Is Delaying a Coloanal Anastomosis the Ideal Solution for Rectal Surgery?

Analysis of a Multicentric Cohort of 564 Patients From the GRECCAR

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Objectives: To assess the specific results of delayed coloanal anastomosis (DCAA) in light of its 2 main indications.

Background: DCAA can be proposed either immediately after a low anterior resection (primary DCAA) or after the failure of a primary pelvic surgery as a salvage procedure (salvage DCAA).

Methods: All patients who underwent DCAA intervention at 30 GRECCAR-affiliated hospitals between 2010 and 2021 were retrospectively included.

Results: Five hundred sixty-four patients (male: 63%; median age: 62 years; interquartile range: 53–69) underwent a DCAA: 66% for primary DCAA and 34% for salvage DCAA. Overall morbidity, major morbidity, and mortality were 57%, 30%, and 1.1%, respectively, without any significant differences between primary DCAA and salvage DCAA ($P = 0.933$; $P = 0.238$, and $P = 0.410$, respectively). Anastomotic leakage was more frequent after salvage DCAA (23%) than after primary DCAA (15%), ($P = 0.016$). Fifty-five patients (10%) developed necrosis of the intra-abdominal colon. In multivariate analysis, intra-abdominal

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colon necrosis was significantly associated with male sex [odds ratio (OR) = 2.67 95% CI: 1.22–6.49; $P = 0.020$], body mass index > 25 (OR = 2.78 95% CI: 1.37–6.00; $P = 0.006$), and peripheral artery disease (OR = 4.68 95% CI: 1.12–19.1; $P = 0.030$). The occurrence of this complication was similar between primary DCAA (11%) and salvage DCAA (8%), ($P = 0.289$). Preservation of bowel continuity was reached 3 years after DCAA in 74% of the cohort (primary DCAA: 77% vs salvage DCAA: 68%, $P = 0.031$). Among patients with a DCAA mannered without diverting stoma, 75% (301/403) have never required a stoma at the last follow-up.

Conclusions: DCAA makes it possible to definitively avoid a stoma in 75% of patients when mannered initially without a stoma and to save bowel continuity in 68% of the patients in the setting of failure of primary pelvic surgery.

Key Word: anastomotic leakage, delayed anastomosis, ileostomy, rectal cancer

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Anastomotic leakage (AL) is a frequent complication after anterior resection and has been reported in up to 36% of patients in some studies.[1] The risk of postoperative death is more than doubled when this complication occurs.[2] In addition, an AL results in significantly worse intestinal function, increase the risk of permanent stoma, leads to a worse quality of life for the long term, and also increases the risk of tumor recurrence.[3–6] To limit the incidence of this complication, the formation of a diverting stoma to protect a coloanal anastomosis (CAA) or a low colorectal anastomosis (CRA) after low anterior resection is often proposed,[7] and has been demonstrated to reduce the rate of AL from 28% to 10% and the need for an urgent reoperation from 25% to 9%.[8] This benefit relies on the absence of fecal content traversing the newly formed anastomosis, allowing optimal healing in a cleaner environment. Based on this same concept, delayed CAA (DCAA) has been proposed as an alternative technique to the immediate formation of a CAA [immediate CAA (ICAA)]. After low anterior resection, this procedure consists of pulling the mobilized colon through the anus to a distance of 5 to 10 cm and leaving the exteriorized colon in this position without anastomosis for a period of 1 to 4 weeks. This waiting period aims to obtain solid adhesions between the colon and the anus remote from the stool. Afterward, the colonic stump that protrudes from the anus is sectioned and the CAA is handsewn. DCAA can be performed without a diverting stoma to avoid stoma-specific complications[9,10] or can be performed in addition to a diverting stoma to maximize the chance of anastomotic healing without AL.[11]

DCAA is indicated for 2 main scenarios, either immediately after low anterior resection (primary DCAA) or after the failure of a primary pelvic surgery as a salvage procedure (salvage DCAA). Existing knowledge about this technique mainly deals with a single indication, either primary DCAA or salvage DCAA.[11–17] The aim of this study was to assess the success rate of DCAA to prevent the occurrence of AL, to preserve bowel continuity, and to analyze the postoperative morbidity in light of its 2 main indications through a large multicentric cohort.

