Updates in Surgery
https://doi.org/10.1007/s13304-024-02033-9

ORIGINAL ARTICLE

Current approach to loop ileostomy closure: a nationwide survey on behalf of the Italian Society of ColoRectal Surgery (SICCR)

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Received: 17 September 2024 / Accepted: 31 October 2024

Abstract

Compared to standardized minimally invasive colorectal procedures, there is considerable perioperative heterogeneity in loop ileostomy reversal. This study aimed to investigate the current perioperative practice and technical variations of loop ileostomy reversal following rectal cancer surgery. A nationwide online survey was conducted among members of the Italian Society of ColoRectal Surgery (SICCR). A link to the questionnaire was sent via mail. The survey consisted of 31 questions concerning the main procedural steps and application of the ERAS protocol after loop ileostomy reversal. Overall, 219 participants completed the survey. One respondent in four used a combination of water-soluble contrast studies (WSCS) and digital rectal examination to assess the integrity of the anastomosis before ileostomy closure. Conversely, 17.8% of them used either only WSCS or only endoscopy. Surgeons routinely perform hand-sewn or stapled anastomoses in 45.2% and 54.8% of the cases, respectively. Side-to-side antiperistaltic stapled anastomosis was the most performed anastomosis (36%). Most surgeons declared that they have never used prostheses for abdominal wall closure (64%), whereas 35% preferred retromuscular mesh placement in selected cases only. Forty-six respondents (66.7%) reported using interrupted stitches for skin closure, while 65 (29.7%) a purse-string suture. Furthermore, skin approximation at the stoma site using open methods was significantly more common among surgeons with greater experience in ileostomy reversal ($p = 0.031$). Overall, a good compliance with the ERAS protocol was found. However, colorectal surgeons were significantly more likely to follow the ERAS pathway than general surgeons ($p < 0.05$). Surgeons use different anastomotic techniques for ileostomy reversal after rectal cancer surgery. Based on current evidence, purse-string skin closure and ERAS pathway should be implemented, while the role of mesh prophylactic strategy needs to be explored further.

Keywords Ileostomy closure · Stoma reversal · Survey · Anastomosis · ERAS protocol · Purse string suture

Introduction

The presence of a diverting ileostomy has been associated with a lower risk of clinically significant anastomotic leakage and lower reoperation rates after low anterior resection for rectal cancer [1–4]. However, the incidence of stoma-related complications is high [5, 6], with a negative impact on patients' quality of life [7]. Although the optimal timing from primary surgery is still debated [8, 9], temporary stoma closure is recommended after excluding anastomotic defects.

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Published online: 09 November 2024

Evidence-based recommendations for stoma surgery, including items for ileostomy closure, have recently been provided [10, 11]. Compared to standardized minimally invasive colorectal procedures, there is considerable perioperative heterogeneity in loop ileostomy reversal. Although it is considered a relatively simple operation, often delegated to trainees [12], some procedural steps such as anastomosis configuration [13], skin closure [14], or management of the abdominal wall defect [15] can be addressed in different ways.

Furthermore, enhanced recovery after surgery (ERAS) protocols have been widely validated in colorectal surgery and their benefits have been largely proven [16]. Studies have explored the role of the ERAS protocol in patients who underwent ileostomy reversal, with promising results [17–19]. However, evidence remains limited in this regard, and its actual application in clinical practice remains unknown.

This study aimed to investigate surgeons' attitudes and technical preferences in the perioperative management of loop ileostomy reversal following rectal cancer surgery among members of the Italian Society of ColoRectal Surgery (SICCR).

Materials and methods

This study was conducted according to the Checklist for Reporting Results of Internet E-Survey (CHERRIES) [20].

A questionnaire on the surgical and perioperative management of loop ileostomy closure was developed by three authors (R.P., F.F., and D.P.). After discussion and revision, a 31-question survey was conducted (Suppl. 1). The survey was officially endorsed by the Italian Society of ColoRectal Surgery (SICCR) and developed using Google Forms Survey® (Google; Mountain View, CA, USA).

The baseline characteristics of the respondents were recorded, including age, hospital setting, main area of surgical practice (general or colorectal surgery), and years of clinical experience. Due to the lack of data on the number of ileostomy reversals in hospitals, we set a cutoff of 12 procedures per year, as this value categorizes low-volume centres for elective major rectal surgery [21].

The survey consisted of two main topics: operative details concerning the main procedural steps (anastomosis construction, skin closure, and management of the abdominal wall defect) and application of the ERAS protocol after loop ileostomy reversal. Items of the ERAS pathway referred to Madan S et al. [19].

All the regular members of the Italian Society of Colorectal Surgery (SICCR) were invited to participate in this nationwide survey. A link to the survey was mailed to the respective parties. The survey was available online for 2 weeks as of May 15th, 2024. The purpose of the survey was explained, and completion implied consent. The estimated time to complete the questionnaire was approximately 10 min, and only one response from each participant was recorded.

All the questions were mandatory to prevent missing data. The web-based program automatically collected all data and exported them to a Microsoft Excel spreadsheet.

Ethical approval was not required as this study did not involve human participants or animals.

Statistical analysis

For descriptive statistics, categorical variables were presented as absolute frequencies and percentages. The difference between the distributions for categorical variables was evaluated using the Chi-square test or Fisher's exact test, as appropriate. For all analyses, a p value < 0.05 was considered statistically significant. Statistical analysis was performed using R Statistical Software version 4.4.0.

