Updates in Surgery (2021) 73:149–156
https://doi.org/10.1007/s13304-020-00918-z

ORIGINAL ARTICLE

Anastomosis configuration and technique following ileocaecal resection for Crohn's disease: a multicentre study

Valerio Celentano[1,2,3] · Gianluca Pellino[4] · Antonino Spinelli[5,6] · Francesco Selvaggi[4] · SICCR Current status of Crohn's disease surgery collaborative · Valerio Celentano · Gianluca Pellino · Matteo Rottoli · Gilberto Poggioli · Giuseppe Sica · Mariano Cesare Giglio · Michela Campanelli · Claudio Coco · Gianluca Rizzo · Francesco Sionne · Francesco Colombo · Gianluca Sampietro · Giulia Lamperti · Diego Foschi · Ferdinando Ficari · Ludovica Vacca · Marta Cricchio · Francesco Giudici · Lucio Selvaggi · Guido Sciaudone · Roberto Peltrini · Andrea Manfreda · Luigi Bucci · Raffaele Galleano · Omar Ghazouani · Luigi Zorcolo · Simona Deidda · Angelo Restivo · Andrea Braini · Francesca Di Candido · Matteo Sacchi · Michele Carvello · Stefania Martorana · Giovanni Bordignon · Imerio Angriman · Angela Variola · Mirko Di Ruscio · Giuliano Barugola · Andrea Geccherle · Francesca Paola Tropeano · Gaetano Luglio · Marta Tanzanu · Diego Sasia · Marco Migliore · Maria Carmela Giuffrida · Enrico Marrano · Gianluigi Moretto · Harmony Impellizzeri · Gaetano Gallo · Giuseppina Vescio · Giuseppe Sammarco · Giovanni Terrosu · Giacomo Calini · Andrea Bondurri · Anna Maffioli · Gloria Zaffaroni · Andrea Resegotti · Massimiliano Mistrangelo · Marco Ettore Allaix · Fiorenzo Botti · Matteo Prati · Luigi Boni · Serena Perotti · Michela Mineccia · Antonio Giuliani · Lucia Romano · Giorgio Maria Paolo Graziano · Luigi Pugliese · Andrea Pietrabissa · GianGaetano Delaini · Antonino Spinelli · Francesco Selvaggi · , on behalf of the Italian Society of Colorectal Surgery SICCR

Received: 19 August 2020 / Accepted: 26 October 2020 / Published online: 6 January 2021

Abstract

A limited ileocaecal resection is the most frequently performed procedure for ileocaecal CD and different anastomotic configurations and techniques have been described. This manuscript audited the different anastomotic techniques used in a national study and evaluated their influence on postoperative outcomes following ileocaecal resection for primary CD. This is a retrospective, multicentre, observational study promoted by the Italian Society of Colorectal Surgery (SICCR), including all adults undergoing elective ileocaecal resection for primary CD from June 2018 May 2019. Postoperative morbidity within 30 days of surgery was the primary endpoint. Postoperative length of hospital stay (LOS) and anastomotic leak rate were the secondary outcomes. 427 patients were included. The side to side anastomosis was the chosen configuration in 380 patients (89%). The stapled anastomotic ($n=286$; 67%), techniques were preferred to hand-sewn ($n=141$; 33%). Postoperative morbidity was 20.3% and anastomotic leak 3.7%. Anastomotic leak was independent of the type of anastomosis performed, while was associated with an ASA grade ≥ 3, presence of perianal disease and ileocolonic localization of disease. Four predictors of LOS were identified after multivariate analysis. The laparoscopic approach was the only associated with a reduced LOS ($p=0.017$), while age, ASA grade ≥ 3 or administration of preoperative TPN were associated with increased LOS. The side to side was the most commonly used anastomotic configuration for ileocolic reconstruction following primary CD resection. There was no difference in postoperative morbidity according to anastomotic technique and configuration. Anastomotic leak was associated with ASA grade ≥ 3, a penetrating phenotype of disease and ileo-colonic distribution of CD.

Keywords Crohn's disease · Inflammatory bowel disease · Ileocaecal resection · Colorectal surgery · National audit

Introduction

Crohn's disease (CD) is a chronic inflammatory condition of the gastrointestinal tract and terminal ileum and caecum are the most commonly affected areas. Surgery can become

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s13304-020-00918-z) contains supplementary material, which is available to authorized users.

Extended author information available on the last page of the article

necessary in up to 80% of the patients, mainly for lack of response to medical management or complications such as strictures, abscesses or fistulae [1]. A limited ileocaecal resection is the most frequently performed procedure for ileocaecal CD and different anastomotic configurations and techniques have been described for restoration of the intestinal continuity, with the aim to minimise postoperative complications and clinical and surgical recurrence. The side to side anastomotic configuration has been reported to have a favourable profile in terms of postoperative CD recurrence [2] and a wide lumen stapled technique has been recommended by surgical societies [3]. Ileocaecal resection for CD has a high reported rate of postoperative complications increased by risk factors such as malnutrition, active inflammation or infection at the time of surgery [4] and immune suppression, with reported rates of intra-abdominal sepsis and anastomotic leak as high as 14–17%, respectively [5]. Moreover, repeated surgery for anastomotic related complications represent one of the main reasons for short bowel syndrome in CD [6] rather than multiple resections over time for surgical recurrence [7].

