Delayed Colo-anal Anastomosis for Rectal Cancer: Pelvic Morbidity, Functional Results and Oncological Outcomes: A Systematic Review

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Abstract

Background Delayed colo-anal anastomosis (DCAA) has received renewed interest thanks to its reduction in anastomotic leakage rate without the use of stoma to protect a low rectal anastomosis. The aim of this review was to summarize the available literature on DCAA following rectal cancer resection and to report clinical, oncological and functional results.

Methods A comprehensive literature review was conducted including MEDLINE/Pubmed, EMBASE, SCOPUS, clinicaltrials.gov and the Cochrane database of systematic reviews through July 2018. The review was conducted according to MOOSE guidelines. Quality was appraised with the methodological index for non-randomized studies (MINORS) tool.

Results Eight observational studies (409 patients) were included. Average MINORS score was 9.6/14 in seven non-comparative studies and 17/22 in one comparative study. Six studies reported no anastomotic leak. Pelvic sepsis/abscess ranged from 0 to 25%. Mortality rate was <3% in seven studies and 12.5% in one. Poor fecal continence was reported in <30% of patients. Need for permanent stoma was ≤2% in six studies. A five-year survival rate ranged from 63.8 to 81% (four studies). Loco-regional recurrence rate ranged from 4.8 to 14.3% at 3 years (four studies) and from 6 to 38.8% at 5 years (three studies).

Conclusion DCAA offers an alternative to primary straight colo-anal anastomosis for low rectal cancer. The benefits include reduced risk of anastomotic leakage and pelvic sepsis, and no need for protective ileostomy, with good functional and oncological outcomes. Results of ongoing randomized controlled trials comparing DCAA with straight colo-anal anastomosis and protective stoma are awaited to draw definitive conclusions.

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Background

Total mesorectal excision with colo-anal anastomosis for low rectal cancer is burdened by a significantly high morbidity, including anastomotic leakage and pelvic abscess [1, 2]. In an attempt to reduce surgical morbidity due to anastomotic failure, a protective stoma is used by most surgeons for low rectal anastomosis [3, 4]. In 1961, Turnbull and Cutait independently described a two-step technique of abdominoperineal pull-through rectal resection with delayed colo-anal anastomosis (DCAA), without need for protective ileostomy [5, 6]. Although over the last three decades the introduction and diffusion of staplers made DCAA obsolete, this procedure has received renewed interest due to its advantages [7]. In fact, DCAA reduces the risk of anastomotic leakage without the need for using a stoma to protect a low rectal anastomosis. A previous review of the literature on 'Turnbull–Cutait' procedure including 1124 patients showed low morbidity with reduced use of stoma and reasonable fecal continence [7]. However, this review included heterogeneous groups of patients with different surgical indications (i.e., primary and/or salvage operation), for either malignant or benign disease.

The aim of this systematic review was to summarize the available literature on DCAA performed as primary operation for rectal cancer, reporting clinical, functional and oncological results.

Materials and methods

Study design

This is a systematic review of observational studies investigating the results of delayed colo-anal anastomosis after rectal resection for cancer. The Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines were used in this review [8].

Search strategy

To identify relevant studies, we systematically searched MEDLINE/Pubmed, EMBASE, SCOPUS, clinicaltrials.gov and the Cochrane Database of Systematic Review between January 1975 and July 2018. Two researchers (GP and MP) independently reviewed search results and screened titles/abstracts. A third researcher (FC) resolved any inconsistency. We obtained the full texts of all potentially eligible studies. In PubMed, the following search strategy was used: ('colo-anal anastomosis' OR 'delayed colo-anal anastomosis' OR 'delayed colorectal anastomosis' OR 'Turnbull–Cutait' OR 'abdominoperineal

pull-though') AND ('rectal cancer' OR 'rectal tumor' OR 'rectal neoplasm'). This search strategy was adapted to suit the other electronic sources. Only clinical studies in English or French were considered. Case reports were excluded. Data from meeting abstracts were not included, as details were not sufficient to allow for data extraction. The reference lists of included articles were hand-searched to identify additional studies of interest.

