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ORIGINAL ARTICLE

Protective ileostomy creation after anterior resection of the rectum (PICARR): a decision-making exploring international survey

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Abstract

In our previous survey of experts, surgeon's decision-making process (DMP) about protective ileostomy (PI) creation after anterior resection was investigated. Based on our previous data, a multiple choice questionnaire has been developed. The aim is to perform a quantitative analysis of the results obtained from an international survey and to describe the clinical practice worldwide. Ten questions were related to participants' demographics and, 20 questions (of which 17 Likert scale questions) investigated the DMP regarding PI creation. To evaluate the tendency of the answers in the Likert-type questions, the mean of the answers obtained was compared with the mean point of the Likert scale. The survey was completed by 1019 physicians. Neoadjuvant chemoradiotherapy and distance of the anastomosis from the anal verge ≤ 10 cm were each considered alone sufficient to justify creation of a PI, with statistically significant differences in comparison to the mean point of the scales in ($p = < 0.0001$ in both cases). Total Mesorectal Excision alone was not considered a factor sufficient to create a PI ($p = 0.416$). Most of the participants agree to define their approach to create a PI "tailored" to patients' risk factors ($p = < 0.0001$) and "influenced by my experience" in case of patients with low/moderate risk of anastomotic leakage ($p = < 0.0001$). This study provides useful insights on the worldwide clinical practice regarding creation of PI following anterior resection. Given the lack of standardization and evidence-based guidelines, this analysis may be helpful to assist surgeons' practice.

Keywords Protective ileostomy · Defunctioning stoma · Decision-making process · Anterior resection of the rectum · Adenocarcinoma

Introduction

Protective ileostomy (PI) creation after elective anterior resection (AR) for rectal cancer is still hotly debated among surgeons, even though it is well recognized that it decreases morbidity and mortality associated with anastomotic leakage (AL) after surgery [1–7]. Although the finding of multiple preoperative risk factors for AL would warrant the creation of a PI, the lack of clear guidelines on when a PI can be safely omitted, leads to highly variable decision-making as to whether to create PI, and often based on individual surgeons' preferences, and influenced by prior experience [1, 8–15].

Creation of a PI does not reduce the risk of AL [7, 8, 16–20]. Hence, the risk of AL should be balanced with risk of ileostomy- and ileostomy closure-related complications, including the impact of a stoma creation on quality of life (QoL) [7, 8, 16–20].

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A survey-based qualitative analysis was previously performed using open-ended questions to investigate individual expert surgeon's decision-making process (DMP) regarding PI creation [8]. Based on the responses collected from international expert colorectal surgeons, a multiple choice questionnaire was developed and disseminated worldwide.

The aim of the present study was to perform a quantitative analysis of the results obtained from the international survey, and to describe the breadth of clinical practices. As in the previous study, the purpose was not to develop evidence-base guidelines or achieve consensus, but to provide guidance to surgeons debating when to perform PI after rectal cancer surgery.

Methods

The present cross-sectional study was conducted according to the ethical guidelines for good research and practice published by the World Health Organization [21] and to the Checklist for Reporting of Survey Studies (CROSS) [22].

Based on data retrieved from our previous study [8], two surgeons (A.B. and F.S.) and one social psychologist (M.R.) developed a multiple-choice electronic questionnaire to be administered to consultant surgeons and trainees irrespective of years of experience, type of practice, or location.

This study was promoted by the European Association for Endoscopic Surgery (EAES), the Italian Society of Endoscopic Surgery and New Technologies (SICE), the Italian Society of Colorectal Surgery (SICCR), the Italian Society of Surgery (SIC), and the Spanish Association of Coloproctology (AECP), who distributed the questionnaire to their members. Moreover, additional participants were recruited through social media platforms, including Linkedin, X (formally Twitter) and WhatsApp, personalized emails and individual outreach. The electronic questionnaire was tested for its functionality and published online using Google Form (Google LLC, Mountain View, California US).

A 30-question multiple-choice questionnaire was developed in English. Ten questions investigated the participants' demographics (gender, age, country of practice, working position, sub-specialty, hospital type, years in practice since residency, approximate number of elective AR performed as primary surgeon and as first assistant).