The Italian Society of Colorectal Surgery (SICCR) recently reported the results of a national multicentre study collecting benchmark data on surgical treatment of CD, highlighting significant variations in practice [8]. This study audited the different anastomotic techniques used and evaluated their influence on postoperative outcomes following ileocaecal resection for primary CD.

Methods

Study settings

The SICCR promoted the snapshot study "Current Status of Crohn's Disease Surgery", which is a retrospective, multicentre, observational study. A steering committee developed the study protocol following the STROBE checklist [9] and this was reviewed independently by the research board of the SICCR. Ethical approval was obtained from the promoting centres and every participating hospital had a named Principal Investigator, liaising with the local ethics committee. Obtaining informed consent from the patients was deemed not necessary by the Ethics Committees in view of the retrospective nature of the study. Participating centres were invited directly and by an open call published on the SICCR website and also disseminated during a 2 months period via the society newsletter.

Eligibility criteria

All patients (aged 16 or older) undergoing elective ileocaecal resection for primary CD from 1st June 2018 to 31st May 2019 were eligible for participation to the study. Patients undergoing proctocolectomy, proctectomy or segmental colectomy were excluded as were patients undergoing urgent or emergency surgery. Indication for surgery included limited terminal ileal disease, CD refractory to medical treatment, obstruction, internal fistulae and abscesses. All patients in whom an ileocolic anastomosis was not fashioned or it was protected by a diverting stoma were also excluded.

Study objectives

Postoperative morbidity within 30 days of surgery was the primary endpoint. Postoperative length of hospital stay (LOS) and anastomotic leak rate were the secondary outcomes.

Data collection

Collected data included: patients' demographics, Montreal classification, preoperative medical treatment and indication for surgery, American Society of Anaesthesiologists (ASA) grade, operative details, surgical access and conversion rate, length of hospital stay, 30-day postoperative morbidity, readmissions and reoperations.

The orientation of the two bowel ends for the ileocolic anastomosis was recorded as anastomotic configuration (end to end, side to side iso-peristaltic, side to side anti-peristaltic, end to side), whilst the suturing technique was either hand-sewn or stapled.

Postoperative morbidity was defined as any complication occurring during the hospital stay or within 30 days after surgery, whilst all readmissions were recorded up to 30 days after discharge.

Statistical analysis

Categorical variables are presented as frequency and percentages, and were compared using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables are presented as mean (± standard deviation) or median (range) according to their distribution, and were compared with the use of Student's *t* test or the Mann–Whitney *U* test in case of normal or skewed distribution, respectively. To identify variables associated with binary outcomes, uni- and multivariable logistic regression analyses were performed. Variables having a p value equal to 0.10 or less at the univariate analysis were included in the multiple regression model. The Odds ratio (ORs) with a 95% confidence interval (CI) was estimated as measure of association. All reported p values were two-tailed, and p values of less than 0.05 were considered to be statistically significant. Statistical analysis was

performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

Results

427 patients were included following exclusion of 30 patients in whom no anastomosis was performed or it was protected by a diverting stoma. Patients' details are reported in Table 1. There were no statistically significant differences in the preoperative BMI, phenotype of disease, perianal disease, and preoperative medical treatment amongst the groups. The side to side anastomosis was the chosen configuration in 380 patients (89%). The stapled anastomotic ($n=286$; 67%), techniques were preferred to hand-sewn ($n=141$; 33%).

Overall morbidity and anastomotic leak rate

Eighty seven patients had postoperative complications (20.3%), with 36 complications being Dindo-Clavien class ≥ 3 (8.4%) and 16 anastomotic leaks (3.7%).

The incidence of postoperative complications in the patients having an anti-peristaltic side to side anastomosis was 23.4% compared to 16% for the iso-peristaltic side to side anastomosis (Table 2.), but this was not statistically significant. At multivariate analyses (Table 3) postoperative morbidity was associated with an ASA grade ≥ 3.

Table 4 reports the morbidity profile of the anti-peristaltic and iso-peristaltic side to side anastomosis according to stapled vs hand-sewn techniques. At multivariate analysis anastomotic leak (Table 5) was independent of the type of anastomosis performed, while was associated with an ASA grade ≥ 3, presence of perianal disease and ileocolonic localisation of disease (Montreal L = 3).