Criteria for considering studies for this review

Observational studies investigating colo-anal anastomosis after rectal resection for cancer were considered eligible for this review. Only the most recent and complete data were included when duplicate publications reporting on similar patients were found. Studies including only salvage surgery cases were excluded. Studies not including humans were excluded.

Data collection extraction

Two researchers (GP and OP) independently extracted key data from the included studies. A third researcher (MP) checked the extracted data. For each study, we retrieved relevant data (morbidity, mortality, anastomotic leak, pelvic sepsis/infection, postoperative functional assessment) and the following data: title, first author, journal, year of publication, study design, sample size and length of follow-up. When queries arose or additional data were required, we contacted study authors.

Assessment of risk of bias

Two researchers (GP, FC) completed the quality appraisal with the Methodological Index for Non-Randomized Studies (MINORS) tool [9]. The MINORS tool includes eight items for non-comparative studies and four additional items for comparative studies. Items are scored as 0 (not reported), 1 (reported but inadequate) and 2 (reported and adequate), with a total score of 16 for non-comparative studies and 24 for comparative studies. A third researcher (OP) resolved any inconsistency.

Data synthesis

A narrative synthesis of included studies was conducted, because some aspects limited the feasibility of a meaningful meta-analysis. Such aspects included the very small sample size (less than 10 patients) of some studies, and an old study dated back 40 years, heterogeneous evaluation of functional results (i.e., different scales) and oncological outcomes (different survival definitions and different time points).

Fig. 1 Meta-analysis of observational studies in epidemiology (MOOSE) flowchart
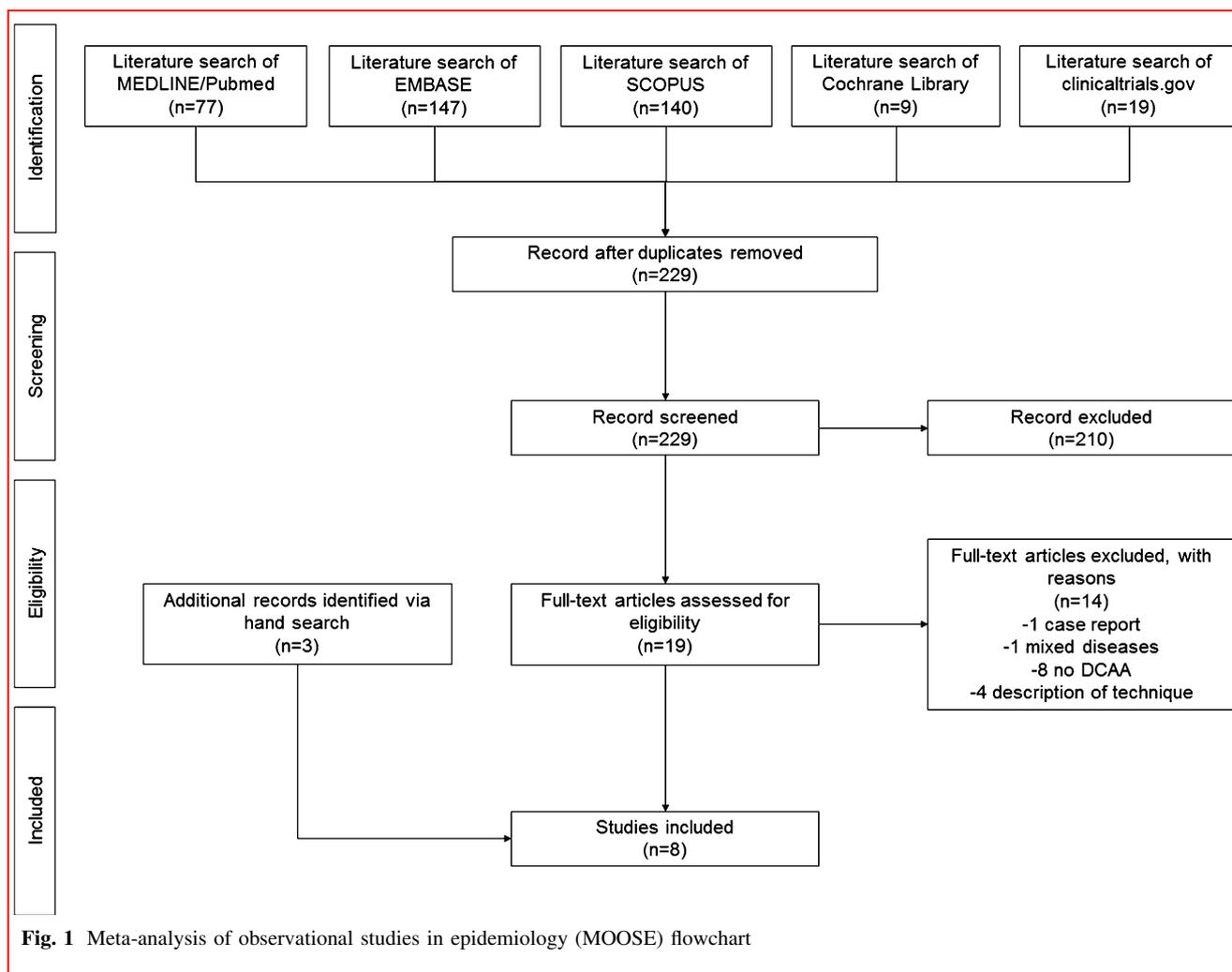
Table 1 Demographic data and tumor characteristics for studies on delayed colo-anal anastomosis for rectal cancer