METHODS

Study Population

All patients who underwent a DCAA, either primary or salvage, between January 2010 and June 2021 in 30 tertiary referral colorectal centres from the French Research Group of Rectal Cancer Surgery (GRECCAR) were included. Data were retrospectively collected by a designated surgeon in each centre. Demographic information included sex, age, body mass index (BMI), American Society of Anesthesiologists score, tobacco use, comorbidities, history of pelvic radiotherapy, primary disease leading to the anterior resection, history of previous CRA or CAA before the DCAA, and date of this surgery. Regarding the DCAA, the following variables were collected: surgical indication, dates of the first and second step of this procedure, surgical approach, intraoperative associated procedures, diverting stoma or not, postoperative complications after the first step and second step of DCAA, and length of stay. Finally, the preservation or not of bowel continuity at the last follow-up was assessed. This study was conducted according to the ethical standards of the Committee on Human Experimentation of each institution, and reported according to the "Strengthening the Reporting of Observational Studies in Epidemiology" guidelines.[18]

Delayed Coloanal Anastomosis: Surgical Technique

The surgical technique for DCAA used by the participating centres in this study followed the published principles of this surgical procedure.[12,19,20] The principle of DCAA is to perform a CAA in 2 steps, both performed under general anesthesia in the lithotomy position. The first step was achieved by midline laparotomy, laparoscopy, or a robotic approach, and consisted of anterior resection of the rectum or resection of the previous CRA or CAA. The colon was then pulled through the anus over a length of 5 to 10 cm. The colon was sufficiently mobilized to allow its exteriorization below the anus without tension and without compromising its vascularity. Alternatively, in the case of insufficient colonic length, the transverse colon was brought down through the mesentery (Toupet procedure), or the inverted right colon was used (Deloyers maneuver).[21–24] The exteriorized colon stump segment was wrapped with gauze at the end of the procedure. DCAA was protected by a diverting stoma (ileostomy or colostomy) when the aim of the DCAA was to optimize the anastomosis healing in patients with a high risk of AL. DCAA was performed without diverting the stoma when the aim was to avoid a diverting stoma for a CAA. Bowel preparation was always given before the first step of DCAA in patients without a stoma in place before the procedure. A drain was possibly placed in the pelvis at the discretion of the operating surgeon. The delay between the two surgical steps was also decided by the operating surgeon, given that the optimal time period between procedures remains unknown. The patient was hospitalized during this period and the viability of the exteriorized colon stump was inspected daily. A normal diet was given as soon as possible to ensure optimal nutritional intake during this period of time. The second step consisted of the removal of the exteriorized colonic stump and a direct single layer handsewn CAA with interrupted sutures of 4-0 absorbable stitches.

Reversal of diverting stoma, when required, was planned 6 to 8 weeks after DCAA if no AL was diagnosed. A computed tomography scan with water-soluble contrast through the stoma was always performed before a reversal to verify the absence of an asymptomatic AL.

Variables and Outcomes Definition

Primary DCAA was defined as the first step of the DCAA being performed during the same procedure immediately after a low anterior resection. In contrast, a salvage DCAA was defined by the formation of a DCAA after the failure of a previous

primary pelvic surgery. The failure of a primary pelvic surgery included a chronic leakage or stenosis of a previous CRA or CAA, a local tumor recurrence on a previous CRA or CAA, and a previous surgical rectal injury without CRA or CAA leading to a chronic rectal fistula with an abscess or with a rectovaginal/recto-vesical/recto-ureteral fistula. Postoperative morbidity was considered as any deviation from the normal postoperative course, graded according to the Clavien-Dindo classification.[25] A complication classified as Clavien-Dindo III or higher was considered major. AL was defined as communication between the intraluminal and extraluminal compartments due to a defect in the integrity of the CAA. Any pelvic abscess that occurred after the formation of the CAA has also been considered AL.[26] A pelvic abscess diagnosed after the first step of DCAA but before the construction of the anastomosis was not considered an AL. AL was classified as early when the delay between the second step of DCAA and the diagnosis of AL was ≤ 30 days and as late beyond this delay. Preservation of bowel continuity was defined by the absence of stoma and functional anastomosis, at least 6 months after the DCAA.

Statistical Analyses

Qualitative data were reported as frequencies and percentages and compared with the χ^2 test if the expected cell count ≥ 5 and with the Fisher exact test if not. Quantitative data were expressed as medians and interquartile range (IQR) and compared using the Mann-Whitney *U* test. This test was also used for the comparison of ordinal data. To assess the preoperative and intraoperative factors associated with intra-abdominal colon necrosis, a multiple logistic regression was conducted, including all factors achieving a P value <0.1 in the univariate analysis. The best model was determined by the lowest Akaike information criterion with a backward selection of the variables. Follow-up time was estimated using the reverse Kaplan-Meier method. The probability of requiring a definitive stoma over time after DCAA was plotted using the Kaplan-Meier method. The log-rank test was used to compare the risk of definitive stoma over time between primary DCAA and salvage DCAA. All tests were 2-sided. A P value of <0.05 was considered statistically significant. All analyses were performed using the R Software version 4.2.3 (R Core Team).

RESULTS

Population and Surgical Procedure

Between January 2010 and June 2021 in 30 tertiary referral colorectal centres, 564 patients underwent DCAA, including 374 patients (66%) for primary DCAA and 190 (34%) for salvage DCAA (Fig. 1; Supplemental Data, Supplemental Digital Content 1, http://links.lww.com/SLA/E796). The median age was 62 years (IQR, 53–69), 63% of the patients were males (353/563), and 22% were American Society of Anesthesiologists 3 or 4. Primary disease leading to DCAA is reported in Figure 1. Salvage DCAA was justified by chronic pelvic sepsis (47%, 89/190): rectovaginal fistula (29%, 56/190), recto-vesical or recto-uretral fistula (9%, 17/190), stenosis of a previous CRA or CAA (6%, 11/190), local tumor recurrence (5%, 9/190), and colonic ischemia after CRA or CAA (4%, 8/190). In the salvage DCAA group, the previous anastomosis that had failed was never a DCAA.