Other anastomotic techniques

The Kono-S anastomosis was performed in ten patients (2.3%) for ileocolic reconstruction. Only 1 patient (10%) in this group had a penetrating phenotype of disease compared to 29.3% in all the included patients. No patients in the Kono-S group had perianal disease, compared to 13.3% amongst all the included patients. Similarly a small proportion of patients in the Kono- S group were on steroidal treatment at the time of the surgery (10%) compared to approximately one third (32.1%) of the overall patient population.

There was a high rate of postoperative morbidity (25%) and anastomotic leak (10%) in the group of patients receiving an end to side ileocolic anastomosis, but this did not reach statistical significance.

Table 1 Anastomotic configurations in the 427 included patients

Anastomosis	*N*	Age	M:F	BMI	Montreal L stage	Perianal disease	Penetrating phenotype	Steroids	Anti-TNF	ASA ≥ 3	Previous surgery
End to end	17 (4%)	44 (17–77)	14:3	22 (14–25)	L1 = 9 (53%) L3 = 8 (47%)	3 (17.6%)	6 (35.3%)	6 (35.3%)	3 (17.6%)	3 (17.6%)	6 (35.3%)
Side-to-side iso-peristaltic	175 (41%)	43 (16–80)	107:68	23 (14.9–35)	L1 = 76 (43.4%) L3 = 99 (56.6%)	27 (15.4%)	55 (31.4%)	48 (27.4%)	22 (12.5%)	24 (13.7%)	44 (25.1%)
Side to side anti-peristaltic	205 (48%)	41 (16–81)	125:80	21.4 (15–42)	L1 = 68 (33.2%) L3 = 137 (66.8%)	26 (12.7%)	53 (25.8%)	75 (36.6%)	17 (8.3%)	17 (8.3%)	61 (29.7%)
End to side	20 (4.7%)	39.5 (19–85)	13:7	21 (17–31)	L1 = 10 (50%) L3 = 10 (50%)	1 (5%)	10 (50%)	7 (35%)	3 (15%)	2 (10%)	9 (45%)
Kono-S	10 (2.3%)	46 (19–77)	2:8	21.8 (17.5–29.1)	L1 = 7 (70%) L3 = 3 (30%)	0	1 (10%)	1 (10%)	1 (10%)	4 (40%)	1 (10%)
All patients	427	42 (16–85)	261:166	22 (14–42)	L1 = 170 (39.8%) L3 = 257 (60.2%)	57 (13.3%)	125 (29.3%)	137 (32.1%)	46 (10.7%)	50 (11.7%)	121 (28.3%)

N number, *M* male, *F* female, *BMI* body mass index, *TNF* tumour necrosis factor, *ASA* American society of anaesthesiologists, Montreal L1 ileal, Montreal L3 ileocolonic

LOS, readmissions and reoperations

Median LOS was 7 days (range 3–95). There were 17 reoperations (4%) and 21 readmissions (4.9%), with details provided in Table 6. Four predictors of LOS were identified after multivariate analysis. The laparoscopic approach was the only associated with a reduced LOS ($p = 0.017$), while age, ASA grade ≥ 3 or administration of preoperative TPN were associated with increased LOS.

Discussion

The side to side was the most commonly used anastomotic configuration for intestinal reconstruction following ileocaecal resection for CD (89%) and stapled techniques (67%) were preferred over hand-sewn. We also found that both iso-peristaltic and anti-peristaltic orientations were commonly used, adding to the findings of the European Society of Coloproctology (ESCP) snapshot study on postoperative outcomes in CD, which did not differentiate between these

Table 2 Postoperative outcomes according to anastomotic configuration

Anastomosis	*N*	Laparoscopy	Conversion	LOS	Morbidity	AL	Dindo ≥ 3	Reop	Read
End to end	17 (4%)	11 (64.7%)	2 (18.2%)	9 (6–17)	3 (17.6%)	1 (5.9%)	1 (5.9%)	0	1 (5.9%)
Side to side—I	175 (41%)	158 (90.3%)	11 (7%)	7 (3–92)	28 (16%)	4 (2.3%)	14 (8%)	7 (4%)	6 (3.4%)
Side to side—A	205 (48%)	133 (64.9%)	18 (13.5%)	7 (3–95)	48 (23.4%)	9(4.4%)	17(8.3%)	8 (3.9%)	13 (6.3%)
End to side	20 (4.7%)	2 (10%)	1 (5%)	7 (5–14)	5 (25%)	2 (10%)	3 (15%)	2 (10%)	0
Kono-S	10 (2.3%)	7 (70%)	1 (10%)	6 (4–14)	3 (30%)	0	1 (10%)	0	1 (10%)
All patients	427	311 (72.8%)	33 (7.7%)	7 (3–95)	87 (20.3%)	16 (3.7%)*	36 (8.4%)	17 (4%)	21 (4.9%)

N number, *LOS* length of hospitals stay, *AL* anastomotic leak, *Dindo ≥ 3* Dindo–Clavien grade 3 or higher complication, *Reop* reoperations, *Read* readmissions, *I* isoperistatic, *A* anti-peristaltic