Results

The questionnaire was completed by 219 participants (response rate: 22%). There were similar proportions of young (< 40 years old) and senior surgeons (Table 1). Most respondents (62%) had more than 5 years of practice

Table 1 Demographics and characteristics of respondents

	N (%)
Age	
< 40 years	102 (46.6)
> 60 years	21 (9.6)
40–60 years	96 (43.8)
Professional experience	
≤ 5 years after residency	59 (27)
> 5 years after residency	136 (62)
Resident	24 (11)
Hospital setting	
Private hospital	15 (6.8)
Public hospital	117 (53.4)
Private university hospital	14 (6.4)
Public university hospital	73 (33.3)
Area of competence	
Colorectal surgery	125 (57)
General surgery	94 (43)
Ileostomy closure per year	
≤ 12	59 (27)
> 12	160 (73)

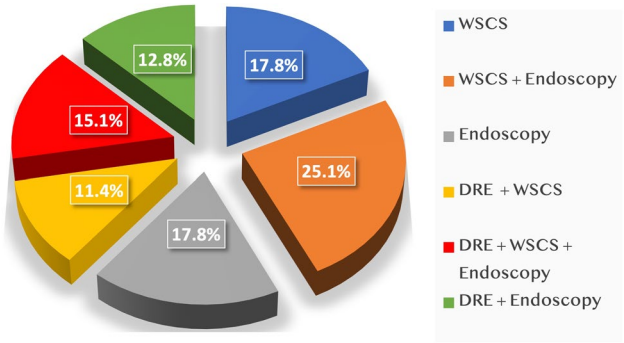

Fig. 1 Combinations of preoperative anastomotic assessments. DRE (Digital Rectal Examination), WSCS (Water-Soluble Contrast Studies)

since completing their residency program. The main specialty areas of competence were general and colorectal surgery (43% and 57% of the cases, respectively). A total of 60 surgeons (73%) performed > 12 ileostomy reversals annually.

Before the reversal of the protective ileostomy, we investigated the surgeons' attitudes toward the evaluation of anastomotic integrity. Figure 1 shows different combinations of preoperative clinical, radiological, and endoscopic assessments.

To minimize the risk of surgical site infections (SSIs), 45% of the surgeons preferred to close the afferent limb before dissection, and almost none of them performed diagnostic laparoscopy (97.3%). An elliptical incision was the most used (60%), followed by a circular incision (32%). Before anastomosis construction, the edge of the stoma was resected consistently by 123 surgeons (63%) and occasionally by 83 surgeons (38%) (Table 2). To restore bowel continuity, surgeons routinely perform hand-sewn or stapled anastomoses in 45.2% and 54.8% of the cases, respectively. Side-to-side antiperistaltic stapled anastomosis was the most commonly performed anastomosis (36%) (Fig. 2). For stapled anastomosis, a 60 mm cartridge was preferred by 99 surgeons (45%), and enterotomy was mainly closed with a second firing (37%) or double-layer suture (33%) (Table 2).

Forty-six respondents (66.7%) reported using interrupted stitches for skin closure, whereas 65 (29.7%) reported using purse-string suture (Fig. 3).

Two main approaches were chosen to manage the wall defect: suturing of the anterior and posterior rectal sheaths separately (49.7%) or the mass closure technique (43.3%) (Table 3). Most surgeons declared that they had never used prostheses during ileostomy reversal (64%), while 35% preferred retromuscular (sublay) mesh placement only in selected cases. Biological, biosynthetic, absorbable, and nonadsorbable synthetic meshes were chosen by 8.7%, 12%, 6.4%, and 9.6% of the respondents, respectively. In the presence of a clinically relevant parastomal hernia (> 5 cm), the most frequent strategy used was to restore bowel continuity and perform hernia repair through the stoma site with (34%) or without (53%) a mesh. Finally, when concomitant midline incisional hernia and ileostomy closure occurred, 72% of the respondents opted for a two-stage procedure rather than simultaneous repair for treatment.

One hundred and twenty-two surgeons (57%) indicated that 30 days was the optimal follow-up period for patients undergoing ileostomy reversal.

Perioperative practices, including the anesthesia protocol and ERAS pathway, are shown in Table 4. Only 35% of the patients were encouraged to drink clear liquids until 2 h before surgery. In their practice, more than half of the interviewees agreed with opioid-free anesthesia (73%), the administration of intravenous antibiotics (95%), and postoperative nausea and vomiting (PONV) prophylaxis

Table 2 Surgical details of ileostomy closure including anastomosis type and skin closure technique

	N (%)
Diagnostic laparoscopy before ileostomy reversal	
Yes	7 (3)
No	212 (97)
Closure of the afferent loop to reduce contamination	
Yes	98 (45)
No	121 (55)
Type of skin incision	
Elliptical peristomal incision	131 (60)
Circular peristomal incision	70 (32)
Mucocutaneous detachment	18 (8)
Resection of the edge of stoma	
Always	123 (56)
Sometimes	83 (38)
Never	13 (6)
Anastomosis technique	
Handsewn	99 (45.2)
Stapled	120 (54.8)
Cartridge for stapled anastomosis	
45 mm	56 (26)
60 mm	99 (45)
80 mm	13 (5.9)
100 mm	2 (0.9)
I always perform hand-sewn anastomosis	49 (22)
Closure of enterotomy for stapled anastomosis	
By stapler	80 (37)
Double-layer suture	72 (33)
Single-layer suture	13 (5.9)
I always perform hand-sewn anastomosis	54 (25)
Skin closure technique	
Purse string, gunsight, no closure	73 (33.3)
Linear closure with or without drain	146 (66.7)