The first step of the DCAA was achieved with a diverting stoma for 161 patients (29%). Details about the population characteristics and surgical procedures are presented in Table 1. Primary DCAA and salvage DCAA differed regarding several preoperative and intraoperative characteristics. Patients in the salvage DCAA group were more often females ($P < 0.001$), younger ($P = 0.007$), less overweight or obese ($P = 0.007$), and less likely to have received pelvic radiotherapy ($P < 0.001$). A diverting stoma ($P < 0.001$) was more often proposed and the delay between the two steps was longer ($P < 0.001$) after salvage DCAA. Concerning the 85% of patients who required a salvage DCAA because of failure of a previous CRA or CAA (n = 162/190), the median delay between the first anastomosis that had failed and the first step of the DCAA was 12.4 months (IQR, 5.1–29.2).

Postoperative Morbidity and Anastomotic Leakage

Overall morbidity was 57%, major morbidity was 30%, and mortality was 1%. Overall morbidity and major morbidity were similar between primary DCAA and salvage DCAA patients. Between the two steps, 39 patients were diagnosed with a pelvic abscess (7%): 13 patients with a diverting stoma and 26 patients without. Only 1 patient among these 26 patients without a stoma had a diverting stoma mannered between the two steps of DCAA due to the occurrence of a pelvic abscess. Two patients did not have the second step of DCAA

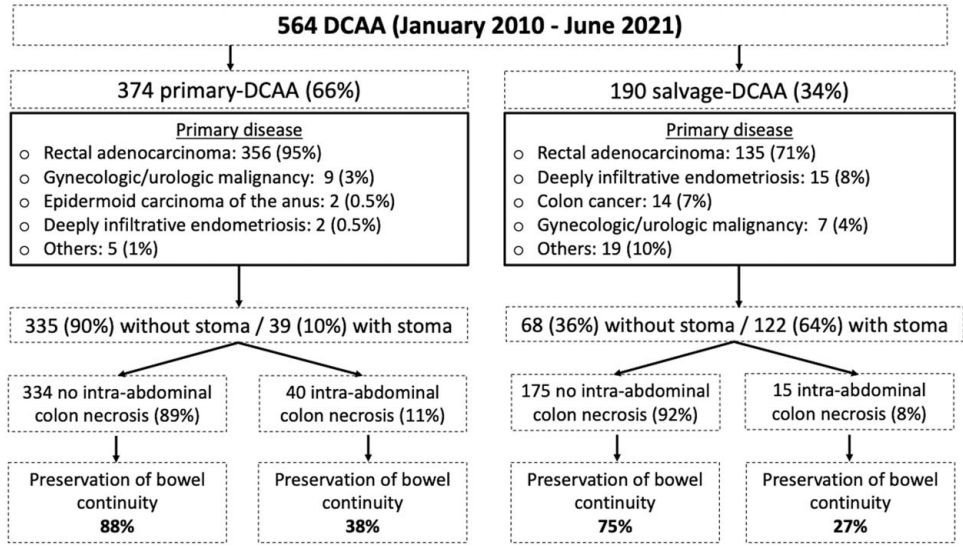

FIGURE 1. Flowchart of the study.