*All anastomotic leaks required re-laparotomy apart from 4 that were treated conservatively (3 in the side to side-A group, 1 in the end to end group)

Table 3 Univariate and multivariate analyses for postoperative morbidity

Morbidity						
Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	*p*	OR	95% CI	*p*
Sex	0,84	0.51–1.37	0,497			
Age	1,01	1–1.03	0,053	1,010	0,99 -1,02	0,317
BMI	0,97	0.91–1.04	0,438			
Asa grade ≥ 3	2,89	1.52–5.4	0,001	2,730	1,25—5,94	0,011
Perianal disease (yes)	0,6	0.25–1.26	0,206			
Montreal L = 3	1,3	0.8–2.12	0,288			
Montreal A	0,98	0.74–1.31	0,905			
Montreal B	1,5	0.95–2.36	0,080	2,184	0,26—18,29	0,606
Montreal B = 3	1,43	0.86–2.34	0,163			
Preoperative TPN	0,98	0.41–2.12	0,963			
Preoperative steroids	0,94	0.56–1.54	0,801			
Preoperative immunosoppression	1,06	0.48–2.15	0,878			
Preoperative biologics	0,65	0.3–1.29	0,247			
Laparoscopic approach (yes)	0,48	0.27–0.87	0,013	0,489	0,23—1,05	0,067
Conversion	1,83	0.8–3.93	0,131			
Anastomosis type (All)	1,34	0.98–1.83	0,066	1,635	0,93—2,87	0,087
Anastomosis configuration (Side-to-side vs. others)	0,82	0.41–1.75	0,585			
Antiperistaltic vs. isoperistaltic	1,61	0.96–2.72	0,073			
Handwsewn vs. stapled	1,27	0.77–2.08	0,339			

Table 4 Postoperative outcomes of the 379 patients who received a side to side anastomoses (stapled vs. hand-sewn techniques)

Anastomosis	*N*	Laparoscopy	Conversion	LOS	Morbidity	AL	Dindo ≥ 3	Reop	Read
Iso-peristaltic stapled	107 (28.2%)	99 (92.5%)	6 (6%)	7	15 (14%)	2 (1.8%)	9 (8.4%)	4 (3.7%)	4 (3.7%)
Iso-peristaltic Hand-sewn	68 (17.9%)	59 (86.7%)	5 (8.4%)	7	13 (19.1%)	2 (2.9%)	5 (7.3%)	3 (4.4%)	2 (2.9%)
Anti-peristaltic stapled	165 (43.6%)	97 (58.8%)	15 (15.4%)	6	37 (22.4%)	6 (3.6%)	13 (7.8%)	5 (3%)	11 (6.6%)
Anti-peristatltic hand-sewn	39 (10.3%)	36 (92.3%)	3 (8.3%)	7	11 (28.2%)	3 (7.7%)	4 (10.2%)	3 (7.7%)	2 (5.1%)

N number, *LOS* length of hospitals stay, *AL* anastomotic leak, *Dindo ≥ 3* Dindo–Clavien grade 3 or higher complication, *Reop* reoperations, *Read* readmissions

Table 5 Univariate and multivariate analyses for anastomotic leak

Anastomotic leak						
Variable	Univariate			Multivariate		
	OR	95% CI	*p*	OR	95% CI	*p*
Sex	0,35	0.08–1.09	0,101			
Age	1,02	0.99–1.05	0,242			
BMI	1,05	0.91–1.18	0,484			
Asa grade ≥ 3	2,71	0.73–8.16	0,096	3,83	1,12—13,10	0,032
Perianal disease (yes)	3,14	0.96–9	0,041	3,14	1,02—9,66	0,046
Montreal L = 3	3,91	1.24–17.22	0,036	4,35	1,19—15,92	0,026
Montreal A	1,09	0.6–2.08	0,792			
Montreal B = 3	1,43	0.48–3.93	0,499			
PreoperativeTPN	0	0	0,988			
Preoperative steroids	1,06	0.32–3.04	0,921			
Preoperative immunosoppression	0,57	0.03–2.92	0,588			
Preoperative biologics	0,35	0.02–1.79	0,317			
Laparoscopic approach (yes)	0,78	0.24–3.49	0,711			
Conversion	0,73	0.04–3.78	0,763			
Anastomosis type (All)	1,3	0.67–2.39	0,424			
Anastomosis configuration (Side-to-side vs. others)	0,52	0.16–2.33	0,321			
Antiperistaltic vs. isoperistaltic	1,96	0.63–7.35	0,269			
Handwsewn vs. stapled	0,99	0.31–2.79	0,991			

two anastomotic orientations [10], whilst our study reported a slightly higher rate of postoperative morbidity with the anti-peristaltic configuration, even if this did not reach statistical significance. Moreover, compared to the ESCP snapshot study, our results included a larger cohort of patients, in spite of focusing on primary CD resection only, which was decided in view of the known higher postoperative complications rate following recurrent CD surgery [11]. Our study reported a postoperative morbidity rate of 20.3%, with 8.7% of the patients having Dindo–Clavien class 3 or higher complications, which calls attention to understanding the factors associated with a worse postoperative outcome.

