



# Early ileostomy reversal after minimally invasive surgery and ERAS program for mid and low rectal cancer

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## Abstract

Diverting loop ileostomy following low anterior resection (LAR) is known to decrease quality of life and prolongs the return back to patients' baseline activity. The aim of this retrospective study was to explore feasibility and safety of an early ileostomy reversal strategy in a cohort of patients undergoing minimally invasive LAR within an enhanced recovery after surgery (ERAS) program. Prospectively collected data from 15 patients who underwent minimally invasive LAR and diverting ileostomy at the Division of General and Hepatobiliary Surgery, University of Verona Hospital Trust between September 2015 and December 2016 were retrospectively analyzed. Of 15 patients, 10 patients underwent laparoscopic LAR and 5 patients a robot-assisted procedure. Post-operative complications were observed in 5 patients. Four patients suffered Clavien–Dindo grade 1 or 2 complications, and one patient required redo surgery due to bowel obstruction at the ileostomy site (grade 3b). Following ileostomy reversal, 10 out of 15 patients experienced complications. Two patients required redo surgery for bowel obstruction (grade 3b), whilst eight patients suffered grade 1 or 2 complications, being surgical site infection the most frequently observed (6 cases). Despite that, 80% of patients had their ileostomy reversed within 30 days and median time from initial surgery to ileostomy reversal was 22 days (range 10–150). Early ileostomy closure after minimally invasive LAR and ERAS program is feasible although it carries non-negligible risk of severe complications which, however, does not hinder its accomplishment.

**Keywords** Rectal cancer · Low anterior resection · Laparoscopic surgery · Robotic surgery · Ileostomy closure

## Introduction

Anastomotic leak is a feared complication of colorectal surgery [1–4]. It is more frequent after rectal surgery especially in low rectal resections preceded by neoadjuvant chemoradiotherapy [5–7]. The current consensus is that diverting

such anastomoses with a loop ileostomy may decrease the clinical impact of an anastomotic leak [1, 2, 7].

Diverting ileostomies, however, are prone to complications such as wound infection, high stoma output, small bowel obstruction, retraction/prolapse and enterocutaneous fistula [8–11]. Such complications may sometime be severe enough to alter the course of the proposed adjuvant treatment [9]. Moreover, ileostomies have a negative effect on the quality of life and bowel function, and interfere with daily activities, lifestyle and sexual activity [12–15].

Ileostomy closures are normally performed between 8 and 12 weeks following surgery, when local and systemic factors allow a safe surgical procedure [9, 16]. However, recent evidences demonstrated how early reversal of ileostomy can be safe and feasible.

The aim of this retrospective study was to analyze feasibility and safety of early closure of diverting ileostomy in patients undergoing laparoscopic and robot-assisted low anterior resection (LAR) within an ERAS protocol.

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## Methods

### Inclusion criteria and population under study

This is a single-center study of prospectively collected and retrospectively analyzed data of patients treated at the Division of General and Hepatobiliary Surgery, University of Verona Hospital Trust from July 2015 to December 2016. Patients older than 18 years undergoing elective minimally invasive (laparoscopic and robotic) LAR for mid and low rectal cancer in which a diverting ileostomy was created were enrolled in the study.

### Low anterior resection

Laparoscopic LAR was performed using a 5-port technique. The camera port was placed below the umbilicus; two 5 mm working ports were placed in the right upper and lower quadrants and a 5 mm port in the left lower quadrant. An 11 mm suprapubic trocar was used to optimize the exposure of the surgical field in the lower pelvis. The rectum was transected with Endo-GIA 60 mm placed through a 12 mm trocar replacing the 5 mm one in the right lower quadrant after dissection of the anorectal junction. The specimen was removed through the extension of the 12 mm trocar (4–6 cm incision) in the right lower quadrant after positioning a wound protector. The anastomosis was performed intra-corporeally in all cases after re-creating pneumoperitoneum. The ileostomy was fashioned by exteriorizing the distal ileum through the mini-laparotomy in the right lower quadrant after partial closure of the fascia and skin when necessary.