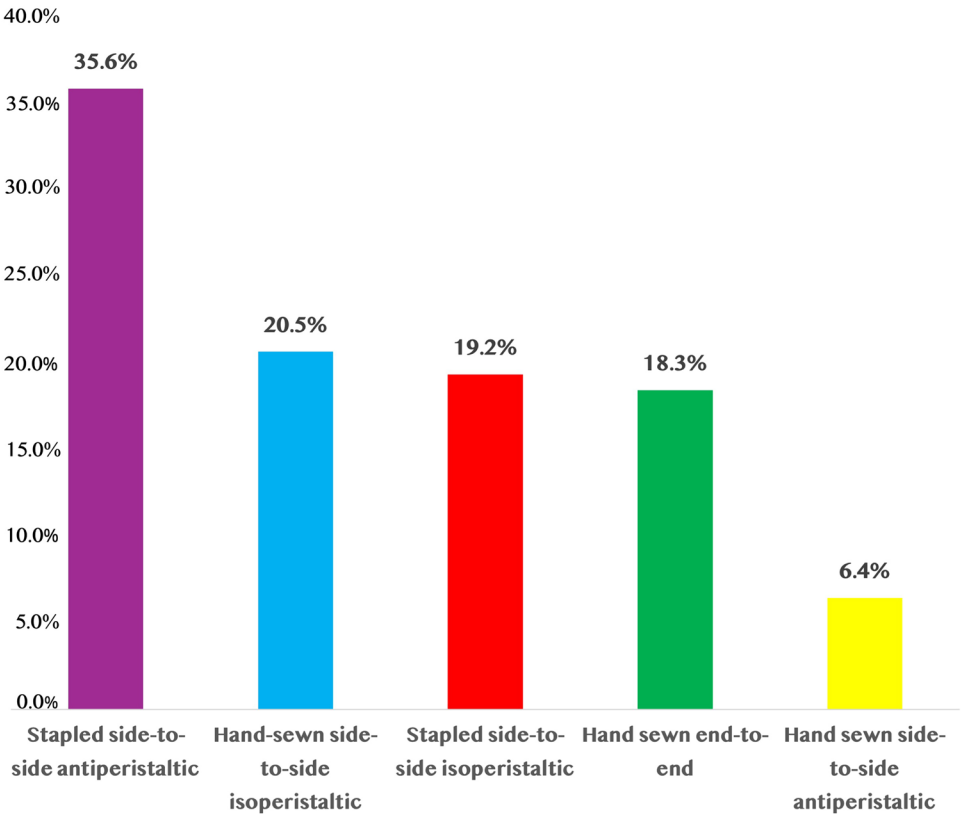

Fig. 2 Surgical techniques for anastomosis construction

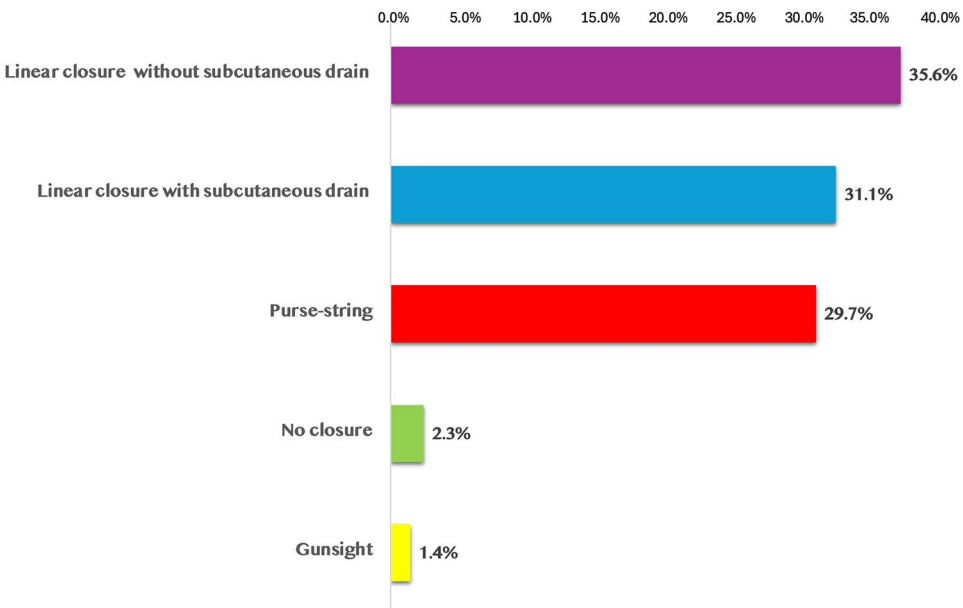

Fig. 3 Surgical techniques for skin closure

(66%), avoiding nasogastric tubes, foley catheters, and abdominal drains (84%, 62%, and 83%, respectively).

There was a variation in the timing of starting drinking water: 37% at 6 h and 38% at 12 h after surgery. Similarly, when no complications occurred, the time to start oral feeding differed among surgeons, with 63.4% initiating feeding within 24 h of surgery and 33.3% initiating feeding after the passage of flatus.