| Author	Country (years)	Design	Patients included (nos.)	Age (years): mean (range)	Distance of tumor from anal verge (cm): mean (range)
Kirwan [10]	United States (1978)	Retrospective	84	57 (35–74)	7.6 (3–12.5)
Olagne [11]	France (2000)	Retrospective	35	62.4 (41–74)	1–2 cm in 15 pts, and >2 cm in 20 pts
Facy [12]	France (2009)	Retrospective	17	58.6[a]	3.4 (2–7)
Jarry [13]	France (2011)	Retrospective	100	64 (27–83)	5 (2–12)[b]
Pujahari [14]	India (2015)	Retrospective	8	63.5	5.5 (5–6.2)
Bianco [15]	Italy (2016)	Retrospective	8	58 (38–73)	3.6 (2–5)
Xiong [16]	China (2016)	Retrospective	72	59 (10.3)[c]	5.5 (0.6)[c]
Sage [17]	France (2018)	Retrospective	85	63 (42–83)[b]	4 (2–12)[b]

[a]Mean of all 17 patients included in the study (12 cancer and 5 non-cancer)

[b]Median (range)

[c]Mean (SD)

Table 2 Treatment data for studies on delayed colo-anal anastomosis for rectal cancer

Author	Patients included (nos.)	Neo-adjuvant chemotherapy [N (%)]	Neo-adjuvant radiotherapy [N (%)]	Open or laparoscopic approach for abdominal time in first operation [N (%)]	Delay to second operation (days): mean	Use of protective stoma
Kirwan [10]	84	Not reported	Not reported	Open 84 (100)	10	Transverse colostomy
Olagne [11]	35	35 (100)	35 (100)	Open 35 (100)	5	No
Facy [12]	17[b]	4/12 (33.3)[b]	6/12 (50)[b]	Open 12/17 (70.6)[b] Laparoscopic 5/17 (29.4)[b]	5	No
Jarry [13]	100	18 (18)	70 (70)	Open 25 (25) Laparoscopic 75 (75)	6	No
Pujahari [14]	8	1 (12.5)	1 (12.5)	Open 7 (87.5) Laparoscopic 1 (12.5)	10.25 (8–14)[a]	No
Bianco [15]	8	7 (87.5)	7 (87.5)	Laparoscopic 8 (100)	13.5 (11–15)[a]	No
Xiong [16]	72	Not reported	Not reported	Open 72 (100)	30	No
Sage [17]	85	63 (74.1)	63 (74.1)	Laparoscopic 80 (94.1) Converted to open 5 (5.9)	6	No