TABLE 1. Demography and DCAA Characteristics

Variables	Entire cohort (N = 564)	Primary DCAA (N = 374)	Salvage DCAA (N = 190)	*P*
Sex (F)	210/563 (37)*	116 (31)	94/189 (50)	<0.001
Age (yr)	62.1 (53.0–69.1)†	62.8 (54.8–70.8)	61.2 (50.3–67.1)	0.007
BMI >25 kg/m^2	263/542 (49)	190/361 (53)	73/181 (40)	0.007
ASA score ≥3	125/562 (22)	92/373 (25)	33/189 (17)	0.052
Active smoker	86/403 (21)	47/236 (20)	39/167 (23)	0.407
Steroid therapy	10/408 (2.5)	6/236 (2.5)	4/172 (2.3)	>0.999
Coronary artery disease	23/458 (5.0)	16/276 (5.8)	7/182 (3.8)	0.350
Stroke	13/458 (2.8)	7/276 (2.5)	6/182 (3.3)	0.775
Peripheral artery disease	13/459 (2.8)	8/277 (2.9)	5/182 (2.7)	>0.999
Antiplatelet therapy	66/479 (14)	39/290 (13)	27/189 (14)	0.795
Anticoagulant therapy	31/430 (7.2)	16/258 (6.2)	15/172 (8.7)	0.322
Diabetes	60/472 (13)	38/283 (13)	22/189 (12)	0.568
Chronic kidney disease	11/429 (2.6)	6/258 (2.3)	5/171 (2.9)	0.760
Previous pelvic radiotherapy	399/562 (71)	302 (81)	97/188 (52)	<0.001
Preoperative ureteral stent	22/487 (4.5)	5/325 (1.5)	17/162 (10)	<0.001
Bilateral	12/487 (2.5)	4/325 (1.2)	8/162 (4.9)	—
Left side	5/487 (1.0)	1/325 (0.3)	4/162 (2.5)	—
Right side	5/487 (1.0)	0/325 (0)	5/162 (3.1)	—
Surgical approach				<0.001
Laparotomy	295/563 (52)	150/373 (40)	145 (76)	—
Laparoscopy	223/563 (40)	184/373 (49)	39 (21)	—
Robot-assisted	45/563 (8.0)	39/373 (10)	6 (3.2)	—
First step of DCAA				
Operative time (min)	253.0 (200.0–319.2)	270.0 (217.5–330.0)	240.0 (186.2–300.0)	<0.001
Blood loss (mL)	200.0 (100.0–350.0)	200.0 (100.0–400.0)	200.0 (100.0–300.0)	0.387
Toupet procedure	38 (6.7)	3 (0.8)	35 (18)	<0.001
Deloyers maneuver	18 (3.2)	6 (1.6)	12 (6.3)	0.003
Defunctioning stoma	161 (29)	39 (10)	122 (64)	<0.001
Ileostomy	149 (26)	37 (9.9)	112 (59)	—
Colostomy	12 (2.1)	2 (0.5)	10 (5.3)	—
Delay between first and second step DCAA (d)	7.0 (6.0–10.0)	7.0 (6.0–8.0)	9.0 (7.0–14.0)	<0.001
Second step of DCAA				
Operative time (min)	30.0 (21.0–45.0)	30.0 (21.0–40.0)	30.0 (21.0–54.5)	0.093

*n/N (%).
†Median (25%–75%).
ASA indicates American Society of Anesthesiologists.

because they died after the first step. Of the cohort, 10% (55/564) developed necrosis of the intra-abdominal colon after the first step of DCAA, meanwhile the rate of necrosis of the exteriorized colon stump was 2% (13/564). The necrosis of the intra-abdominal colon was always segmental and never involved the entire colon. All patients who developed necrosis of the intra-abdominal colon (n = 55) underwent emergency surgery to resect the necrosed segment of the colon and: 24 patients (44%) were given a permanent end colostomy, 20 patients (36%) had a new colonic stump pulled through the anus for a DCAA, and 11 patients (20%) underwent an ICAA performed, always with a diverting stoma. The overall rate of AL after anastomosis creation was 18% (96/538): 27% of them were diagnosed with the diverting stoma still in place (26/96). AL was more frequent after salvage DCAA (23%) than after primary DCAA (15%), (P = 0.016). Details about post-operative morbidity are presented in Table 2.

Long-term Bowel Continuity

Preservation of bowel continuity was assessed after the exclusion of the 68 patients with a follow-up inferior to 6 months. Among the 496 remaining patients, the median follow-up was 31.4 months (IQR, 17.3–52.1) [primary DCAA: 32.1 months (IQR, 17.7–50.1) and salvage DCAA: 29.6 months (IQR, 15.6–55.6)]. The risk of requiring a definitive stoma over time given by Kaplan-Meier estimation is shown in Figure 2A. Preservation of bowel continuity 1 year and 3 years after DCAA was reached for 83% and 74% of patients, respectively. The reasons for the nonpreservation of bowel continuity (n = 120) were: primary failure of DCAA with bowel continuity that was never restored (n = 58, 48%), secondary failure of DCAA with an initial restoration of bowel continuity but with a stoma mannered due to the occurrence of a delayed AL (n = 33, 28%), pelvic tumor recurrence (n = 17, 14%), or because of a poor functional outcome (n = 12, 10%). Preservation of bowel continuity was significantly lower after salvage DCAA compared with primary DCAA (bowel continuity 3 years after DCAA: 68% vs 77%, respectively, log-rank test: P = 0.031, Fig. 2B). Among patients with a DCAA mannered without diverting stoma, 75% (301/403) have never required a stoma at the last follow-up. This rate was 76% (254/335) in the subgroup of primary DCAA without diverting stoma versus 69% (47/68) in the subgroup of salvage DCAA without diverting stoma (P = 0.246).

Necrosis of the intra-abdominal colon after the first step of DCAA altered the rate of bowel continuity preservation (bowel continuity 3 years after DCAA: 32%; log-rank test, P < 0.001), whereas necrosis of the exteriorized colon only did not (bowel continuity 3 years after DCAA 85% if exteriorized colon necrosis versus 74% if not; log-rank test, P = 0.510).

Focus on Intra-abdominal Colon Necrosis

Preoperative and intra-operative factors associated with the occurrence of intra-abdominal colon necrosis after the first

TABLE 2. Morbidity and AL After DCAA.