Robot-assisted surgery was performed with a hybrid approach using a 6-port technique as previously described [17]. The robotic platform was used exclusively for the rectal dissection and the transection of the rectum was performed using an Endo-GIA 60 mm introduced through a 12 mm trocar replacing the 8 mm robotic trocar in the right lower quadrant after dissection of the anorectal junction. The rest of surgical procedure was carried out with the same technique used for the laparoscopic approach.

### Ileostomy fashioning, management and reversal

Loop ileostomy was fashioned with minimal spouting above the skin using a silicon bar (baguette) exteriorizing the distal ileum through the mini-laparotomy in the right lower quadrant. The ileostomy bar was removed after 6–9 days post-operatively.

Prior to the ileostomy closure, the colorectal anastomosis was evaluated with a water-soluble contrast enema (WSCE). This was usually carried out between 2 and

3 weeks following the initial surgery using a Foley catheter inserted transanally. WSCE was performed with the patient on a dynamic X-ray fluoroscopy bed to obtain multiple views of the anastomosis.

Ileostomy reversal was performed by dissecting the two limbs of the ileostomy followed by primary closure in two cases and resection and anastomosis in the remaining 13. When bowel resection was performed, the technique of choice was a handsewn side-to-side anti-peristaltic anastomosis. The wound was closed over anatomical planes and skin was closed with interrupted sutures after betadine lavage.

### Peri-operative management

Enhanced recovery after surgery program (ERAS) was applied in the peri-operative management both for LAR and ileostomy reversal as previously described [18].

Intravenous fluid restriction was adopted, free oral fluids and feeding were allowed early after surgery to prevent starvation and to allow independence from intravenous fluid therapy as soon as possible. After LAR, urinary catheter was removed on POD 2 in female patients and on POD 3–4 in males. With regards to ileostomy reversal, our ERAS protocol included a right-sided TAP block, local anesthetic wound infiltration with 20 ml of 0.5% bupivacaine and no urinary catheter placement. Post-operative analgesia regimen was chosen according to the anesthesiologist's preference.

### Post-operative measurements

Patients were reviewed at least twice a day by a member of the surgical team. Any deviation from the normal post-operative course, even asymptomatic, was considered a complication and recorded as such. Complications were graded according to the Clavien-Dindo classification [19].

Anastomotic leakage was defined as the presence of communication between the intra- and extra-luminal compartments caused by a defect of the integrity of the intestinal wall at the anastomosis site. The presence of an abscess in proximity of the anastomosis was similarly considered an anastomotic leak in accordance to previous reports [20]. When an anastomotic leakage was evident on the WSCE without any accompanying symptom, this was not computed among post-operative complications and was defined as radiological anastomotic leakage. A fluid collection was considered an abscess in the presence of clinical symptoms or signs such as fever, pain, or paralytic ileus. An incisional surgical site infection (SSI) was defined as an infection that occurred at the incision site in the presence of one of the following: purulent drainage from the incision, positive culture of incision fluid swab, incisional pain, tenderness, localized swelling, redness, or heat with opening of the

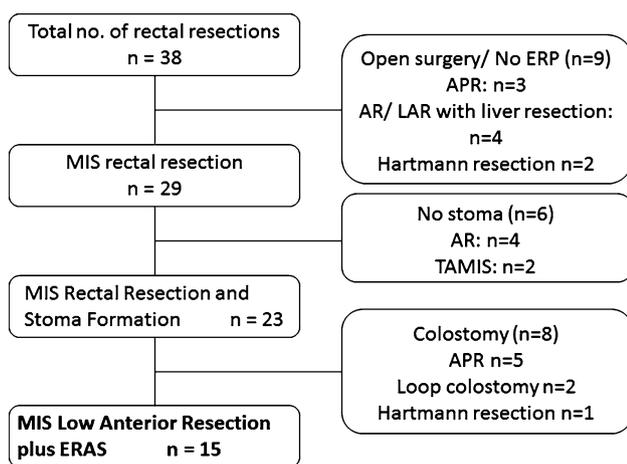
incision. A superficial SSI was defined as involvement of only the skin or subcutaneous tissue. A deep SSI was defined as involvement of deeper layers (e.g., fascial and muscle layers) [21]. Post-operative ileus was defined as the cessation of coordinated bowel motility that prevented effective transit of intestinal contents or tolerance of oral intake lasting more than 3 days and impairing the regular post-operative management [22]. When post-operative management was impaired by ineffective transit of intestinal contents caused by mechanical obstruction, this was recorded as mechanical bowel obstruction (e.g., internal hernia, volvulus, ileostomy stenosis, etc.).