[a] Mean (range)

[b] 17 Patients included in the study (12 cancer and 5 non-cancer)
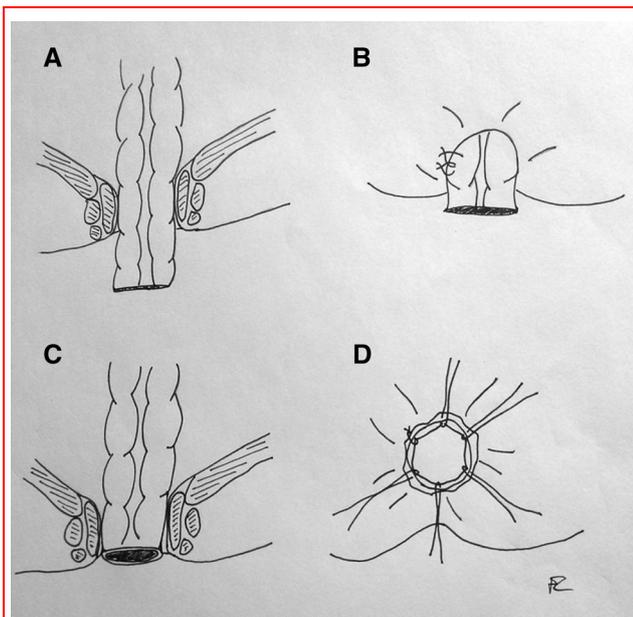
Fig. 2 First procedure. Trans-anal recovery of the specimen, pull-through of the distal colon, leaving 8–10 cm of colonic stump partially or fully open and sutured to the buttocks, usually on one side only (**a**, **b**). Second procedure. Hand-sewn colo-anal anastomosis, performed with interrupted sutures (**c**, **d**)

Results

Study selection

Overall, the searches yielded 229 non-duplicated articles; 210 articles were excluded based on title and/or abstract, while 19 articles were retrieved for full-text review. Eight studies not evaluating DCAA, four papers with only the description of the technique, one study including patients with different diseases and one case report were excluded. Three additional studies were found via hand search. Ultimately, eight observational studies were included in the qualitative synthesis (Fig. 1) [10–17].

Study and patient characteristics

A total of eight studies [10–17] meeting our criteria (patients with primary DCAA for rectal cancer) were included; seven were in English and one in French. Publication time was from 1978 to 2018, with one study before 1980 [10] and the others after 2000 [11–17]. Only one study compared DCAA with immediate colo-anal anastomosis [16]. Studies included from 8 to 100 patients, with a total of 409 patients comprised in this review. Patient characteristics of the included studies are reported in Table 1. Seven studies analyzed only rectal cancer patients [10, 11, 13–17], while one [12] included a mixed population (70% rectal cancer and 30% other diseases; we extrapolated data for rectal cancer patients only).

Operative data are reported in Table 2. The first step of the procedure included mobilization of the colon and pelvic dissection, either with standard laparotomic approach in four studies or laparotomic/laparoscopic in three studies (information not reported in one study). The perineal stage started with incision at the dentate line, recovery of the specimen either trans-anally or abdominally for bulky mass, pull-through of the distal colon, leaving 8–10 cm of

colonic stump partially or fully open and sutured to the buttocks, usually on one side only (Fig. 2a, b). The second procedure was performed 5–10 days later, to allow for maturation of the pulled colon to the anal margin: A hand-sewn colo-anal anastomosis was performed with interrupted sutures (Fig. 2c, d). The surgeons did not use any protective stoma, except transverse colostomy in one study, published in 1978 [10].