After categorizing the surgeons into subgroups based on their baseline characteristics, no differences were identified in the methods used for the construction of the anastomosis (Table 5). In contrast, ostomy site skin approximation

Table 3 Management of abdominal wall defect during ileostomy closure

	N (%)
Preferred method for abdominal wall closure	
Suture of anterior and posterior rectal sheath separately	109 (49.7)
Mass closure technique	92 (43.3)
Suture of anterior rectal sheath	5 (2.3)
Mesh reinforcement	3 (1.4)
Both suture of anterior and posterior rectal sheath separately and mass closure technique	9 (4.1)
Both suture of anterior rectal sheath and suture of anterior and posterior rectal sheath separately	1 (0.5)
Use of mesh	
Always	3 (1.4)
In selected patients	76 (35)
Never	140 (64)
Mesh placement	
Retromuscular (sublay)	63 (29)
Onlay	6 (2.7)
Inlay	4 (1.8)
Intraperitoneal	6 (2.7)
I do not use mesh	140 (64)
Type of mesh	
Biologic	19 (8.7)
Biosynthetic	26 (12)
Synthetic not adsorbable	21 (9.6)
Synthetic adsorbable	14 (6.4)
I do not use mesh	139 (63.5)
Management of clinically relevant parastomal hernia (> 5 cm)	
Ileostomy reversal and minimally invasive mesh repair	11 (5)
Ileostomy reversal and mesh repair through stoma site	75 (34)
Ileostomy reversal and suture repair through stoma site	117 (53)
Ileostomy reversal and mesh repair through midline laparotomy	10 (4.6)
Ileostomy reversal and suture repair through midline laparotomy	6 (2.7)
Management of concomitant midline incisional hernia	
Ileostomy reversal and delayed hernia repair (two stages)	157 (72)
Ileostomy reversal and simultaneous hernia repair	62 (28)
Optimal duration of follow-up after ileostomy reversal	
7 days	38 (17)
30 days	122 (56)
6 months	34 (16)
1 year	19 (8.7)
2 years	6 (2.7)

using open methods was significantly more common among surgeons with greater experience in ileostomy reversal ($p = 0.031$).

Finally, the answers concerning the eight items of the ERAS pathway were assessed (Table 6). Compared with general surgeons, there was statistical evidence that colorectal surgeons more accurately followed the ERAS protocol regarding preoperative nutritional care ($p = 0.044$), abdominal drain placement ($p = 0.002$), resumption of water ($p < 0.001$), and oral feeding ($p = 0.030$).

Discussion

This study was designed to explore the contemporary surgical management of patients scheduled for protective ileostomy closure following rectal cancer surgery. Members of the Italian Society of Colorectal Surgery (SICCR) were asked to participate in a survey addressing operative details and perioperative approaches. The main topics were anastomotic technique, skin closure, management of abdominal wall defects, and the ERAS pathway.

Table 4 ERAS care. NPO (nihil per os), PONV (postoperative nausea and vomiting)

	N (%)
Preoperative nutritional care	
Clear liquids till 2 h to surgery	77 (35)
NPO from 6 h before surgery	82 (37)
NPO from 12 h before surgery	60 (27)
Type of anesthesia	
General	198 (90.4)
Spinal	21 (9.6)
Antibiotic prophylaxis	
Yes, i.v	207 (94.5)
Yes, per os	5 (2.3)
No	7 (3.2)
Opioid anesthetic agents	
Yes	160 (73)
No	59 (27)
PONV prophylaxis	
Yes	145 (66)
No	74 (34)
Nasogastric tube	
Yes	35 (16)
No	184 (84)
Foley catheter	
Yes	84 (38)
No	135 (62)
Abdominal drain	
Yes	38 (17)
No	181 (83)
Oral sips of water	
Within 6 h of surgery	81 (37)
Within 12 h of surgery	83 (38)
Within 24 h of surgery	40 (18)
After passage of flatus	15 (6.8)
Solid feed	
Within 24 h of surgery	139 (63.4)
After passage of flatus	73 (33.3)
After passage of stools	7 (3.2)

Although several patient-related factors can influence the choice of the preoperative workup, we found significant heterogeneity in the evaluation of anastomotic integrity before ileostomy reversal. In this setting, guidelines suggest that routine radiological evaluation may not be necessary in the absence of clinical suspicion of anastomotic impairment [10]. Furthermore, a meta-analysis of 13 studies and 1903 patients compared the sensitivity and specificity of clinical, radiologic, and endoscopic assessments before diverting ostomy closure. The analysis demonstrated a higher accuracy of endoscopy and digital rectal examination, which appeared to be the best diagnostic tests to assess the integrity of the anastomosis [22]. However, only 12.8% of the respondents preferred this combination in the present study, while 25% of them employed both water-soluble contrast studies and endoscopy.

Stapled and hand-sewn anastomoses were preferred by 55% and 45% of surgeons, respectively. However, it cannot be ruled out that some surgeons perform both procedures in daily practice. In this regard, we can speculate that between 22 and 25% of the participants always performed hand-sewn anastomoses based on the answers provided. Therefore, it is conceivable that a higher percentage of participants used mechanical anastomosis. However, a similar distribution of the two methods of anastomosis construction was found among surgeons when they were compared by age, specialty, and experience in ileostomy reversal. This is consistent with previous recommendations supporting the use of both techniques [10]. A slight inclination towards stapled anastomosis is supported by a lower incidence of postoperative bowel obstruction and shorter operation time [11, 13, 23–27].

A recent Cochrane review, including 9 RCTs and 757 patients, compared purse-string skin closure versus linear skin closure after stoma reversal. Despite the high risk of performance and detection bias in each of the included studies, purse-string closure may be related to a lower incidence of wound infection and a higher level of patient satisfaction [28]. In this study, approximately 30% of the surgeons employed the purse-string technique, and 65% used linear closure with interrupted stitches. Surgeons performing > 12 ileostomy reversals per year were significantly more inclined to use the purse-string approximation and other open methods than low-volume surgeons. However, linear closure remained the most popular technique, even in this subgroup (62% vs. 38%). Since evidence has demonstrated benefits in favour of purse-string closures [14, 28, 29], compliance with the current guidelines is advocated [11, 23].