Twenty questions investigated the DMP regarding PI creation. Of these, 17 questions were Likert scale questions (15 questions with a scale from 1 to 7, and 2 questions with a scale from 1 to 10) (Supplementary material). Participants were asked to provide their degree of agreement to create a PI in the presence of risk factors responsible for AL, intraoperative technical factors, or risks of postoperative complications related to AL or ileostomy- and ileostomy closure-related complications. All questions were extrapolated from our previous study [8].

All fields were mandatory. The questionnaire was available online from May 5, 2023 until June 1, 2024.

Statistical analysis

Responses were analyzed and compared based on training level (consultant surgeons or resident) as previously described in our published study [8].

Continuous variables are expressed as mean ± standard deviation (SD), or median and range, while categorical variables are expressed as frequencies and percentages. Student's t test and chi-square test were used for the comparison between groups for continuous and categorical variables, respectively.

Moreover, to evaluate the tendency of the answers in the Likert-type questions, the mean of the answers obtained was compared with the mean point of the Likert scale (3.5 for Likert scale from 1 to 7 and 5 for Likert scale from 1 to 10).

A p value lower than 0.05 was considered statistically significant. Statistical analysis was carried out using SPSS software 25.0 (SPSS Inc., Chicago, Illinois, USA).

Results

1019 participants completed the survey, including 812 consultant surgeons (79.7%) and 207 residents (20.3%). The majority of participants were male (772, 75.8%) with a mean age of 41.45 ± 10.56 years. The majority of the participants were Italian (563, 55.3%), followed by Spanish (104, 10.2%), and Greek (46, 4.5%). Participants demographic information are reported in Table 1.

The first DMP question (question 11) explored whether any additional risk factors may influence surgeons' decision to create a PI, separate from the risk factors previously elicited in our prior study among expert surgeons (Table 2) [8]. 275 surgeons (27%) described additional risk factors, with some overlap with previously elicited risk factors. However, several new risk factors were reported including the surgeon's experience, the type of anastomosis, the use of comorbidities index (including Geriatric index, frailty index, Eastern Cooperative Oncology Group [ECOG] performance status, Charlson comorbidity index, The American College of Surgeons National Surgical Quality Improvement Program [ACS-NSQIP] Surgical Risk Calculator), the patient's ability to care for themselves and the operative volume center per year (Table 3).

All the responses investigating the DMP regarding PI creation (Likert scales) are reported in detail graphically with a statistical analysis in the Supplementary material, while