Variables	Entire Cohort (N = 564)	Primary DCAA (N = 374)	Salvage DCAA (N = 190)	*P*
Morbidity after the first step of DCAA and before the second step				
Overall morbidity	230 (41)*	152 (41)	78 (41)	0.925
Major morbidity	112 (20)	71 (19)	41 (22)	0.465
Clavien-Dindo classification	0.300			
I	31 (5.5)	26 (7.0)	5 (2.6)	—
II	87 (15)	55 (15)	32 (17)	—
III	94 (17)	60 (16)	34 (18)	—
IV	16 (2.8)	10 (2.7)	6 (3.2)	—
V (mortality)	2 (0.4)	1 (0.3)	1 (0.5)	—
No second step of DCCA	26 (4.6)	20 (5.3)	6 (3.2)	0.241
Details of main complications				
Intra-abdominal colon necrosis	55 (9.8)	40 (11)	15 (7.9)	0.289
Pelvic abscess	39 (6.9)	28 (7.5)	11 (5.8)	0.453
Urinary tract infection	32 (5.7)	23 (6.1)	9 (4.7)	0.493
Ileus	19 (3.4)	12 (3.2)	7 (3.7)	0.767
Necrosis of the exteriorized colon	13 (2.3)	10 (2.7)	3 (1.6)	0.558
Respiratory complication	11 (2.0)	6 (1.6)	5 (2.6)	0.520
Acute kidney injury	10 (1.8)	6 (1.6)	4 (2.1)	0.739
Urinary retention	9 (1.6)	6 (1.6)	3 (1.6)	>0.999
Bacteremia	6 (1.1)	1 (0.3)	5 (2.6)	0.018
Intra-abdominal bleeding	5 (0.9)	3 (0.8)	2 (1.1)	>0.999
Venous thromboembolism	4 (0.7)	4 (1.1)	0	0.306
Urinary tract injury	4 (0.7)	2 (0.5)	2 (1.1)	0.606
Cardiovascular event	4 (0.7)	2 (0.5)	2 (1.1)	0.606
Small bowel injury	3 (0.5)	1 (0.3)	2 (1.1)	0.264
Morbidity after the second step of DCAA				
Overall morbidity	143/538 (27)	94/354 (27)	49/184 (27)	0.985
Major morbidity	71/538 (13)	42/354 (12)	29/184 (16)	0.205
Clavien-Dindo classification	0.061			
I	21/538 (3.9)	19/354 (5.4)	2/184 (1.1)	—
II	51/538 (9.5)	33/354 (9.3)	18/184 (9.8)	—
III	60/538 (11)	34/354 (9.6)	26/184 (14)	—
IV	7/538 (1.3)	6/354 (1.7)	1/184 (0.5)	—
V (mortality)	4/538 (0.7)	2/354 (0.6)	2/184 (1.1)	—
Length of stay (d)	15.0 (11.0–21.0)†	14.0 (11.0–19.0)	17.0 (13.0–23.0)	<0.001
Details of main complications				
Early AL‡	71/538 (13)	43/354 (12)	28/184 (15)	0.318
Late AL‡	25/538 (4.6)	10/354 (2.8)	10/354 (2.8)	0.005
Urinary tract infection	29/538 (5.4)	19/354 (5.4)	10/184 (5.4)	0.974
Urinary retention	14/542 (2.6)	13/358 (3.6)	1/184 (0.5)	0.042
Venous thromboembolism	5/542 (0.9)	3/358 (0.8)	2/184 (1.1)	>0.999
Cardiovascular event	4/542 (0.7)	2/358 (0.6)	2/184 (1.1)	0.608
Respiratory complication	2/542 (0.4)	2/358 (0.6)	0/184 (0)	0.551
Global morbidity of DCAA (including morbidity after the first and the second step)				
Overall morbidity	319 (57)	212 (57)	107 (56)	0.933
Major morbidity	169 (30)	106/374 (28)	63 (33)	0.238
Mortality	6 (1.1)	3/374 (0.8)	3 (1.6)	0.410
Overall AL‡	96/538 (18)	53/354 (15)	43/184 (23)	0.016

*n/N (%).
†Median (25%–75%).
‡Patients who did not undergo the second step of DCAA were not included in the analysis of anastomotic leakage as they did not have a CAA.
DCAA indicates Delayed coloanal anastomosis.

step of DCAA are reported in Table 3. In multivariate analysis, this specific postoperative complication was associated with male sex [odds ratio (OR) = 2.67; 95% CI: 1.22–6.49; $P = 0.020$], overweight or obesity (BMI > 25) (OR = 2.78 95% CI: 1.37–6.00; $P = 0.006$), and peripheral artery disease (OR = 4.68; 95% CI: 1.12–19.1; $P = 0.030$).