**Statistical analysis**

All demographic, clinical, and outcome data were prospectively collected and stored in a PC dataset. Categorical data are reported as absolute numbers and percentages. Continuous data are presented as mean (standard deviation) or median (range). The statistical analysis was performed using SPSS software version 21.0 version (IBM Corporation, Armonk, NY).

**Results**

Patients’ management according to stoma formation for the 38 patients treated by rectal resection between July 2015 and December 2016 is reported in Fig. 1. The 15 patients who underwent laparoscopic or robotic LAR represent the total number of cases in which a diverting ileostomy was performed. All patients who underwent LAR and ileostomy reversal were managed according to our ERAS protocol.



**Fig. 1** Patients’ management according to stoma formation for the 38 patients treated by rectal resection during the study period. 15 patients who underwent laparoscopic or robotic low anterior resection and loop ileostomy entered the study

Out of the 15 patients, 9 were male and the median age was 60 years (range 41–84). Main indication for surgery was primary adenocarcinoma of the mid and low rectum (14 patients). In one patient, the indication to surgery was the presence of a large adenomatous polyp not amenable of endoscopic resection. Other clinical and histopathology characteristics are reported in Table 1.

Clinical outcomes data and post-operative complications following initial rectal resection are reported in Table 2. Ten patients were treated with a laparoscopic approach and five patients with a robot-assisted procedure. No patients required conversion to open surgery. Median hospital stay was 6 days (range 5–21).

Within this group, five patients suffered post-operative complications. Clavien-Dindo grade 1–2 complications occurred in four patients and Clavien-Dindo grade 3b in one patient. The latter patient required surgical re-intervention due to bowel obstruction at the ileostomy site occurring on POD 5. The ileostomy was reversed on POD 10 after a CT scan and WSCE confirmed the site of occlusion and excluded an anastomotic leakage. She was finally discharged on POD 21.

Amongst Clavien-Dindo grade 1–2 complications, anastomotic leak, renal insufficiency, atrial fibrillation and lymphorrhea were observed in one patient each. Among these, a lady presented an uneventful in-hospital post-operative course (discharged on POD 5) but was readmitted on POD 8 for pelvic pain and vaginal discharge after WSCE demonstrated an anastomotic leakage with indirect vaginal fistula. The patient received conservative treatment and waited 150 days to have her ileostomy reversed.

Overall, no post-operative mortality was observed. Overall post-operative morbidity was 33.3%. Both reoperation and readmission rate were 6.7%. Another case of radiological anastomotic leak was observed in a 64-year-old lady who received preoperative chemo-radiation and robot-assisted LAR. Ileostomy reversal was delayed till POD 63.

Table 3 shows clinical outcomes following ileostomy reversal procedure. Median time to ileostomy closure was 22 days (range 10–150) and it was carried out within 30 days in 12 out of the 15 patients (80%). Delayed ileostomy closure in the two above-mentioned patients with clinical and radiological anastomotic leaks was reversed on POD 63 and POD 150, respectively. Another patient suffered a worsening of his renal insufficiency and waited until POD 44 to have her ileostomy reversed.