Table 1 Demographics participants' characteristics

N	Questions	All participants *N* = 1019	Consultant surgeons *n* = 812 (79.7%)	Residents *n* = 207 (20.3%)
2	Gender ratio (*n*, %), woman: man	247 (24.2): 772 (75.8)	166 (20.4): 646 (79.6)	81 (39.1): 126 (60.9)
3	Mean age, years ± standard deviation	41.45 ± 10.56	44.33 ± 9.85	30.14 ± 2.85
	Country of practice, *n* (%)			
4	Albania	2 (0.2)	2 (0.2)	–
	Armenia	1 (0.09)	1 (0.1)	–
	Australia	1 (0.09)	1 (0.1)	–
	Austria	5 (0.5)	5 (0.6)	–
	Azerbaijan	1 (0.09)	1 (0.1)	–
	Bahrain	1 (0.09)	1 (0.1)	–
	Bangladesh	1 (0.09)	1 (0.1)	–
	Belgium	7 (0.7)	7 (0.9)	–
	Bosnia and Herzegovina	4 (0.4)	3 (0.4)	1 (0.5)
	Bulgaria	6 (0.6)	6 (0.7)	–
	Canada	1 (0.09)	–	1 (0.5)
	China	1 (0.09)	1 (0.1)	–
	Croatia	3 (0.3)	3 (0.4)	–
	Cuba	1 (0.09)	1 (0.1)	–
	Cyprus	2 (0.2)	2 (0.2)	–
	Czech Republic	4 (0.4)	4 (0.5)	–
	Egypt	10 (1)	9 (1.1)	1 (0.5)
	Ethiopia	1 (0.09)	–	1 (0.5)
	France	8 (0.8)	7 (0.9)	1 (0.5)
	Germany	7 (0.7)	4 (0.5)	3 (1.4)
	Greece	46 (4.5)	35 (4.3)	11 (5.3)
	Hungary	3 (0.3)	3 (0.4)	–
	India	17 (1.7)	16 (2)	1 (0.5)
	Ireland	5 (0.5)	3 (0.4)	2 (1)
	Israel	2 (0.2)	1 (0.1)	1 (0.5)
	Italy	563 (55.3)	422 (52)	141 (68.1)
	Japan	1 (0.09)	1 (0.1)	–
	Kenya	3 (0.3)	2 (0.2)	1 (0.5)
	Kosovo	2 (0.2)	2 (0.2)	–
	Latvia	1 (0.09)	1 (0.1)	–
	Lithuania	3 (0.3)	3 (0.4)	–
	Luxembourg	2 (0.2)	2 (0.2)	–
	Malaysia	1 (0.09)	1 (0.1)	–
	Malta	1 (0.09)	1 (0.1)	–
	Mexico	2 (0.2)	1 (0.1)	1 (0.5)
	Marocco	1 (0.09)	1 (0.1)	–
	Moldova	1 (0.09)	1 (0.1)	–
	Montenegro	3 (0.3)	2 (0.2)	1 (0.5)
	Netherlands	13 (1.3)	12 (1.5)	1 (0.5)
	Pakistan	4 (0.4)	2 (0.2)	2 (1)
	Palestine	1 (0.09)	1 (0.1)	–
	Peru	2 (0.2)	2 (0.2)	–
	Philippines	2 (0.2)	2 (0.2)	–
	Poland	6 (0.6)	4 (0.5)	2 (1)
	Portugal	6 (0.6)	5 (0.6)	1 (0.5)
	Qatar	1 (0.09)	1 (0.1)	–

Table 1 (continued)

N	Questions	All participants *N* = 1019	Consultant surgeons *n* = 812 (79.7%)	Residents *n* = 207 (20.3%)
	Republic of Korea	1 (0.09)	1 (0.1)	–
	Romania	35 (3.4)	29 (3.6)	6 (2.9)
	Russia	7 (0.7)	3 (0.4)	4 (1.9)
	Serbia	7 (0.7)	6 (0.7)	1 (0.5)
	Singapore	1 (0.09)	1 (0.1)	–
	Slovakia	2 (0.2)	2 (0.2)	–
	Slovenia	4 (0.4)	2 (0.2)	2 (1)
	South Korea	1 (0.09)	1 (0.1)	–
	Spain	104 (10.2)	99 (12.2)	5 (2.4)
	Sweden	3 (0.3)	3 (0.4)	–
	Switzerland	30 (2.9)	28 (3.4)	2 (1)
	Tunisia	4 (0.4)	3 (0.4)	2 (1)
	Turkey	19 (1.9)	13 (1.6)	6 (2.9)
	United Kingdom	27 (2.6)	22 (2.7)	5 (2.4)
	Ukraine	1 (0.09)	–	1 (0.5)
	United Arab Emirates	2 (0.2)	2 (0.2)	–
	USA	12 (1.2)	11 (5.3)	1 (0.5)
6	Sub-specialty, n (%)			
	General surgeon	639 (62.7)	465 (57.3)	174 (84)
	Colorectal surgeon	380 (37.3)	347 (42.7)	33 (16)
7	Type of Hospital, n (%)			
	Public	534 (52.4)	432 (53.2)	102 (49.3)
	Private	95 (9.3)	85 (10.5)	10 (4.8)
	Academic	390 (38.3)	295 (36.3)	95 (45.9)
8	Mean number of years of practice after the end of the residency, years ± standard deviation	12.58 ± 10.23	12.58 ± 10.23	–
9	Median approximate number of elective anterior resection performed as surgeon in your career (range)	30 (0–4000)	50 (0–4000)	–
10	Median approximate number of elective anterior resection performed as first assistant in your career (not as tutor) (range)	50 (0–3700)	95 (0–3700)	10 (0–350)

Table 4 reports all answers as mean and the comparison with the mean point of each scale.