Optimal management of abdominal wall defects after stoma reversal has gained popularity in the last decade since a mesh prophylactic strategy demonstrated benefits in reducing stoma site incisional hernias with similar postoperative complication rates following standard closure [15, 30–32]. Although more than 90% of the surgeons declared that they performed separate closure of the anterior and posterior rectal sheaths or mass closure, 35% used mesh reinforcement in selected patients only. In contrast, 64% of the respondents did not place a prosthesis during ileostomy reversal. No recommendations have been made in this regard. As both obesity and parastomal hernias are associated with an increased risk of stoma site incisional hernia [33], and a mesh-based repair technique is typically recommended for patients with a midline incisional or spigelian hernia [34, 35], mesh reinforcement should be more represented among surgeons' preferences.

Table 5 Subgroup comparison of anastomosis and skin closure technique use

	< 40 years *N* (%)	≥ 40 years *N* (%)	p	Colorectal surgery *N* (%)	General surgery *N* (%)	*p*	≤ 12 procedures per year *N* (%)	> 12 procedures per year *N* (%)	*p*
Anastomosis									
Handsewn	44 (43)	55 (47)	0.566	56 (45)	43 (46)	0.889	31 (53)	68 (43)	0.185
Stapled	58 (57)	62 (53)		69 (55)	51 (54)		28 (47)	92 (58)	
Skin closure									
Purse string, gunsight and no closure	36 (35)	37 (32)	0.565	48 (38)	25 (27)	0.067	13 (22)	60 (38)	0.031
Linear closure	66 (65)	80 (68)		77 (62)	69 (73)		46 (78)	100 (62)	

Table 6 Subgroup comparison of ERAS pathway use

	< 40 years *N* (%)	≥ 40 years *N* (%)	*p*	Colorectal surgery *N* (%)	General surgery *N* (%)	*p*	≤ 12 procedures per year *N* (%)	> 12 procedures per year *N* (%)	*p*
Clear liquids till 2 h to surgery	31 (30)	46 (39)	0.168	51 (41)	26 (28)	0.044	19 (32)	58 (36)	0.578
Non-opioid anesthetics	66 (65)	94 (80)	0.009	95 (76)	65 (69)	0.258	45 (76)	115 (72)	0.515
PONV administration	74 (73)	71 (61)	0.064	43 (34)	31 (33)	0.826	40 (68)	105 (66)	0.763
Avoidance of nasogastric tube	88 (86)	96 (82)	0.395	109 (87)	75 (80)	0.138	49 (83)	135 (84)	0.812
Avoidance of Foley catheter	59 (58)	76 (65)	0.280	78 (62)	57 (61)	0.791	35 (59)	100 (63)	0.668
Avoidance of abdominal drain	86 (84)	95 (81)	0.543	112 (90)	69 (73)	0.002	46 (78)	135 (84)	0.267
Oral sips of water by 6 h post-surgery	36 (35)	45 (38)	0.628	61 (49)	20 (21)	< 0.001	14 (24)	67 (42)	0.014
Solid feed by 24 h post-surgery	59 (58)	80 (68)	0.106	87 (70)	52 (55)	0.030	32 (54)	107 (67)	0.085

A meshless strategy has also been adopted by approximately 55% of the surgeons to repair a clinically relevant parastomal hernia (> 5 cm). Consequently, a 30-day follow-up after surgery (56%) may not be justified because the incidence of stoma site incisional hernia is likely to increase with time [36, 37].

Furthermore, we investigated the optimal strategy for patients scheduled for stoma closure in the presence of an incisional hernia. In this study, 157 (72%) respondents selected the staged procedure. This finding is consistent with the limited data showing that simultaneous stoma reversal and midline incisional hernia repair may be associated with a higher risk of postoperative complications [38–40].

The introduction of ERAS protocols for ileostomy closure reduced hospital stays without affecting morbidity or readmission rates [17, 19, 41]. Although we found good compliance with the investigated items, colorectal surgeons were significantly more likely to follow the ERAS pathway than general surgeons.

This study had some limitations. The survey included respondents with different degrees of experience as general and colorectal surgeons. As ileostomy closure is considered a surgical procedure commonly performed by a broad category of surgeons, the answers provided are representative of real users, thereby increasing the external validity of the study. In contrast, only the Italian perspective was evaluated, excluding the opinions of foreign surgeons.

The questionnaire may be limited because patient-related and intraoperative factors can affect the decision-making process on a case-by-case basis. Although the setting was

intentionally limited to patients who underwent a protective ileostomy after rectal cancer surgery, the fixed range of options may not be representative of a more complex response. However, the present survey aimed to support evidence-based standardization of the procedures used in surgeons' daily practice. The answers were selected based on their own experiences and knowledge, and the heterogeneity of some items could underline the need for further research and affect the future direction of the guidelines.

This is the first nationwide survey on this topic focusing on surgical details and perioperative management. To achieve the best outcomes, clinical practice should be based on the safety and efficacy of treatment. We identified aspects that should be improved such as the ERAS pathway among general surgeons, the implementation of the purse-string skin closure technique, and investigations for other techniques such as the mesh prophylaxis strategy.

Conclusions

This survey showed that protective ileostomy reversal after rectal cancer surgery is not a standardized procedure in the surgical community. Preoperative examination and anastomotic technique vary significantly; linear closure of the skin was not completely replaced by purse-string approximation, and adherence to the ERAS pathway is more a prerogative of colorectal surgeons than general surgeons. Although safety and efficacy of mesh placement to prevent stoma site incisional hernia have been demonstrated, routine use and type of prosthesis deserve further research.