Ileostomy reversal technique entailed resection and anastomosis of the ileostomy loop in 13 cases and primary closure in 2. Median hospital stay after ileostomy reversal was 4 days (range 2–41). No post-operative mortality was recorded, but complications occurred in 10 out of the 15 patients (66.7%). Four patients suffered Clavien-Dindo grade

**Table 1** Patients' demographic and clinical characteristics at the time of laparoscopic and robotic low anterior resection<sup>a</sup>

|  | No. of cases | %         |
|--|--------------|-----------|
| Median (range) age (years)                 | 60           | 41–84     |
| Gender                                     |              |           |
| Male                                       | 9            | 60        |
| Female                                     | 6            | 40        |
| Mean ( $\pm$ SD) BMI                       | 23.7         | $\pm$ 2.4 |
| ASA class                                  |              |           |
| ASA 1                                      | 5            | 33.3      |
| ASA 2                                      | 8            | 53.3      |
| ASA 3                                      | 2            | 13.3      |
| No. of comorbidities                       |              |           |
| None                                       | 9            | 60        |
| One  | 3            | 20        |
| Two or more                                | 3            | 20        |
| Previous abdominal surgery                 |              |           |
| None                                       | 8            | 53.3      |
| One  | 6            | 40        |
| Two or more                                | 1            | 6.7       |
| Indication for surgery                     |              |           |
| Adenoma with HGD                           | 1            | 6.7       |
| Adenocarcinoma                             | 14           | 93.3      |
| Mean ( $\pm$ SD) distance from the AV (cm) | 6.1          | $\pm$ 1.4 |
| Presence of risk factors                   |              |           |
| None                                       | 11           | 73.3      |
| Radiotherapy                               | 4            | 26.7      |
| Completeness of tumor resection (UICC-R)   |              |           |
| No residual tumor (R0)                     | 13           | 86.6      |
| Microscopic residual tumor (R1)            | 1            | 6.7       |
| Macroscopic residual tumor (R2)            | 1            | 6.7       |
| Depth of tumor invasion (pT)               |              |           |
| pTis                                       | 1            | 6.7       |
| pT1  | 3            | 20        |
| pT2  | 4            | 26.7      |
| pT3  | 3            | 20        |
| pT4a                                       | 3            | 20        |
| pT4b                                       | 1            | 6.7       |
| Lymph node involvement (pN)                |              |           |
| pN0  | 11           | 73.3      |
| pN1  | 3            | 20        |
| pN2  | 1            | 6.7       |
| Systemic metastasis (M)                    |              |           |
| M0   | 14           | 93.3      |
| M1a  | 0            | –         |
| M1b  | 1            | 6.7       |
| UICC/ AJCC TNM stage                       |              |           |
| Stage 0                                    | 1            | 6.7       |
| Stage I                                    | 6            | 40        |
| Stage II                                   | 4            | 26.7      |
| Stage III                                  | 3            | 20        |
| Stage IV                                   | 1            | 6.7       |

<sup>a</sup>Normally distributed data were presented as mean ( $\pm$ SD). Non-normally distributed data were presented as median (range)**Table 2** Surgical procedures' data and post-operative complications after laparoscopic and robotic low anterior resection<sup>a</sup>

|   | No. of cases | %         |
|---|--------------|-----------|
| Type of MIS surgery                             |              |           |
| Laparoscopic                                    | 10           | 66.7      |
| Robotic   | 5            | 33.3      |
| Associated surgical procedure                   |              |           |
| None  | 13           | 86.7      |
| Yes   | 2            | 13.3      |
| Mean ( $\pm$ SD) size of surgical incision (cm) | 5            | $\pm$ 1.1 |
| Mean ( $\pm$ SD) duration of anesthesia (mins)  | 350          | $\pm$ 61  |
| Mean ( $\pm$ SD) duration of surgery (mins)     | 298          | $\pm$ 60  |
| Mean ( $\pm$ SD) blood loss (ml)                | 75           | $\pm$ 48  |
| Need for conversion                             |              |           |
| No  | 15           | 100       |
| Yes   | 0            | –         |
| RBC transfusion                                 |              |           |
| No  | 13           | 86.7      |
| Yes   | 2            | 13.3      |
| Redo surgery                                    |              |           |
| No  | 14           | 93.3      |
| Yes   | 1            | 6.7       |
| Unplanned readmission                           |              |           |
| No  | 14           | 93.3      |
| Yes   | 1            | 6.7       |
| Median (range) post-op. hospital stay (days)    | 6            | 5–21      |
| Post-operative complications (Clavien-Dindo)    |              |           |
| None  | 10           | 66.7      |
| Grade 1   | 1            | 6.7       |
| Grade 2   | 3            | 20        |
| Grade 3a  | 0            | –         |
| Grade 3b  | 1            | 6.7       |
| Grade 4   | 0            | –         |
| Grade 5   | 0            | –         |