Despite the possible associations with a higher rate of postoperative complications for the end to end ileocolic anastomosis [12] it has been previously reported that patients having an end to end anastomosis for intestinal reconstruction following CD surgery have better postoperative quality of life and reduced readmission to hospital at 2 years from surgery compared to the side to side anastomosis [13]. Moreover, the widely adopted denomination of the side to side anti-peristaltic anastomosis as "functional end to end anastomosis" has also been questioned by experimental studies evaluating peristalsis and bacteria at the anastomotic site [14]. In our cohort of patients, an end to end anastomosis was used in only 17 cases (4%). Additionally, a very small proportion of patients had a Kono-S ileocolic anastomosis formation (2.3%), which seemed to be preferred in patients at low risk for postoperative complications and recurrence, as no patient suffered from perianal disease and only one patient was affected by a penetrating phenotype of CD.

The high number of patients recruited and the multicentre design are the main strengths of our study, together with the focus on key performance indicators of CD surgery, outcomes which are often not so thoroughly audited as in

Table 6 Readmissions and reoperations according to anastomotic configuration

End to end	Reoperations: 0 Readmissions: 1 (abdominal pain)
Side to side—isoperistaltic	Reoperations: 7 (4 anastomotic leak. 1 abdominal wall bleeding, 1 small bowel injury, 1 intra-abdominal collection) Readmissions: 6 (3 bleeding, 1 peritonitis, 1 intra-abdominal collection, 1 bowel obstruction)
Side to side—antiperistaltic	Reoperations: 8 (6 anastomotic leak, 1 intra-abdominal bleeding, 1 small bowel injury) Readmission s: 13 (3 Entero-cutaneous fistula, 3 Intra-abdominal collection, 3 abdominal pain, 2 bleeding, 1 wound haematoma, 1 obstruction)
End to side	Reoperations: 2 (2 anastomotic leak) Readmissions: 0
Kono-S	Reoperations: 0 Readmissions: 1 (bleeding)

cancer surgery. This national snapshot study also allowed collection of data on the use of laparoscopic surgery, which was the chosen approach in 72.8% of the patients with a conversion rate of 7.7%, similar to the experience reported in two specialist centres [15] including 538 patients with a 71.2% use of laparoscopy and 12.3% conversion rate. We reported an anastomotic leak in 3.7% of the patients, which compares favourably with published rates of 4.5% [16] when the ileocolic anastomosis is not protected by a diverting stoma. We found that anastomotic leak was associated with ASA grade ≥ 3, a penetrating phenotype of disease and ileo-colonic distribution of CD [17], which could guide the decision-making on when to fashion an ileostomy rather than a primary anastomosis.

Our study did not evaluate the extent of the mesenteric resection. Coffey et al. showed a significantly decreased surgical recurrence rate when incorporating a substantial portion of mesentery in the resected specimen [18]. While the mesentery is likely to play a pathogenic role in CD, it is also crucial for intestinal perfusion, and extensive removal may compromise bowel tissue with concerns also regarding haemorrhagic dangers associated with division of the mesentery in patients with CD and potential need for increased length of resected bowel if larger mesenteric segments are excised [19]. Another limitation of our study is the self-reporting nature of the data collection and the retrospective design. Whilst the lack of statistically significant differences for the primary and secondary outcomes according to anastomotic technique or configuration might be due to the limited power of the study, it certainly highlights the need for multidisciplinary led decision making and patient centred approach, moving the focus from a single causative factor (i.e. anastomotic technique, preoperative treatment) to a multifactorial approach.

Conclusions

The side to side was the most commonly used anastomotic configuration for ileocolic reconstruction following primary CD resection. There was no difference in postoperative morbidity according to anastomotic technique and configuration. Anastomotic leak was associated with ASA grade ≥ 3, a penetrating phenotype of disease and ileo-colonic distribution of CD.