The majority of consultants and residents agreed with the risk factors for creating a PI identified in our previous study. Neoadjuvant chemoradiotherapy (n-CRT) and distance of the anastomosis from the anal verge ≤ 10 cm were considered independently sufficient to justify PI. The comparison between the mean of responses of consultant and resident in comparison to the mean point of the scales in case of n-CRT, and distance of the anastomosis from the anal verge was statistically significantly in favor to create a PI ($p = < 0.0001$ in both cases). Moreover, the comparison between consultants and residents showed that the degree of agreement of consultants is significantly statistically higher than that of residents in case of n-CRT (Table 4).

On the contrary, consultants and residents did not consider Total Mesorectal Excision (TME) alone independently sufficient to create a PI. The comparison between the mean of the answers and the mean point of the scale was statistically significant difference for residents ($p = < 0.0001$) (Table 4). To note that, overall, 338 participants (33.2%, 254 consultants and 84 residents) considered the distance of the anastomosis from the anal verge ≤ 10 cm an independent factor for the creation a PI (Likert scale range from 4 to 7). However, the same cohort of participants did not consider TME an independent factor for PI creation (Likert scale range from 1 to 4).

Overall, patient's strong opposition to have a PI is very important in the DMP of both consultants and residents, with a statistically significant difference in comparison to the mean point of the scale in both cases ($p = < 0.0001$). However, patient's strong opposition did not influence surgeons' DMP in case of high-risk patients to develop AL,

Table 2 Risk factors previously elicited in our prior study among expert surgeons [8]

Patient's factors:	Intraoperative factors:
Age	Operative approach (minimally invasive or open)
Gender	Number of stapler firings
American Society of Anesthesiology (ASA) grade	Anastomotic fluorescence assessment
High body mass index	Intraoperative leak test
Diabetes mellitus	Extensive additional resection for tumor growth
Preoperative serum albumin	Intraoperative blood loss
Preoperative hemoglobin	Ghost ileostomy creation
Malnutrition	Operative time
Preoperative weight loss	Pelvic drain
Cardiovascular disease	Rectal tube
Electrolytes disorders	Difficult dissection
Perioperative blood transfusions	Incomplete doughnuts
Smoking	Surgeons' perception
Steroid (or immunosuppression) therapy	Endoscopic evaluation
Non-steroidal anti-inflammatory drugs (NSAID)	Anastomotic tension
Alcohol habits	Intraoperative events (anesthetic, cardiorespiratory, hemodynamic)
Preoperative oral antibiotic preparation	Partial Mesorectal Excision
Comorbidities	Different bowel caliber
Advanced kidney disease (dialysis)	Pulsatile arterial flow
Patients refusing	Pull-through coloanal anastomosis
Chronic liver disease	Narrow pelvis
Respiratory disease	Transanal Total Mesorectal Excision
Abscess	Mechanical bowel preparation
Tumor factors:	Mechanical anastomosis
Neoadjuvant chemoradiotherapy (n-CRT)	Conversion to open surgery
Distance of the anastomosis from the anal verge	Intraoperative bowel perforation
Tumor size	Intraoperative inotropic treatment
Tumor stage	
Other factors:	
24 h of care available	

with a statistically significant difference in comparison to the mean point of the scale ($p = < 0.0001$) (Table 4).

Most of the participants, both consultants and residents, agree to create a definitive or a protective colostomy instead of a PI, for patients with multiple comorbidities, elderly and frail and in patients with renal failure and at risk for ileostomy-related complications, with statistically significant difference in comparison to the mean point of the Likert scale ($p = < 0.0001$) (Table 4).

Similarly, both consultants and residents agreed to create PI in patients unable to tolerate AL in terms of having enough physiological reserve to withstand the potential septic complications of an AL, even in the absence of risk factors for AL, with statistically significant difference in comparison to the mean point of the Likert scale ($p = < 0.0001$) (Table 4).

Intraoperatively, the subjective sensation of difficulty in performing the surgical procedure alone is considered as a factor sufficient to create a PI by most of the participants with a statistically significant difference in comparison to the mean point of the scale ($p = < 0.0001$). On the other hand, in the absence of adverse intraoperative findings (including positive leak test, AL visualized by endoscopy and absence of pulsatile arterial flow) in patients with low/moderate risk of AL, most participants agreed to not create a PI, without achieving a statistically significant difference with the mean point of the scale (Table 4).