These findings raise awareness of the possibility of improving routine practices. Further efforts are warranted to develop evidence-based recommendations in this setting.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s13304-024-02033-9.

Acknowledgements Stoma Closure Collaborative Group: Alba Oliva, Alberto Serventi, Alberto Vannelli, Alessandro Ussia, Alessio Palumbo, Alex Bruno Bellocchia , Alfredo Annicchiarico, Alice Frontali, Andrea Avanzolini, Andrea Balla, Andrea Bondurri, Andrea Comba, Andrea Lauretta, Andrea Marco Tamburini, Andrea Morini, Angelo Di Vittori, Anna Maffioli, Annalisa Comandatore, Annamaria Minicozzi, Antonella Nicotera, Antonella Usai, Antonia Lavinia Zuliani, Antonio Cappiello, Antonio Castaldi, Antonio Giuliani, Antonio Langone, Antonio Luberto, Antonio Mario Scanu, Arcangelo Picciariello, Beatrice Salmaso, Bruno Nardo, Bruno Scotto, Carlo Alberto Manzo, Carlo Camplone, Chiara Marafante, Chiara Meroni Claudia Paolini, Claudio Coco, Claudio Feo, Claudio Guerci, Corrado Bottini, Corrado Pedrazzani, Cristina Folliero, Daniela Di Pietrantonio, Daniela Rega, Daniele Morezzi, Daniele Zigiotto, David Alessio Merlini, Davide Muschitiello, Davide Piccolo, Debora Cavallo, Demetrio Errigo, Diego Coletta, Diego Sasia, Diletta Corallino, Donato Paolo Pafundi, Eleonora Cardone, Emanuela Benatti, Emanuele Damiano Luca Urso, Emanuele Pontecorvi, Enrico Ciferri, Enrico Gibin, Enrico Lucci, Ernesto De Giulio, Ersilia Corrado, Ester Marra, Fabio Carbone, Fabio Marino, Fabio Rondelli, Fabrizio D'Acapito , Federico Cozzani, Federico Festa, Federico Lovisetto, Filippo Carannante, Francesca Ascari, Francesca Cravero, Francesca Paola Tropeano, Francesca Sabattini, Francesco Balestra, Francesco Bianco, Francesco Celotto, Francesco Colombo, Francesco Madeddu, Francesco Menegon Tasselli, Francesco Pata, Francesco Pezzolla, Gabriele Viola, Gabriella De Santi, Gabriella Teresa Capolupo, Gaetano Gallo, Gaetano Luglio, Gennaro Mazzarella, Giacomo Fuschillo, Gian Andrea Binda, Gianluca Baronio, Gianluca Curletti, Gianluca Masciana, Gianluca Pellino, Gianluca Rizzo, Gianluigi Moretto, Gianmaria Casoni Pattacini, Gianpiero Gravante, Gianrocco Manco, Giorgio Dalmonte, Giorgio Maria Paolo Graziano, Giovanni Cestaro, Giovanni Milito, Giovanni Tomasicchio, Giovanni Tortorelli, Giulia Bagaglini, Giulia De Carlo, Giulia Poli, Giulia Turri, Giuliano Barugola, Giuliano D'Onghia, Giulio Aniello Santoro, Giuseppe Berardi, Giuseppe Carollo, Giuseppe Di Gioia, Giuseppe Massimiliano De Luca, Giuseppe Rocco, Giuseppe Sena, Gloria Goi, Gregorio Di Franco, Guglielmo Clarizia, Guglielmo Niccolò Piozzi, Iacopo Monaci, Ilaria D'Addea, Ilaria Govoni, Ilenia Garosio, Ilenia Merlini, Iman Komaei, Imerio Angriman, Jacopo Martellucci, Laura Antolino, Luca Cestino, Luca Domenico Bonomo, Luca Ferrario, Luca Morelli, Lucia Franzoso, Lucio Selvaggi, Luigi Conti, Luigi Masoni, Luigi Zorcolo, Marco Beggiato, Marco Brizzolari, Marco Brolese, Marco Clementi, Marco Frascio, Marco Milone, Marco Platto, Maria Cariati, Maria Carmela Giuffrida, Maria Di Lena, Maria Roberta Fortunato, Marina Valente, Mario Giuffrida, Mario Trompetto, Marta Mozzon, Massimiliano Caccetta, Massimiliano Mistrangelo, Matteo Franceschi, Matteo Rottoli, Maurizio Ronconi, Mauro Podda, Mauro Pozzo, Michele Cricrì, Michele De Rosa, Michele Manigrasso, Niccolò Furbetta, Nicola Leone, Nicoletta Sveva Pipitone Federico, Nicolò Tamini, Paola Batistotti, Paola Campennì, Paola Meroni, Paolo Baccari, Paolo Massucco, Pasquale Ascenzi, Patrizia Marsanic, Peter Marinello, Pierpaolo Di Lascio, Pietro Anoldo, Pierluca Sallustio, Raffaele De Luca, Raffaele Lombardi, Rea Lo Dico, Renato Costi, Rita Laforgia, Roberta Longhin, Roberta Tutino, Roberto Perinotti, Salomone Di Saverio, Salvatore Guarino, Salvatore Incardona, Sara D'Errico, Sergio Sforza, Silvia Quaresima, Silvio Guerriero, Simona Ascanelli, Tommaso Bruno, Tommaso Cioppa, Tommaso Fontana, Tommaso Violante, Ugo Grossi, Valentina Miacci, Valentina Rampulla, Valerio Lantone, Valter Ripetti, Vania silvestri, Veronica De Simone, Vincenzo Adamo, Vinicio Mosca, Vittoria Bellato.