Acknowledgements The SICCR Current status of Crohn's disease surgery collaboratives are: Valerio Celentano, Portsmouth Hospitals NHS Trust, Portsmouth, United Kingdom; University of Portsmouth, Portsmouth, United Kingdom; Department of Surgery and Cancer, Imperial College, London, United Kingdom; Gianluca Pellino, Lucio Selvaggi, Guido Sciaudone, Francesco Selvaggi, Department of Advanced Medical and Surgical Science, Universita' degli Studi della Campania Luigi Vanvitelli. Naples, Italy; Matteo Rottoli, Gilberto Poggioli, Marta Tanzanu, Surgery of the Alimentary Tract, Sant'Orsola Hospital, Department of Medical and Surgical Sciences, Alma Mater Studiorum University of Bologna, Bologna, Italy; Giuseppe Sica, Michela Campanelli, Minimally Invasive and Gastro-Intestinal Surgical Unit, Department of Surgery, Policlinico Tor Vergata, Rome, Italy; Mariano Cesare Giglio, Department of Clinical Medicine and Surgery, Federico II University of Naples, Naples, Italy; Claudio Coco, Gianluca Rizzo, Francesco Sionne, U.O.C. Chirurgia Generale 2 - Fondazione Policlinico Universitario "Agostino Gemelli" IRCCS, Università Cattolica del Sacro Cuore - Rome, Italy; Francesco Colombo, Gianluca Sampietro, Giulia Lamperti, Diego Foschi, IBD Surgical Unit, Luigi Sacco University Hospital, Milan, Italy; Ferdinando Ficari, Ludovica Vacca, Marta Cricchio, Francesco Giudici, IBD Unit, Careggi University Hospital, Florence, Italy; Roberto Peltrini, Andrea Manfreda, Luigi Bucci, University of Naples Federico II, Naples, Italy; Raffaele Galleano, Omar Ghazouani, Santa Corona Hospital, Pietra Ligure, Italy; Luigi Zorcolo, Simona Deidda, Angelo Restivo, Colon and Rectal Surgery Unit, University of Cagliari, Italy; Andrea Braini, Friuli Occidentale Hospital, Pordenone, Italy; Francesca Di Candido, Matteo Sacchi, Michele Carvello, Stefania Martorana, Antonino Spinelli, Humanitas Clinical and Research Center IRCCS, Division of Colon and Rectal Surgery, Via Manzoni 56 20089 Rozzano, Milano – Italy; Giovanni Bordignon, Imerio Angriman, Surgical Unit, Department of Surgical Oncological and Gastroenterological Sciences University of Padova. Padova, Italy; Angela Variola, Mirko Di Ruscio, Giuliano Barugola, Andrea Geccherle, IRCCS "Sacro Cuore - Don Calabria" , Negrar (Vr), Italy; Francesca Paola Tropeano, Gaetano Luglio, Department of Public Health, University of Naples Federico II, Naples, Italy; Diego Sasia, Marco Migliore, Maria Carmela Giuffrida, Department of Surgery. Santa Croce e Carle Hospital, Cuneo, Italy; Enrico Marrano, Gianluigi Moretto, Harmony Impellizzeri, GianGaetano Delaini, Department of Surgery, "Pederzoli" Hospital, Peschiera del Garda, Verona, Italy; Gaetano Gallo, Giuseppina Vescio, Department of Medical and Surgical Sciences, University of Catanzaro, Catanzaro, Italy;

Giuseppe Sammarco, Department of Health sciences, University of Catanzaro, Catanzaro, Italy; Giovanni Terrosu, Giacomo Calini, Department of Surgery, University Hospital "Santa Maria della Misericordia", Udine, Italy; Andrea Bondurri, Anna Maffioli., MD, Gloria Zaffaroni, Unit 1, General Surgery, Luigi Sacco University Hospital, Milan, Italy; Andrea Resegotti, Massimiliano Mistrangelo, Marco Ettore Allaix, Department of Surgical Sciences, Citta della Salute e della Scienza di Torino, Presidio Molinette, University Hospital, Turin, Italy; Fiorenzo Botti, Matteo Prati, Luigi Boni, Department of General Surgery, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy; Serena Perotti, Michela Mineccia, Division of General and Oncologic Surgery, Mauriziano Hospital, Turin, Italy; Antonio Giuliani, Lucia Romano, San Salvatore Hospital. Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila. L'Aquila, Italy; Giorgio Maria Paolo Graziano, Luigi Pugliese, Andrea Pietrabissa, Fondazione IRCCS Policlinico San Matteo di Pavia, Università degli Studi di Pavia, Pavia, Italy; Antonino Spinelli, Humanitas University, Department of Biomedical Sciences, Via Rita Levi Montalcini 4, 20090 Pieve Emanuele Milano, Italy

Author contributions All authors of the SICCR Current status of Crohn's disease surgery Collaborative and their affiliations are listed in Acknowledgements. Specification of authors' contribution is detailed in online appendix.

Funding No funding was received for the study.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

Ethical approval The study was approved by the SICCR research committee, and received ethical approval by all local ethics committees.

Research involving human participants The study was conducted according to the principles of the Declaration of Helsinki.

Informed consent Informed consent was deemed not necessary from the ethics committees.