DISCUSSION

DCAA belongs to the technical arsenal in rectal surgery. By considering all the indications for DCAA achieved in 30 tertiary centres performing rectal surgery, this study provides an overview of the current practice regarding this operation. We found that DCAA satisfies its 2 main objectives whether for primary DCAA or for salvage DCAA. When proposed as an alternative to ICAA with diverting stoma, 75% of the patients have definitively avoided a stoma at the last follow-up. Although this rate seems to be lower than the data published on DCAA ranging from 92% to 96%,[12,16,17] the success rate we observed is still high. Furthermore, in the primary DCAA group, the AL rate was 15% versus 15% and 25% after ICAA in 2 prospective randomized control studies conducted by our GRECCAR research group suggesting that DCAA is an effective way to avoid stoma formation in a considerable proportion of patients

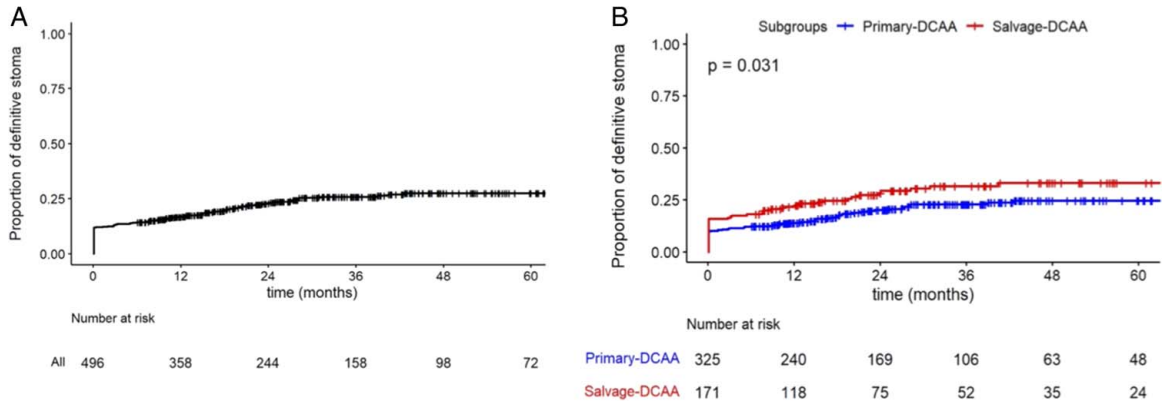

FIGURE 2. Proportion of patients requiring a definitive stoma over time after DCAA in the entire cohort (A) and among patients among primary DCAA and salvage DCAA subgroups (B).

without increasing the risk of developing an AL. Concerning salvage DCAA, bowel continuity was saved 3 years after the surgery for 68% of the patients in our cohort. Although this rate is inferior to the rate found in the primary DCAA group (77%, $P = 0.031$), this success rate is still considerable in this cohort where the alternative was the formation of a definitive stoma.

In parallel to these satisfactory results on the 2 main indications of DCAA, this procedure exposes the patient to significant postoperative morbidity. Considering both the first and second steps of DCAA, 57% of patients developed a complication and 30% had major complications. This rate of major complications seems to be higher than the rate reported in the literature after ICAA, which varies between 14% and 23%, whether in the context of primary ICAA or redo ICAA.[12,27–30] Nevertheless, postoperative mortality in our work was 1% correspondingly low and comparable to the mortality reported after ICAA.[2,27,31] Although the second step of DCAA is less invasive than the first step, there is still a considerable complication rate

TABLE 3. Univariate and Multivariate Analysis of Risk Factors of Intra-abdominal Colon Necrosis After DCAA

	Univariate analysis			Multivariate analysis	
Variables	**No intra-abdominal colon necrosis**	**Intra-abdominal colon necrosis**	***P***	**OR (95% CI)**	***P***
Sex (M)	308/508 (61)*	45/55 (82)	0.002	2.67 (1.22–6.49)	0.020
Age (yr)	62.4 (53.1-69.5)†	60.6 (52.8-66.6)	0.528	—	—
BMI >25 kg/m^2	232/490 (47)	31/52 (60)	0.092	2.78 (1.37–6.00)	0.006
ASA score ≥3	106/507 (21)	19/55 (35)	0.021	1.82 (0.84–3.81)	0.12
Active smoker	71/359 (20)	15/44 (34)	0.029	NS	NS
Steroid therapy	8/364 (2.2)	2/44 (4.5)	0.294	—	—
Coronary artery disease	20/411 (4.9)	3/47 (6.4)	0.720	—	—
Stroke	11/411 (2.7)	2/47 (4.3)	0.633	—	—
Peripheral artery disease	8/412 (1.9)	5/47 (11)	0.006	4.68 (1.12–19.1)	0.030
Antiplatelet therapy	56/430 (13)	10/49 (20)	0.155	—	—
Anticoagulant therapy	29/386 (7.5)	2/44 (4.5)	0.757	—	—
Diabetes	52/423 (12)	8/49 (16)	0.422	—	—
Chronic kidney disease	9/385 (2.3)	2/44 (4.5)	0.314	—	—
Previous pelvic radiotherapy	362/508 (71)	37/54 (69)	0.673	—	—
Delay between first and second step DCAA (d)	7.0 (6.0-10.0)	8.5 (5.0-15.0)	0.503	—	—
Salvage DCAA	175/509 (34)	15/55 (27)	0.289	—	—
Surgical approach			0.843	—	—
Laparotomy	266/508 (52)	29/55 (53)	—	—	—
Laparoscopy	200/508 (39)	23/55 (42)	—	—	—
Robot-assisted	42/508 (8.3)	3/55 (5.5)	—	—	—
Operative time (min)	250.0 (200.0-318.8)	260.0 (230.0-323.8)	0.463	—	—
Blood loss (mL)	200.0 (100.0-350.0)	200.0 (60.0-600.0)	0.947	—	—
Toupet procedure	34/509 (6.7)	4/55 (7.3)	0.779	—	—
Deloyers maneuver	13/509 (2.6)	5/55 (9.1)	0.023	3.42 (0.80–12.1)	0.070
Defunctioning stoma	146/509 (29)	15/55 (27)	0.826	—	—
Surgical volume of the centre <2 DCAA per year	174/501 (35)	22/55 (40)	0.437	—	—