Author contributions Study conception and design: RP, FF, DPar. Data collection: RP, FF. Data analysis: DPac. Manuscript drafting: RP, FF, DPar, DPac. Manuscript revision: FS, AV, VP, RPi, PDN. All the authors approved the final version of the manuscript.

Funding No funding for this research.

Data availability Data can be available upon reasonable request to the corresponding author.

Declarations

Conflict of interest The authors declare that they have not conflict of interest.

Ethical approval The article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent is not required.

The collaborators for the "StomaClosure Collaborative Group" are listed in the acknowledgements.

References

1. Gu WL, Wu SW (2015) Meta-analysis of defunctioning stoma in low anterior resection with total mesorectal excision for rectal cancer: evidence based on thirteen studies. World J Surg Oncol 13:9. https://doi.org/10.1186/s12957-014-0417-1
2. Pisarska M, Gajewska N, Małczak P et al (2018) Defunctioning ileostomy reduces leakage rate in rectal cancer surgery - systematic review and meta-analysis. Oncotarget 9(29):20816–20825. https://doi.org/10.18632/oncotarget.25015
3. Mrak K, Uranitsch S, Pedross F et al (2016) Diverting ileostomy versus no diversion after low anterior resection for rectal cancer: A prospective, randomized, multicenter trial. Surgery (United States) 159:1129–1139. https://doi.org/10.1016/j.surg.2015.11.006
4. Peltrini R, Magno G, Pacella D et al (2023) Postoperative morbidity following loop ileostomy reversal after primary elective or urgent surgery: a retrospective study with 145 patients. J Clin Med 12(2):452. https://doi.org/10.3390/jcm12020452
5. Cottam J, Richards K, Hasted A, Blackman A (2007) Results of a nationwide prospective audit of stoma complications within 3 weeks of surgery. Colorectal Dis 9(9):834–838. https://doi.org/10.1111/j.1463-1318.2007.01213.x
6. Parini D, Bondurri A, Ferrara F et al (2023) Surgical management of ostomy complications: a MISSTO–WSES mapping review. World J Emerg Surg 18(1):48. https://doi.org/10.1186/s13017-023-00516-5
7. Yau T, Watkins D, Cunningham D et al (2009) Longitudinal assessment of quality of life in rectal cancer patients with or without stomas following primary resection. Dis Colon Rectum 52(4):669–677. https://doi.org/10.1007/DCR.0b013e31819eb970
8. Emile SH, Horesh N, Garoufalia Z et al (2024) Outcomes of early versus standard closure of diverting ileostomy after proctectomy meta-analysis and meta-regression analysis of randomized controlled trials. Ann Surg 279(4):613–619. https://doi.org/10.1097/SLA.0000000000006109
9. Podda M, Coccolini F, Gerardi C et al (2022) Early versus delayed defunctioning ileostomy closure after low anterior resection for rectal cancer: a meta-analysis and trial sequential analysis of safety and functional outcomes. Int J Colorectal Dis 37(4):737–756. https://doi.org/10.1007/s00384-022-04106-w
10. Davis BR, Valente MA, Goldberg JE et al (2022) The American Society of colon and rectal surgeons clinical practice guidelines for ostomy surgery. Dis Colon Rectum 65(10):1173–1190. https://doi.org/10.1097/DCR.0000000000002498
11. Ferrara F, Parini D, Bondurri A et al (2019) Italian guidelines for the surgical management of enteral stomas in adults. Tech Coloproctol 23(11):1037–1056. https://doi.org/10.1007/s10151-019-02099-3
12 Luglio G, Terracciano F, Giglio MC et al (2017) Ileostomy reversal with handsewn techniques. Short-term outcomes in a teaching hospital. Int J Colorectal Dis 32(1):113–118
13. Madani R, Day N, Kumar L et al (2019) Hand-sewn versus stapled closure of loop ileostomy: a meta-analysis. Dig Surg 36(3):183–194. https://doi.org/10.1159/000487310
14 Gachabayov M, Lee H, Chudner A et al (2019) Purse-string vs. linear skin closure at loop ileostomy reversal: a systematic review and meta-analysis. Tech Coloproctol 23(3):207–220
15. Peltrini R, Imperatore N, Altieri G et al (2021) Prevention of incisional hernia at the site of stoma closure with different reinforcing mesh types: a systematic review and meta-analysis. Hernia 25(3):639–648. https://doi.org/10.1007/s10029-021-02393-w
16. Ni X, Jia D, Chen Y et al (2019) Is the enhanced recovery after surgery (ERAS) program effective and safe in laparoscopic colorectal cancer surgery? A meta-analysis of randomized controlled trials. J Gastrointest Surg 23(7):1502–1512. https://doi.org/10.1007/s11605-019-04170-8
17. Bracey E, Chave H, Agombar A et al (2015) Ileostomy closure in an enhanced recovery setting. Colorectal Dis 17(10):917–921. https://doi.org/10.1111/codi.12989
18. Slieker J, Hübner M, Addor V et al (2018) Application of an enhanced recovery pathway for ileostomy closure: a case–control trial with surprising results. Tech Coloproctol 22(4):295–300. https://doi.org/10.1007/s10151-018-1778-1
19. Madan S, Sureshkumar S, Anandhi A et al (2023) Comparison of enhanced recovery after surgery (ERAS) pathway versus standard care in patients undergoing elective stoma reversal surgery- a randomized controlled trial. J Gastrointest Surg 27(11):2667–2675. https://doi.org/10.1007/s11605-023-05803-9
20. Eysenbach G (2004) Improving the quality of web surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 6(3):e34. https://doi.org/10.2196/jmir.6.3.e34
21. Pucciarelli S, Zorzi M, Gennaro N et al (2018) Relationship between hospital volume and short-term outcomes: a nationwide population-based study including 75,280 rectal cancer surgical procedures. Oncotarget 9(24):17149–17159. https://doi.org/10.18632/oncotarget.24699
22. Lindner S, Eitelbuss S, Hetjens S et al (2021) Less is more—the best test for anastomotic leaks in rectal cancer patients prior to ileostomy reversal. Int J Colorectal Dis 36(11):2387–2398. https://doi.org/10.1007/s00384-021-03963-1
23. Hasegawa H, Radley S, Morton DG, Keighley MRB (2000) Stapled versus sutured closure of loop ileostomy a randomized controlled trial. Ann Surg 231(2):202–204. https://doi.org/10.1097/00000658-200002000-00008
24. Löffler T, Rossion I, Goußen K et al (2015) Hand suture versus stapler for closure of loop ileostomy—a systematic review and meta-analysis of randomized controlled trials. Langenbecks Arch Surg 400(2):193–205. https://doi.org/10.1007/s00423-014-1265-8
25. Gustavsson K, Gunnarsson U, Jestin P (2012) Postoperative complications after closure of a diverting ileostoma-differences according to closure technique. Int J Colorectal Dis 27(1):55–58. https://doi.org/10.1007/s00384-011-1287-4
26. Löffler T, Rossion I, Bruckner T et al (2012) 2012) HAnd suture versus STApling for closure of loop ileostomy (HASTA Trial): results of a multicenter randomized trial (DRKS00000040. Ann Surg 256(5):828–835
27. Meshkati Yazd SM, Shahriarirad R, Keramati MR et al (2024) Comparison of hand-sewn anterior repair, resection and hand-sewn anastomosis, resection and stapled anastomosis techniques for the reversal of diverting loop ileostomy after low anterior rectal resection: a randomized clinical trial. Tech Coloproctol 28(1):30. https://doi.org/10.1007/s10151-023-02898-9
28. Hajibandeh S, Hajibandeh S, Maw A (2024) Purse-string skin closure versus linear skin closure in people undergoing stoma reversal. Cochrane Database Syst Rev 3(3):CD014763
29 Carannante F, Costa G, Miacci V et al (2024) Comparison of purse-string technique vs linear suture for skin closure after ileostomy reversal. A randomized controlled trial. Langenbecks Arch Surg 409(1):141
30. Bhangu A, Nepogodiev D, Ives N et al (2020) Prophylactic biological mesh reinforcement versus standard closure of stoma site (ROCSS): a multicentre, randomised controlled trial. Lancet 395(10222):417–426. https://doi.org/10.1016/S0140-6736(19)32637-6
31. Dewantoro D, Manson P, Brazzelli M, Ramsay G (2024) Reversal of stoma with biosynthetic mesh fascial reinforcement: a systematic review and meta-analysis. Colorectal Dis 26(4):632–642. https://doi.org/10.1111/codi.16913