Consultants and residents agreed to define their "tailored" approach to PI based on patients' risk factors ($p = < 0.0001$) and "influenced by my experience" in case of patients with low/moderate risk of AL ($p = < 0.0001$) (Table 4).

Most consultants and residents did not consider ghost ileostomy as a safe alternative to replace PI. A statistically significant difference was observed for consultants in comparison to the mean point of the Likert scale ($p = < 0.0001$) (Table 4). Regarding the use of fluorescence angiography for the evaluation of anastomotic perfusion as an independent

Table 3 Further risk factors involved in the surgeon's decision-making process proposed

Question 11—from 275 participants (27%) (226 consultants, 27.8% and 49 residents, 23.7%)
Surgeon's experience
Intensive care unit availability
Transanal Transection and Single-Stapled Anastomosis (TTSS)
Geriatric index, frailty index, Eastern Cooperative Oncology Group (ECOG) performance status, Charlson comorbidity index, The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) Surgical Risk Calculator
Intraabdominal adhesions for previous surgery, previous small bowel resection, recent pelvic surgery
Need of postoperative chemotherapy
Patient's cognitive impairment, intellectual disability, psychiatric disorder, ability to manage stoma care, socio-economic status
Preoperative C-reactive protein
Hypothermia
Extensive diverticular disease near the anastomosis
Microbiota, intestinal bacteria
Bowel thickness
Bowel obstruction
Inclusion in a "Enhanced Recovery After Surgery" (ERAS) protocol
Presence of a salvage protocol in case of anastomotic leakage
Short term versus long term neoadjuvant chemoradiotherapy (n-CRT)
Liquid stool, distended bowel
Preoperative fecal incontinence or soiling
Bedridden patient
Medico-legal factors
Number of procedures performed annually for center
Anterior tumor
Difficult anatomy
Use of hand suturing versus stapling
Obstructive sleep apnea syndrome (OSAS)
Double stapled anastomosis
Aerobic fitness
Escherichia coli in anastomotic site
Omission of combined bowel preparation

factor sufficient to decide on the creation of a PI, an agreement between consultants and residents was observed, with no significant difference between the two groups ($p = 0.207$) (Table 4).

Both consultants (Never: 29.4%, Rarely: 32.9%) and residents (Never: 22.7%, Rarely: 36.2%), never or rarely use scores or algorithms to standardize PI creation (Table 5). Finally, most consultants and residents agreed that the usefulness of a PI is limited to patients who experience postoperative AL, which occurs in fewer than 30% of cases in some studies [7, 8, 16–20]. This assumption significantly influences their DMP in comparison to the mean point of the scale ($p = < 0.0001$) (Table 4).

Discussion

The present study was conducted with the aim of reporting the current clinical practice in relation to creation of a PI after AR for rectal cancer and to provide useful information for surgeons. A quantitative analysis was carried out analyzing data obtained from a multiple-choice questionnaire developed on a previous qualitative analysis of answers retrieved from expert surgeons [8]. As in the previous study [8], PI creation is a very common procedure in several scenarios, even if most surgeons report their DMP is tailored based on patient's characteristics and on the surgeons experience.

Table 4 Likert scales answers in mean and the comparison with the mean value of the scale, including a comparison between consultants and residents

N°	Questions	Participants' responses (1019), mean ± standard deviation	Difference between participants' responses and the mean point of the Likert scale, *p* value	Consultants' responses (812), mean ± standard deviation	Difference between consultants' responses and the mean point of the Likert scale, *p* value	Residents' Responses (207), mean ± standard deviation	Difference between residents' responses and the mean point of the Likert scale, *p* value	Difference between consultants and residents, *p* value
12	The risk factors, most frequently considered in the decision to create a PI are in order: distance of the anastomosis from the anal verge, n-CRT, intraoperative leak test, intraoperative blood loss, immunosuppression therapy, anastomotic fluorescent assessment, malnutrition, number of stapler firings, multivisceral resection, multiple comorbidities, operative time and intraoperative difficult dissection. How much do you agree with these risk factors?	6.22 ± 1.00	**< 0.0001**	6.26 ± 0.99	**< 0.0001**	6.04 ± 1.02	**< 0.0001**	**0.006**
13	How much do you agree that n-CRT alone is sufficient to create a PI?	4.74 ± 1.76	**< 0.0001**	4.84 ± 1.76	**< 0.0001**	4.35 ± 1.70	**< 0.0001**	**< 0.0001**
14	How much do you agree that "Total Mesorectal Excision" alone is sufficient to create a PI?	3.45 ± 1.90	0.416	3.55 ± 1.93	0.416	3.04 ± 1.70	**< 0.0001**	**< 0.0001**