References

1. Pellino G, Keller DS, Sampietro GM, Angriman I, Carvello M, Celentano V, Colombo F, Di Candido F, Laureti S, Luglio G, Poggioli G, Rottoli M, Scaringi S, Sciaudone G, Sica G, Sofo L, Leone S, Danese S, Spinelli A, Delaini G, Selvaggi F, Italian Society of Colorectal Surgery SICCR (2020) Inflammatory bowel disease position statement of the Italian society of colorectal surgery (SICCR): Crohn's disease. Tech Coloproctol. https://doi.org/10.1007/s10151-020-02183-z (**[Epub ahead of print] Review**)
2. Feng JS, Li JY, Yang Z, Chen XY, Mo JJ, Li SH (2018) Stapled side-to-side anastomosis might be benefit in intestinal resection for Crohn's disease: a systematic review and network meta-analysis. Med (Baltim) 97(15):e0315. https://doi.org/10.1097/MD.0000000000010315
3. Bemelman WA, Warusavitarne J, Sampietro GM, Serclova Z, Zmora O, Luglio G, de van BuckOverstraeten A, Burke JP, Buskens CJ, Colombo F, Dias JA, Eliakim R, Elosua T, Gecim IE, Kolacek S, Kierkus J, Kolho KL, Lefevre JH, Millan M, Panis Y, Pinkney T, Russell RK, Shwaartz C, Vaizey C, Yassin N, D'Hoore A (2018) ECCO-ESCP consensus on surgery for Crohn's Disease. J Crohns Colitis 12(1):1–16. https://doi.org/10.1093/ecco-jcc/jjx061
4. Ghoneima AS, Flashman K, Dawe V, Baldwin E, Celentano V (2019) High risk of septic complications following surgery for Crohn's disease in patients with preoperative anaemia, hypoalbuminemia and high CRP. Int J Colorectal Dis 34(12):2185–2188
5. Rosenfeld G, Qian H, Bressler B (2013) The risks of post-operative complications following pre-operative infliximab therapy for Crohn's disease in patients undergoing abdominal surgery: a systematic review and meta-analysis. J Crohns Colitis 7(11):868–877
6. Uchino M, Ikeuchi H, Bando T et al (2012) Risk factors for short bowel syndrome in patients with Crohn's disease. Surg Today 42(5):447–452
7. Celentano V, O'Leary DP, Caiazzo A, Flashman KG, Sagias F, Conti J, Senapati A, Khan J (2019) Longer small bowel segments are resected in emergency surgery for ileocaecal Crohn's disease with a higher ileostomy and complication rate. Tech Coloproctol 23(11):1085–1091
8. SICCR current status of Crohn's disease surgery collaborative (2020) National variations in perioperative assessment and surgical management of Crohn's disease: a multicentre study. Colorectal Dis. https://doi.org/10.1111/codi.15334 (**Online ahead of print**)
9. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative (2008) The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 61(4):344–349
10. European society of coloproctology collaborating group (2017) Risk factors for unfavourable postoperative outcome in patients with Crohn's disease undergoing right hemicolectomy or ileocaecal resection an international audit by ESCP and S-ECCO. Colorectal Dis. https://doi.org/10.1111/codi.13889 (**Epub ahead of print**)
11. Johnston WF, Stafford C, Francone TD, Read TE, Marcello PW, Roberts PL, Ricciardi R (2017) What Is the risk of anastomotic leak after repeat intestinal resection in patients with Crohn's disease? Dis Colon Rectum 60(12):1299–1306
12. Adamina M, Bonovas S, Raine T, Spinelli A, Warusavitarne J, Armuzzi A, Bachmann O, Bager P, Biancone L, Bokemeyer B, Bossuyt P, Burisch J, Collins P, Doherty G, El-Hussuna A, Ellul P, Fiorino G, Frei-Lanter C, Furfaro F, Gingert C, Gionchetti P, Gisbert JP, Gomollon F, González Lorenzo M, Gordon H, Hlavaty T, Juillerat P, Katsanos K, Kopylov U, Krustins E, Kucharzik T, Lytras T, Maaser C, Magro F, Marshall JK, Myrelid P, Pellino G, Rosa I, Sabino J, Savarino E, Stassen L, Torres J, Uzzan M, Vavricka S, Verstockt B, Zmora O (2020) ECCO guidelines on therapeutics in Crohn's disease: surgical treatment. J Crohns Colitis 14(2):155–168. https://doi.org/10.1093/ecco-jcc/jjz187
13. Gajendran M, Bauer AJ, Buchholz BM, Watson AR, Koutroubakis IE, Hashash JG, Ramos-Rivers C, Shah N, Lee KK, Cruz RJ, Regueiro M, Zuckerbraun B, Schwartz M, Swoger J, Barrie A, Harrison J, Hartman DJ, Salgado J, Rivers WM, Click B, Anderson AM, Umapathy C, Babichenko D, Dunn MA, Binion DG (2018) Ileocecal anastomosis type significantly influences long-term functional status, quality of life, and healthcare utilization in postoperative Crohn's disease patients independent of inflammation recurrence. Am J Gastroenterol 113(4):576–583. https://doi.org/10.1038/ajg.2018.13 (**Epub 2018 Mar 6**)
14. Kano M, Hanari N, Gunji H, Hayano K, Hayashi H, Matsubara H (2017) Is, "functional end-to-end anastomosis" really functional? A review of the literature on stapled anastomosis using linear staplers. Surg Today 47(1):1–7 (**Epub 2016 Mar 17**)
15. de van BuckOverstraeten A, Eshuis EJ, Vermeire S, Van Assche G, Ferrante M, D'Haens GR, Ponsioen CY, Belmans A, Buskens CJ, Wolthuis AM, Bemelman WA, D'Hoore A (2017) Short- and