<sup>a</sup>Normally distributed data were presented as mean ( $\pm$ SD). Non-normally distributed data were presented as median (range)

1, 4 patients grade 2 and 2 patients a grade 3b complication. No unplanned readmission was recorded.

Clavien-Dindo grade 1–2 complications were mainly related to SSI (six patients, 40%), five patients suffered a superficial SSI and one patient experienced a deep SSI. A case of prolonged post-operative ileus and atrial fibrillation was also observed.

Two patients required further surgery (Clavien-Dindo grade 3b) for bowel obstruction at ileostomy site on POD 7 and POD 8, respectively. The first patient received laparoscopic exploration and subsequent resection and anastomosis for a stenosis at the ileostomy site reversal after direct closure. He was discharged on POD 14. The second patient required a laparotomy due to bowel angulation at

**Table 3** Surgical procedure data and post-operative complications after early ileostomy closure<sup>a</sup>

|  | No. of cases | %        |
|--|--------------|----------|
| Type of closure                                |              |          |
| Resection and anastomosis                      | 13           | 86.7     |
| Direct   | 2            | 13.3     |
| Type of anastomosis                            |              |          |
| Side-to-side anti-peristaltic                  | 11           | 84.6     |
| End-to-end                                     | 2            | 14.4     |
| Mean ( $\pm$ SD) duration of anesthesia (mins) | 115          | $\pm$ 21 |
| Mean ( $\pm$ SD) duration of surgery (mins)    | 97           | $\pm$ 30 |
| RBC transfusion                                |              |          |
| No   | 14           | 93.3     |
| Yes  | 1            | 6.7      |
| Redo surgery                                   |              |          |
| No   | 13           | 86.7     |
| Yes  | 2            | 13.3     |
| Unplanned readmission                          |              |          |
| No   | 14           | 93.3     |
| Yes  | 1            | 6.7      |
| Median (range) post-op hospital stay (days)    | 4            | 2–41     |
| Post-operative complications (Clavien-Dindo)   |              |          |
| None   | 5            | 33.3     |
| Grade 1  | 4            | 26.6     |
| Grade 2  | 4            | 26.6     |
| Grade 3b                                       | 2            | 13.3     |
| Grade 4  | 0            | –        |
| Grade 5  | 0            | –        |

<sup>a</sup>Normally distributed data were presented as mean ( $\pm$ SD). Non-normally distributed data were presented as median (range)

the ileostomy site following resection and anastomosis of the ileostomy loop. He was treated by resection and re-anastomosis and was discharged on POD 41. His post-operative course was further complicated by bleeding and intra-abdominal fluid collection, both treated with conservative measures.

Considering the overall duration of “surgical course”, defined as the time passed from the day of LAR to the date of discharge after ileostomy closure (including the time spent at home between the two procedures), the median time was 27 days (range 18–153). Interestingly, the surgical course was concluded within 42 days in 13 cases (86.7%) and within 56 days in 14 cases (93.3%).

Among the 15 cases under study, seven patients required post-operative adjuvant chemotherapy. Median interval time from LAR to first chemotherapy dose administration was 48 days (range 35–79). Six out of these seven patients (85.7%) started the scheduled chemotherapy within 56 days; only the lady who suffered from a radiological anastomotic leak delayed adjuvant treatment until POD 79.

## Discussion

Diverting ileostomy following LAR is generally recommended. Such a precaution has proven to decrease morbidity in the event of an anastomotic leak of the low colorectal anastomosis.