Table 4 (continued)

N°	Questions	Participants' responses (1019), mean ± standard deviation	Difference between participants' responses and the mean point of the Likert scale, *p* value	Consultants' responses (812), mean ± standard deviation	Difference between consultants' responses and the mean point of the Likert scale, *p* value	Residents' Responses (207), mean ± standard deviation	Difference between residents' responses and the mean point of the Likert scale, *p* value	Difference between consultants and residents, *p* value
15	How much do you agree that distance of the anastomosis from the anal verge ≤ 10 cm alone is sufficient to create a PI?	3.85 ± 1.88	**< 0.0001**	3.80 ± 1.89	**< 0.0001**	4.03 ± 1.80	**< 0.0001**	0.113
16	In your DMP, how important is the patient's strong opposition to have a PI?	3.79 ± 1.71	**< 0.0001**	3.73 ± 1.73	**< 0.0001**	4.02 ± 1.61	**< 0.0001**	**0.023**
17	In your DMP in case of a low-risk patient to develop AL, how important is the patient's refusal to have a PI?	4.64 ± 1.78	**< 0.0001**	4.58 ± 1.82	**< 0.0001**	4.85 ± 1.62	**< 0.0001**	**0.038**
18	In your DMP in case of a high-risk patient to develop AL, how important is the patient's refusal to have a PI?	2.84 ± 1.78	**< 0.0001**	2.83 ± 1.82	**< 0.0001**	2.88 ± 1.63	**< 0.0001**	0.694
19	In case of a patient with multiple comorbidities, elderly and frail, how much do you agree to create a definitive colostomy?	5.21 ± 1.51	**< 0.0001**	5.29 ± 1.51	**< 0.0001**	4.89 ± 1.47	**< 0.0001**	**0.001**

Table 4 (continued)

N°	Questions	Participants' responses (1019), mean ± standard deviation	Difference between participants' responses and the mean point of the Likert scale, *p* value	Consultants' responses (812), mean ± standard deviation	Difference between consultants' responses and the mean point of the Likert scale, *p* value	Residents' Responses (207), mean ± standard deviation	Difference between residents' responses and the mean point of the Likert scale, *p* value	Difference between consultants and residents, *p* value
20	In case of a patient with renal failure or at risk of complications due to dehydration, how much do you agree to create a protective colostomy instead of a PI?	4.73 ± 1.66	**< 0.0001**	4.72 ± 1.72	**< 0.0001**	4.77 ± 1.42	**< 0.0001**	0.652
21	If you feel the patient unable to tolerate an AL, how much do you agree to create a protective ileostomy even in the absence of risk factors for AL?	4.93 ± 1.66	**< 0.0001**	4.96 ± 1.67	**< 0.0001**	4.80 ± 1.59	**< 0.0001**	0.191
22	In case of subjective intraoperative sensation of difficulty alone, how much do you agree to create a PI?	4.82 ± 1.47	**< 0.0001**	4.88 ± 1.50	**< 0.0001**	4.56 ± 1.34	**< 0.0001**	**0.003**
23	In the event that a patient with low/moderate risk of AL if intraoperative factors, such as negative leak test, anastomosis visualization by endoscopy, pulsatile arterial flow at the colonic end occurred, how much do you agree to not create the protective ileostomy?	5.15 ± 2.44	0.042	5.12 ± 2.49	0.147	5.27 ± 2.26	0.088	0.426

Table 4 (continued)