*n/N (%).
†Median (25%–75%).
Variables with a *P* value <0.1 were selected for the multivariate analysis. "Active smoker" is written "NS" in the multivariate analysis as he was not in the final model determined by the lowest Akaike information criterion with a backward selection of the variables.
ASA indicates American Society of Anesthesiologists; NS, nonsignificant.

afterward with 27% of overall complications, including 13% of major complications.

Intra-abdominal colon necrosis was particularly high in our cohort. The rate of 10% is considerably higher than the rates reported after ICAA, which varies between 0.1% and 2%.[32–34] Furthermore, this complication was particularly serious given that 68% of these patients ended up with a definitive stoma 3 years after the surgery. The increased risk of intra-abdominal necrosis of the colon can potentially be explained by the necessity to mobilize the colon more extensively to perform a DCAA when compared with an ICAA given that the colon needs to pass through the anus and to protrude beyond the anal verge by at least 5 cm. Our study suggests that this more extensive mobilization of the colon, which is specific to the DCAA exposes to an increased risk of devascularisation. Deloyers maneuver performed when the colon length was too short to perform a DCAA, increased the risk of intra-abdominal colon necrosis in univariate analysis ($P = 0.023$). The use of this maneuver requires a full mobilization of the colon and then a twist of it on the ileocaecal pedicle, which may compromise the vascularization of the colon. Our multivariate analysis of the risk factors for the occurrence of this complication reinforces this finding, as male sex, peripheral artery disease, and BMI >25 are also risk factors for atherosclerosis, and hence are likely to alter the blood flow inside the marginal artery of the colon, the artery that becomes essential for providing the blood supply to the mobilized colon due to the vascular ligation of other arteries, most notably the inferior mesenteric artery. Furthermore, BMI >25 is also a characteristic that can complicate the mobilization of the colon and increases the risk of iatrogenic injury to the marginal artery. The implementation of an indocyanine green test to assess the vascularization of the colon at the end of the first stage of the DCAA could be a promising prospect to be explored.[35]

One of the main limitations of this study is its retrospective nature. Furthermore, the absence of a control group assessing ICAA with diverting stoma limits the analysis of DCAA as an alternative to the reference technique. Finally, our work did not evaluate the intestinal function of DCAA and just reported the number of patients who required a stoma because of a poor functional result. Although some studies suggest that the intestinal function is similar between DCAA and ICAA,[17,36] others reported higher low anterior resection syndrome scores after DCAA.[12,37] Thus, this crucial outcome deserves further investigation. Another relevant perspective that we were not able to address in this work is the psychological impact of DCAA, particularly during the interval period between the first and second stages of the procedure when the colonic stump remains exteriorized for several days.

CONCLUSIONS

DCAA as an alternative to ICAA with a diverting stoma makes it possible to definitively avoid a stoma in 75% of patients. In the situation of salvage of bowel continuity, this surgical technique leads to the preservation of the bowel continuity in 68% of patients 3 years after the surgery. Despite the high success rate, this technique exposes patients to a high risk of morbidity, including a 30% major complication rate, and does not preclude the risk of AL given that this complication occurred in 18% of cases. This study also identified a significant risk of intra-abdominal colon necrosis after DCAA likely due to the extensive mobilization of the colon. Assessing the functional result of DCAA remains a determining issue to be addressed to define precisely the role of this procedure in rectal surgery.

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DISCUSSANT

Fabrizio Michelassi (New York, United States)

I would like to thank the ESA for the privilege of the floor, and the authors for sharing the results of this retrospective study on DCCA, conducted between 2010 and 2021, at 30 hospitals affiliated with the French Research Group of Rectal Cancer Surgery. The study included 564 patients: two-thirds of them for primary DCAA and one-third for salvage DCAA. Overall morbidity was 57%, with major morbidity seen at 30%. Of the patients, 10% developed necrosis of the distal intra-abdominal colon brought down to the pelvis and through the anus. AL occurred in 17% overall. Preservation of bowel continuity was achieved in about two-thirds of patients 3 years after surgery.