Baxk et al. have shown how diverting ileostomy can both reduce the impact of anastomotic leak and the number of leaks related to surgical procedures [23]. Alves et al. randomized 116 and 118 patients to diverting vs. non-diverting ileostomy groups, respectively, and found that the diverting group suffered symptomatic anastomotic leak in 10.3% (12 of 116) of cases compared to 28% (33 of 118) of the non-diverting group [24].

Diverting ileostomy, however, comes to costs in terms of both quality of life and additional morbidity related to the reversal procedure which are even more marked when adjuvant treatments are needed [25]. Following LAR, ileostomy reversal is typically carried out between 8 and 12 weeks. It appears obvious that such timing may clash with the administration of adjuvant treatments, which would invariably take priority within the patients’ care pathway and further delay ileostomy closure.

In our institution, a diverting ostomy is generally performed after LAR with low colorectal anastomosis. It is not however deemed necessary following rectal resection with partial TME (Fig. 1). With this approach, we experienced a clinical leak rate of 5.2% (2 of 38) and a radiological leak rate of 10.4% (4 of 38) (data not shown).

The aim of our study was to study a small number of patients suitable for early ileostomy closure and evaluate possible benefits in term of surgical results and quality of life. At the same time, we wanted to evaluate how early ileostomy closure could impact later stages of patients’ treatment, such as adjuvant chemotherapy treatment.

With the refinement of both minimally invasive techniques and ERAS programs, the timing for ileostomy closure has progressively shortened. The definition of early ileostomy closure refers to ostomy reversal procedure that is carried out within 30 days from the primary surgery. The ideal timing of ileostomy closure, however, is currently an open question. The answer to that question lies within a trade-off between an early procedure and the potential complications related to it. It is known that delayed ostomy closure carries a significant burden on patient psychology and quality of life and that stoma morbidity in terms of dehydration, electrolytes, acid base imbalances and renal failure can be high [26]. Ostomy reversal therefore should be considered as early as possible [27].

Benefits of early ileostomy closure include: (i) significant reduction of ileostomy side effects (high output, electrolyte imbalance, dehydration), particularly in patients

requiring adjuvant chemotherapy; (ii) reduction of costs as a result of fewer hospital admissions; (iii) improvement of quality of life parameter due to shorter ileostomy time (iv) earlier return to baseline and working activities [27, 28].

Notably, in our experience, considering the interval time from initial LAR to discharge following ileostomy reversal, half of the patients concluded their “surgical course” within 4 weeks (median time 27 days; range 18–153), 86.7% of the cases within 6 weeks and 93.3% of the cases within 93.3%. As a reflection, 85.7% (6 of 7) of the patients who required adjuvant treatment were able to start their chemotherapy within 8 weeks from the initial surgery (median time 48 days; range 35–79).

When considering early closure, however, the safety of the procedure related to local inflammatory factors, quality of tissues and previous surgical trauma must be taken into account. In our study, the complications following early ileostomy closure occurred in one third of the patients, with two patients suffering severe complications requiring redo surgery (Clavien-Dindo grade 3b).

Complication rates following ileostomy reversal across different authors vary between 18 and 40% [29, 30]. Bowel obstruction, wound infection, intra-abdominal abscess, anastomotic leakage, enterocutaneous fistula and bleeding being the most common complications [31]. These types of complications require additional surgical procedures in 3–8% of cases [32, 33]. A systematic review carried out by Chow et al. [9] on a total of 6,107 patients reported that following ileostomy closure, 7.2% of patients suffered from small bowel obstruction (2.5% of these requiring surgical intervention), 1.4% suffered an anastomotic leak at the ostomy closure site and 1.3% of patients suffered an entero-cutaneous fistula.