N°	Questions	Participants' responses (1019), mean ± standard deviation	Difference between participants' responses and the mean point of the Likert scale, *p* value	Consultants' responses (812), mean ± standard deviation	Difference between consultants' responses and the mean point of the Likert scale, *p* value	Residents' Responses (207), mean ± standard deviation	Difference between residents' responses and the mean point of the Likert scale, *p* value	Difference between consultants and residents, *p* value
24*	Considering a continuum from "standardized" to "tailored" protective ileostomy creation, based on patient's risk factors, how would you define your approach?	5.24 ± 1.71	**< 0.0001**	5.24 ± 1.74	**< 0.0001**	5.24 ± 1.63	**< 0.0001**	0.999
25*	Considering a continuum from "protocolised" to "Influenced by my experience" PI creation, in case of a patient with low/moderate risk of AL, how would you define your approach?	6.60 ± 2.54	**< 0.0001**	6.64 ± 2.60	**< 0.0001**	6.45 ± 2.28	**< 0.0001**	0.295
26	How do you agree with this statement "the ghost ileostomy can replace the PI in terms of patient's safety"?	3.06 ± 1.68	**< 0.0001**	2.98 ± 1.69	**< 0.0001**	3.34 ± 1.58	0.168	**0.004**
27	How much do you agree that acceptable anastomotic perfusion evaluated by fluorescence angiography alone with or without important risk factors, is sufficient to not create a PI?	3.58 ± 1.68	0.089	3.55 ± 1.71	0.337	3.71 ± 1.56	**0.049**	0.207

Table 4 (continued)

N°	Questions	Participants' responses (1019), mean ± standard deviation	Difference between participants' responses and the mean point of the Likert scale, *p* value	Consultants' responses (812), mean ± standard deviation	Difference between consultants' responses and the mean point of the Likert scale, *p* value	Residents' Responses (207), mean ± standard deviation	Difference between residents' responses and the mean point of the Likert scale, *p* value	Difference between consultants and residents, *p* value
30[a]	If yes, how much does this assumption influence you?	4.01 ± 2.01	**< 0.0001**	3.99 ± 2.09	**< 0.0001**	4.06 ± 1.67	**< 0.0001**	0.604

*: Likert scale from 1 to 10. PI: protective ileostomy. n-CRT: neoadjuvant chemoradiotherapy. DMP: decision-making process. AL: anastomotic leakage. [a]: in reference to question 29. Statistically significant differences in bold

In the previous study, expert surgeons added several risk factors in addition to those retrieved from the literature [8]. In the current study, additional risk factors were proposed, such as surgeon's experience, type of anastomosis, preoperative patient's status evaluation using formalized scoring and the centers operative volume center per year.

Most respondents agreed that n-CRT, distance of the anastomosis from the anal verge ≤ 10 cm, patients with preoperative risk factor for AL, patient's inability to tolerate AL and subjective perception of intraoperative difficulty independently justified creation of a PI. However, performance of TME did not independently justify PI, and adequate anastomotic perfusion evaluated by fluorescence angiography slightly favored against creating a PI. The incongruency between the results obtained in case of distance of the anastomosis from the anal verge ≤ 10 cm and TME, and it is probably due to the participants confound TME with partial mesorectal excision (PME). Moreover, as reported in our previous analysis, end colostomy was considered as a better alternative to PI in elderly and frail patients and patients at high risk for ileostomy-related complications [8]. Also, the use of algorithms to help surgeons in their DMP to create PI is not very widespread in clinical practice [8]. Another interesting aspect emerged in the previous study and confirmed in the present one is the influence of patients' opposition to have a PI in the surgeons' DMP, at least in patients with a low risk of AL.

Similar studies have been published in literature about this topic [8, 12, 14, 23–28]. Bisset et al. published two studies in 2022 and in 2024 about surgeons' DMP regarding colorectal anastomosis [24, 25]. The first analysis is a quantitative study using a cross-sectional design and a survey for data collection based on 127 consultant surgeons' responses (mainly from United Kingdom) [24]. They found that a specific surgeon's personality can influence the DMP in specific scenarios related to primary anastomosis, PI creation, or permanent colostomy, and that surgeons' personality is an independent factor influencing variation in the DMP [24]. This quantitative analysis differs from our study since our aim is not to evaluate the influence of surgeons' personality on DMP, but rather to assess if experts' DMP is shared among the surgical community.

