk for dehydration and skin irritation [14–16]. This aspect becomes essential when we consider that up to 25% of patients fail to achieve stoma reversal, which eventually becomes a permanent stoma [17–19].

It was recently reported that the construction of a diverting ileostomy during primary surgery was an independent risk factor for stoma at 1 year, compared with no stoma patients [20], and may potentially delay the diagnosis of anastomotic leak.

Today, the improvement in diagnostic tools, diffusion of colorectal cancer screening, improvement of surgical technique, neoadjuvant treatments and the introduction of new drugs for medical therapy has led to an increase in the overall survival of these patients. The natural consequence of this is renewed interest in the long-term functional outcome of patients who have undergone low anterior resection for cancer and the need to consider therapeutic planning for all those aspects that may also affect the quality of life and the functional status after the operation, without compromising the oncological safety.

Although most of the functional impairments recover by 6–12 months after the operation, long-term studies report the presence and the persistence of adverse functional symptoms up to 15 years after resection [21].

Even if most of the risk factors related to LARS are only slightly modifiable (neoadjuvant treatments, anastomotic factors such as height or leak etc.), the type of stoma performed should still be discussed. Many studies suggest a potential role of previous ileostomy in patients who persistently experience bowel dysfunction after anterior resection [9, 10, 22] even if very few studies analyse the postoperative dysfunction related to time of stoma closure, and no studies compare ileostomy versus colostomy.

This was confirmed also in our study, where LARS scores are strongly related to the presence of a diverting stoma and in particular to time of defunctioning. Certainly, patients in whom an ostomy has not been primarily performed also have additional positive factors that deserve to be considered (younger, no neoadjuvant therapy, earlier tumour stages, good body mass index and ASA score etc.). Moreover, also the length of bowel defunctioning seems to be relevant, considering that patients with ileostomy may experience a more severe and persistent functional dysfunction compared with patients after colostomy. This was partially suggested in a previous study, in which patients with a late ileostomy closure experienced worse scores on urgency and soiling compared with patients with an early closure [23].

Early ileostomy closure may be helpful in reducing ileostomy related impaired functional alteration. The early closure of loop defunctioning ileostomy seems to be safe and feasible and has comparable outcomes to delayed closure [24–26].

The precise aetiology of stoma related bowel dysfunction is not completely understood, but it could be related to diversion colitis, enteric nervous system alterations or changes in epithelial function of the terminal ileum, causing bile acid malabsorption, small bowel bacterial overgrowth or bacterial recolonization of the colon after stoma reversal. For example, it has been suggested that after anterior resection the expression of interstitial cells of Cajal in the neorectum was reduced and did not recover to preoperative levels over time [27, 28]. Moreover, evaluation of the enteric nervous system after diversion colostomy revealed negative morphological and quantitative changes [29, 30].

Besides neural changes, mucosal, immunological, hormonal and muscular alterations of the colon have been described after diversion and in the majority of patients (if not all) macroscopic or microscopic evidence of colitis can be demonstrated [31–33].

It seems reasonable that the reduction of motor activity and the exclusion from luminal nutrients represent the main events directly involved with these changes but, although the presence of an ileostomy is supposed to reduce the entire motility of the colon, this has not been confirmed for patients with a transverse colostomy, where the motility of the defunctionalized colon is maintained [34], partially explaining more favourable results. Moreover, to reduce these effects, a potential role of colonic trans-stomal irrigation could be considered (less feasible in patients with an ileostomy), aiming to maintain

TABLE 3 Pragmatic approach to the choice of ostomy in cases of sphincter-saving surgery.

Consider no stoma if:	Consider ileostomy if:	Consider colostomy if:
• Very selected patients	• Minimally invasive surgery	• Elderly patients (>75)
• Young age	• Elective surgery	• ASA score >3
• No neoadjuvant treatment	• Possibility of early closure (<90 days)	• Advanced tumour
• Alternative surgical approach (pull-through, transanal excision etc.)	• No advanced tumour	• Intra-operative complications
• Low ASA score	• No intra-operative complications or suspicion of anastomotic failure	• Emergency or laparotomic approach
		• Expectation of priority postoperative therapies

Abbreviation: ASA, American Society of Anesthesiologists.

an adequate trophic function of the mucosa and microbiota [35–37]. However, the real correlation between these changes and the clinical symptoms is in many cases still to be clarified, such as how much of these alterations may be recoverable after stoma reversal.

Considering our results, in which maintaining an ileostomy for a long period seems to be the most unfavourable option, beside the main risk factors reported in the literature for a permanent unreversed stoma, such as age, ASA score (>3), anastomotic complications, tumour stage and laparotomy [38–41] and the risk of dehydration in elderly patients, a pragmatic approach for clinical practice could be proposed (Table 3).

In fact, in patients in whom there are the best conditions for an early closure (within 6 months) ileostomy may still be considered as the best option. However, in patients at high risk of delayed or non-closure, a colostomy (transverse colostomy) deserves to be considered. Of course, surgical experience, intra-operative issues, multidisciplinary perioperative evaluation or other clinical factors may still influence the choice of ostomy type, but without forgetting the role of the patient and the functional implications of our surgical actions.

Although the parameters analysed in this study were carefully standardized (TME, stoma, LARS score etc.), the need to use a multicentre study to obtain an adequate sample of patients for analysis rather than a randomized trial and the influence of multiple factors (not all yet fully understood) in the development of the variable postoperative dysfunction after rectal resection may be potential limitations of this type of study, which need further confirmation.

Moreover, the LARS score was not specifically drawn for outcomes evaluation, potentially underestimating some results.

However, the impact of an ostomy should not be ignored, not only with regard to quality of life or potential complications, but also with regard to functional outcomes.

CONCLUSIONS

The presence of a defunctioning stoma seems to have a negative impact on functional bowel activity after low rectal resection, especially for delayed closure and for ileostomy. This should be considered when the type of stoma (ileostomy vs. colostomy) is selected for each patient. An appropriate counselling, considering not only oncological but also functional factors, should be done for each patient, choosing together the best available option.

AUTHOR CONTRIBUTIONS

Jacopo Martellucci: Conceptualization; methodology; data curation; formal analysis; validation; investigation; writing – original draft. **Luigi Brusciano:** Conceptualization; methodology; data curation; investigation. **Marco Puccini:** Conceptualization; investigation; methodology; data curation. **Ludovico Docimo:** Supervision; formal analysis. **Fabio Cianchi:** Supervision; formal analysis. **Piero Buccianti:** Supervision; formal analysis. **Paolo Prosperi:** Supervision; formal analysis.

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None.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to report related to the present study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval and patient consent were obtained to the extent required by the retrospective and observational nature of the study and current local policies.

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