The majority of these findings, however, pertain to ileostomy closures carried out between 5 and 10 months following the primary LAR [34, 35]. Despite that, our complication rate does not excessively differ from the ones found in the above reported series where ileostomy closure has been carried out at a much later stage. Some authors claim that early closure of ileostomy is linked to higher complication rate and reported higher morbidity for ileostomy closures carried out before 109 days from the ileostomy formation [36]. Conversely, other authors have reported no increase in anastomosis related complications after minimally invasive LAR followed by early ileostomy reversal, and demonstrated that, in carefully selected patients, early reversal of de-functioning ileostomy is feasible, technically easier and save costs [37]. The most valuable study on this topic is a randomized controlled trial carried out by Danielsen et al. [38] who showed how early ileostomy closure patients (8–13 days) have a lower complication rate compared to late closure patients (> 12 weeks). Other authors have showed similar results. Hinderburg et al. in a series of 127 patients

showed that the mean number of complications was significantly lower in the early ileostomy closure group compared to the control group ( $P < 0.001$ ), demonstrating that temporary ileostomy closure carried out 8–13 days after rectal resection is safe [39].

The other factor to consider in early ileostomy closure is the potential to unmask latent problems of the primary colorectal anastomosis. Closure as early as 8 days may unmask hidden leaks of the colorectal anastomosis, even whereby a leak has been disproven by radiological findings prior to reversal. Unfortunately, clear evidences on this aspect of ileostomy reversal are lacking.

To obviate this problem, careful clinical and radiological evaluation of the colorectal anastomosis must be made prior to early ileostomy reversal. Evaluation of the integrity of the anastomosis is a crucial part of early ileostomy closure. Some authors have suggested certain criteria to be fulfilled before attempting early ileostomy closure. These are: uneventful primary surgery, absence of systemic or local infection, normal bowel function and careful radiological and endoscopic evaluation of the anastomosis [24, 39, 40]. According to some authors, assessment of anastomotic integrity can be safely carried out with WSCE and proctoscopic examination as early as POD 7 [24, 39–42]. However, false negative rates for anastomotic leak by WSCE evaluation have been reported to be up of 7.5% [24]. In our series, early ileostomy closure did not correspond to an increased rate of anastomotic leaks. Six of the early ileostomy closure patients suffered a SSI and two had to be re-operated for bowel obstruction. Both of these patients developed bowel obstruction at the site of the ileostomy closure. One had been closed primarily with no associated bowel resection resulting in a stricture of the closure site; the second patient underwent resection and side-to-side anti-peristaltic anastomosis. It may be possible that the above-mentioned complications as well as the SSI are related to the timing of closure. Ileostomy closure between the 2nd and 3rd week following LAR signifies facing surgery within an acutely inflamed environment.

Six authors have reported the result from ‘early closure’ referring to an ileostomy reversal procedure that was carried out within 30 days of the initial surgery. The results from these reports are encouraging in that the overall morbidity appears to be less. The rate of wound infection, however, has been reported to be higher in the ‘early’ group compared to the control group. It is reasonable to think that the higher wound infection complications in the early closure could be improved by standardizing the technique of ileostomy formation and closure so as to maintain more efficient separation between the contaminated and non-contaminated surgical fields.

The main limitation of this study is the small number of patients. The complication rate is somewhat higher

than the average reported in the literature. Both SSI and bowel obstruction at ileostomy site closure can probably be reduced with careful refinements of the surgical technique. But, a higher number of patients, longer follow-up and a matched control group are needed to draw more definitive conclusions.

## Conclusion

Early ileostomy closure within 30 days from primary LAR is feasible. Careful patient selection and surgical technique must be utilized to minimize complications. Larger series and longer follow-up are required to draw more definitive conclusions.

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## Compliance with ethical standards

**Conflict of interest** Drs. Corrado Pedrazzani, Federica Secci, Eduardo Fernandes, Ivans Jelovskis, Guido Mantovani, Cristian Conti, Enrico Lazzarini, Giulia Turri, and Alfredo Guglielmi have no conflicts of interest or financial ties to disclose.

**Research involving human participants and/or animals** The research has complied with all National and institutional policies on the use of human subjects.

**Informed consent** Informed consent was obtained from all patients, and the study was approved by the local ethic committee.

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