I have the following questions: The first question revolves around the morbidity of this procedure. The authors report that 30% of DCAA patients developed a major complication and 17% suffered from an anastomotic dehiscence. Although we can easily understand the high morbidity associated with this major procedure, it is more difficult to understand the high rate of anastomotic dehiscence, the very complication that this technique is devised to protect against.

Second, the authors did not assess the ultimate defecatory function of these patients. We learn from the manuscript that poor function led to 10% of patients requiring a definitive stoma. Yet, it would be important to know the number of bowel movements/day, incidence of diurnal and nocturnal incontinence, and usage of protective pads. How many patients developed stenosis of the CAA? How was it treated?

Third, there were several days, or at least a week, between the first and second stages of the procedure. During this interval, the colonic stump remained exteriorized through the anus. What was the morbidity associated with this phase? Did patients find this phase distressing?

Finally, in view of the high morbidity listed, the prolonged length of stay that it comports, the lack of any assessment of postoperative function, and the absence of a control group assessing the results of an ICAA, it is difficult to assess the place of DCAA in the repertoire of surgical techniques for this highly complex group of patients. Can the authors elaborate on this based on their experience?

Response from Maxime K. Collard (Paris, France)

Thank you very much for your questions. The first one regards the high morbidity rate, which was expected; however, the high rate of AL (17%) was a surprising result, as we would have expected a lower leakage rate with this procedure. Some available publications report a very low rate of AL (2%–5%) with this procedure. In this real-life study of 30 colorectal centers, we did not reach a lower rate of AL, which was also the result of the randomized control trial, where the aim was to see whether we could avoid the stoma for the patient, but not to reduce the rate of AL. In this study, the rate of AL after delayed CRA was 13%. Other large cohorts of DCAA obtained similar results. In our subgroup of primary surgery, it was 15%. So, we have confirmed what the larger studies previously found, which is an important result of the study. As we said, the DCAA is not the solution for AL.

Second, regarding the functional outcome, this is a very relevant point. Currently, we are still gathering data on this point. I can give you some preliminary results, but I do not have the results for all the patients. We have collected data from 177 patients, and we have obtained a rate of 41% in the patients who had restored bowel continuity. Here again, it is quite similar to the data available in the literature, including the randomized control trials. Of the patients, 10% with a definitive stoma had a poor functional outcome; however, within the entire cohort, it only represented around 2% of the patients. I do not have the data on the rate of anastomotic stricture, but many patients required a definitive stoma due to delayed AL. Probably, many of them developed a secondary stricture of their anastomosis. I can confirm that no patient required a stoma due to a stricture in our database.

Third, indeed, the morbidity was not negligible after the first surgical step: major morbidity was 20%; and pelvic abscess was 7%, which increased the rate of AL. During this period, we also saw a high rate of necrosis of the intrabdominal colon. All of this makes it a risky period, which is why all the centers we included kept patients at the hospital during this waiting period; none of them went back home ahead of the surgery.

Regarding the psychological impact of this surgery, I lack precise data on this. It might become the topic of a more specific study, which could answer the interesting question of whether it is worth having this over a temporary stoma for a few weeks. Personally, we

did not get the impression that the patients had a poor experience during this waiting period, but this is not backed up by scientific facts.

Finally, I think we need to take the primary context into account, and in contrast, we need to look at the salvage context. In the primary context, the results are not as good as expected: high morbidity and an AL rate similar to the ICAA. From our point of view, research should be based on a more selective approach to avoid stoma in selected patients and to maintain the diverted stoma in high-risk patients. This is the topic of an ongoing randomized control trial. Conversely, redo surgery is completely different. In some patients who have a rectovaginal fistula, for example, it would be of interest to first have the suture of the vagina, followed by anastomosis 1 to 3 weeks afterward. We will never have a controlled trial on this because it represents a rare disease; nevertheless, it seems to be useful in the context of salvage surgery.

Dieter Hahnloser (Lausanne, Switzerland)

I would like to congratulate the French colorectal surgeons on their great collaborative research. One of your conclusions, which you mentioned in your previous answer, is that we probably should not perform this procedure anymore. However, during your presentation, you also suggested that pulling out the descending colon 5 cm or above might have caused intracorporeal necrosis of the colon (which occurred in a high percentage of cases). By not doing so and performing a well-vascularized primary anastomosis without a protective stoma, this would most likely not have happened. So, should not the conclusion of your paper be that we should stop performing this for primary cancer?

Response from Maxime K. Collard (Paris, France)

Again, I think that this is an interesting point of the article. We can see that the interpretation may be very different. Indeed, this paper demonstrates that we can avoid a stoma in 3 out of 4 patients, which is a positive result. Our feeling is that, perhaps, selecting low-risk patients to avoid a stoma and DCAA, might make things easier. However, we can not say that DCAA is useless in this context.