32. Mäkäräinen EJ, Wiik HT, Kössi JAO et al (2024) Prevention of incisional hernia with retrorectus synthetic mesh versus biological mesh following loop ileostomy closure (Preloop trial). Br J Surg 111(1):zand362
33. Ramírez-Giraldo C, Van-Londoño I, Monroy DC et al (2023) Risk factors associated to incisional hernia in stoma site after stoma closure: A systematic review and meta-analysis. Int J Colorectal Dis 38(1):267. https://doi.org/10.1007/s00384-023-04560-0
34. Sanders DL, Pawlak MM, Simons MP et al (2023) Midline incisional hernia guidelines: the European Hernia Society. Br J Surg 110(12):1732–1768. https://doi.org/10.1093/bjs/znad284
35. Henriksen NA, Kaufmann R, Simons MP et al (2020) EHS and AHS guidelines for treatment of primary ventral hernias in rare locations or special circumstances. BJS Open 4(2):342–353. https://doi.org/10.1002/bjs5.50252
36. Guzmán-Valdivia G (2008) Incisional hernia at the site of a stoma. Hernia 12(5):471–474. https://doi.org/10.1007/s10029-008-0378-9
37. Bhangu A, Nepogodiev D, Futaba K (2012) Systematic review and meta-analysis of the incidence of incisional hernia at the site of stoma closure. World J Surg 36(5):973–983. https://doi.org/10.1007/s00268-012-1474-7
38. Peltrini R, Pacella D, Rossi L et al (2024) Systematic review and meta-analysis of postoperative outcomes after combined stoma reversal and incisional hernia repair versus stoma reversal alone. Minerva Surg 79(3):339–345. https://doi.org/10.23736/S2724-5691.23.10171-7
39. Oma E, Baastrup NN, Jensen KK (2021) Should simultaneous stoma closure and incisional hernia repair be avoided? Hernia 25(3):649–654. https://doi.org/10.1007/s10029-020-02312-5
40. Baastrup NN, Hartwig MFS, Krarup PM et al (2019) Anastomotic leakage after stoma reversal combined with incisional hernia repair. World J Surg 43(4):988–997. https://doi.org/10.1007/s00268-018-4866-5
41. Berger NG, Chou R, Toy ES et al (2017) Loop ileostomy closure as an overnight procedure: Institutional Comparison with the National Surgical Quality Improvement Project Data Set. Dis Colon Rectum 60(8):852–859. https://doi.org/10.1097/DCR.0000000000000793