medium-term outcomes following primary ileocaecal resection for Crohn's disease in two specialist centres. Br J Surg 104(12):1713–1722. https://doi.org/10.1002/bjs.10595 (**Epub 2017 Jul 26**)
16. Neary PM, Aiello AC, Stocchi L, Shawki S, Hull T, Steele SR, Delaney CP, Holubar SD (2019) High-risk ileocolic anastomoses for Crohn's disease: when is diversion indicated? J Crohns Colitis 13(7):856–863. https://doi.org/10.1093/ecco-jcc/jjz004
17. Garofalo E, Lucarini A, Flashman KG, Celentano V (2019) A positive proximal resection margin is associated with anastomotic complications following primary ileocaecal resection for Crohn's disease. Int J Colorectal Dis 34(9):1585–1590
18. Coffey CJ, Kiernan MG, Sahebally SM, Jarrar A, Burke JP, Kiely PA, Shen B, Waldron D, Peirce C, Moloney M, Skelly M, Tibbitts P, Hidayat H, Faul PN, Healy V, O'Leary PD, Walsh LG, Dockery P, O'Connell RP, Martin ST, Shanahan F, Fiocchi C, Dunne CP (2018) Inclusion of the mesentery in ileocolic resection for Crohn's disease is associated with reduced surgical recurrence. J Crohns Colitis 12(10):1139–1150
19. Buskens CJ, de Groof EJ, Bemelman WA, Wildenberg ME (2017) The role of the mesentery in Crohn's disease. Lancet Gastroenterol Hepatol 2(4):245–246

Affiliations

Valerio Celentano[1,2,3] · Gianluca Pellino[4] · Antonino Spinelli[5,6] · Francesco Selvaggi[4] · SICCR Current status of Crohn's disease surgery collaborative · Valerio Celentano · Gianluca Pellino · Matteo Rottoli · Gilberto Poggioli · Giuseppe Sica · Mariano Cesare Giglio · Michela Campanelli · Claudio Coco · Gianluca Rizzo · Francesco Sionne · Francesco Colombo · Gianluca Sampietro · Giulia Lamperti · Diego Foschi · Ferdinando Ficari · Ludovica Vacca · Marta Cricchio · Francesco Giudici · Lucio Selvaggi · Guido Sciaudone · Roberto Peltrini · Andrea Manfreda · Luigi Bucci · Raffaele Galleano · Omar Ghazouani · Luigi Zorcolo · Simona Deidda · Angelo Restivo · Andrea Braini · Francesca Di Candido · Matteo Sacchi · Michele Carvello · Stefania Martorana · Giovanni Bordignon · Imerio Angriman · Angela Variola · Mirko Di Ruscio · Giuliano Barugola · Andrea Geccherle · Francesca Paola Tropeano · Gaetano Luglio · Marta Tanzanu · Diego Sasia · Marco Migliore · Maria Carmela Giuffrida · Enrico Marrano · Gianluigi Moretto · Harmony Impellizzeri · Gaetano Gallo · Giuseppina Vescio · Giuseppe Sammarco · Giovanni Terrosu · Giacomo Calini · Andrea Bondurri · Anna Maffioli · Gloria Zaffaroni · Andrea Resegotti · Massimiliano Mistrangelo · Marco Ettore Allaix · Fiorenzo Botti · Matteo Prati · Luigi Boni · Serena Perotti · Michela Mineccia · Antonio Giuliani · Lucia Romano · Giorgio Maria Paolo Graziano · Luigi Pugliese · Andrea Pietrabissa · GianGaetano Delaini · Antonino Spinelli · Francesco Selvaggi · , on behalf of the Italian Society of Colorectal Surgery SICCR

✉ Valerio Celentano
valeriocelentano@yahoo.it

[1] Portsmouth Hospitals NHS Trust, Portsmouth, UK

[2] University of Portsmouth, Portsmouth, UK

[3] Department of Surgery and Cancer, Imperial College, London, UK

[4] Department of Advanced Medical and Surgical Science, Universita' degli Studi della Campania Luigi Vanvitelli, Naples, Italy

[5] Colon and Rectal Surgery Unit, Humanitas Clinical and Research Center, Rozzano, Italy

[6] Department of Biomedical Sciences, Humanitas University, Rozzano, Italy