The second analysis is a qualitative study using semi-structured individual interviews for data collection on how surgeons' attributes may influence their DMP about colorectal anastomosis [25]. Based on seventeen answers, authors reported the detrimental impact of AL on surgeons' mental and physical health [25]. AL influences their future DMP leading to changes in clinical practice even when a technical error is not identified [25]. Moreover, surgeons consider AL to be personal 'failures', with a negative impact on surgeon welfare [25]. This study differs from the present one mainly due to its qualitative nature, and to the focus of PI

Table 5 Results from questions 28 and 29

N°	Questions	All participants N = 1019	Consultants n = 812 (79.7%)	Residents n = 207 (20.3%)	p value
28	With the aim to standardize the PI creation and to help surgeons in their DMP, some scores or algorithms have been proposed in the literature. How frequently do you use these scores or algorithms? n (%) *				
	Never	286 (28)	239 (29.4)	47 (22.7)	0.0545
	Rarely	342 (33.6)	267 (32.9)	75 (36.2)	0.3622
	Sometimes	249 (24.4)	191 (23.5)	58 (28.1)	0.1789
	Often	125 (12.3)	101 (12.4)	24 (11.6)	0.7410
	Always	17 (1.7)	14 (1.7)	3 (1.4)	0.7828
29	The usefulness of a PI is limited to patients who experience postoperative AL, which occurs in fewer than 30% of cases in some studies. However, most patients who undergo a PI creation are exposed to ileostomy-related complications and subsequent surgery without any clear benefits. Given this information, do you take these factors into consideration when deciding whether to perform a PI? n (%)				
	Yes	881 (86.5)	690 (85)	191 (92.3)	**0.0062**
	No	138 (13.5)	122 (15)	16 (7.7)	

PI protective ileostomy. *DMP* decision-making process. *AL* anastomotic leakage. *: references are reported in the supplementary material. Statistically significant differences in bold

being indirect since the investigation about DMP is related to anastomosis creation [25].

Yi et al. in their retrospective case–control study analyzed the risk factors that influenced surgeons' DMP for PI creation after elective AR for rectal cancer [26]. Male gender, n-CRT, surgical time of more than 180 min, and T3/4 tumor stage were identified as factors influencing DMP regarding PI creation [26].

Similarly, Wang et al. in their retrospective case–control study that included patients who underwent low or ultralow elective AR for rectal cancer, preoperative radiotherapy, anastomosis below the level of the levator ani and an interspinous distance < 94.8 mm were independent factors associated with PI creation on multivariate analysis [27].

With the aim to support surgeons in their DMP to create PI, Shao et al. developed an artificial intelligence model to identify risk factors responsible for AL to create PI only in selected patients with high risk of AL [28]. The model proposed seems to be promising to increase the number of PI created in patients with risk of AL and decreasing it in patients without it [28]. However, this model is very similar to some scores already available in the literature [29, 30].

The present study differs from the previous ones mainly due to the large number of participants included, its international nature and its study design. It reflects contemporaneous practice and adds new concepts about surgeons' DMP for the PI creation, such as the influence of patient's refusal to have a PI, the influence of TME or the role of fluorescence angiography, but confirming the importance of the n-CRT and the distance of the anastomosis from the anal verge ≤ 10 cm.

The main limitations of the present study are that the majority of the surgeons included are Europeans. It was not possible to report the response rate to the survey, due to the means of dissemination used, as we do not know how many surgeons received the invitation to participate. Since most of the respondents were mostly Europeans, the outcome might not be applicable to other countries with fewer resources as the decision-making of performing ileostomy may be influenced by the availability of immediate access of postoperative imaging for instance. Additionally, although wide distribution of the survey though various channels and societies achieved a high number of responses, it precluded our ability to calculate a response rate which would have informed our assessment over selection bias. Nevertheless, a high number of participants were included in this study, and this increases the quality of the data obtained.

Conclusions

Even if the indication to perform ileostomy after rectal cancer surgery is still far from standardized, it seems that the majority of surgeons have similar decision-making process.

Moreover, this study provides useful information about the worldwide clinical practice regarding creation of defunction stoma after anterior resection. To the lack of standardization and evidence-based guidelines, this analysis may be helpful to assist surgeons' practice, and it could serve as a starting point for the development of randomized controlled trials.

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