Quality assessment

The MINORS scores [9] for the methodological quality appraisal of included articles are shown in Supplementary Table 1. The item of unbiased assessment of study endpoint (blind evaluation of objective endpoints) was not applicable in included studies. Seven studies [10–15, 17] were non-comparative retrospective studies with an average MINORS score of 9.6 (range 8–11) out of 14, while one study [16] was a comparative retrospective study with a MINOR score of 17 out of 22.

Postoperative outcomes

Details on postoperative outcomes are shown in Table 3. Six out of eight studies reported no anastomotic leak [10–12, 14–16]. Pelvic sepsis/abscess ranged from 0 to 25%. Mortality rate was less than 3%, except in one study (12.5%, one in eight patients) [14]. Need for reoperation was nil in four studies [10, 14–16], less than 3% in one study [11] and 10–17.6% in three studies [12, 13, 17].

Functional outcomes

Seven studies [10–14, 16, 17] reported on fecal continence (Table 4). The information was not directly reported in one study [15] but could be retrieved from another paper by the same authors [18] (Table 4). Evaluation was performed with different scales: Visick Grading System [10], Wexner Continence Score [13, 15, 17], Lyon Scale [11, 12] and Kirwan Grading Scale [16]. One study [14] reported no incontinence without details on functional assessment and follow-up time. The need for permanent stoma ranged from 0 to 27% (Table 4). Anastomotic stenosis was reported in five studies [11, 13, 15–17], ranging from 1.4 to 25.8% (Table 4).

Survival and recurrence

All studies reported oncological follow-up data, but using different descriptions and time intervals. Four studies [10, 11, 13, 17] reported 5-year survival rate ranging from 63.8 to 81%, while the other four [12, 14–16] reported medians or survival rate at less than 5 years. Loco-regional recurrence rate ranged from 6 to 38.8% at 5 years [10, 11, 17], and from 4.8 to 14.3% at 3 years [12–14, 16], while it was nil in one study [15] at median 10.4 months after surgery. Details on recurrence and survival are summarized in Table 4.

Conclusions

The Turnbull and Cutait procedure (DCAA) was originally developed as an alternative to straight colorectal anastomosis in adult patients with mid-rectal cancer or rectal Chagas and in children with Hirschsprung disease in order to avoid permanent stoma [5, 6]. Over the last 30 years, with the advent of stapling devices, DCAA has been progressively abandoned and immediate anastomosis has become the preferred technique. However, some surgeons have recently reintroduced this procedure when treating patients with dehiscence following colorectal resection, chronic recto-vaginal or recto-urethral fistula, pelvic infections (i.e., complex anorectal conditions that might

Table 3 Postoperative data for studies on delayed colo-anal anastomosis for rectal cancer

Author	Patients included (nos.)	Anastomotic leak (%)	Pelvic abscess/sepsis (%)	30-day mortality (%)	Reoperation (%)
Kirwan [10]	84	0	6 (7.1)	1 (1.2)	0
Olagne [11]	35	0	1 (2.8)	0	1 (2.8)
Facy [12]	17[b]	0	2 (11.8)[b]	0	3 (17.6)[b]
Jarry [13]	100	2 (2)	8 (8)	3 (3)	14 (14)
Pujahari [14]	8	0	0	1 (12.5)	0
Bianco [15]	8	0	0	0	0
Xiong [16]	72	0	2 (2.8)	0	0
Sage [17]	85	9 (10.6)[a]	21 (25)[a]	2 (2.3)	9 (10.6)

[a]Within or after postoperative day 30

[b]17 Patients included in the study (12 cancer and 5 non-cancer)

Table 4 Functional results and long-term oncological outcome for studies on delayed colo-anal anastomosis for rectal cancer

Author	Patients included (nos.)	Need for permanent stoma (%)	Anastomotic stenosis (%)	Fecal continence (%)	Overall survival (%)	Local recurrence rate (%)
Kirwan[10]	84	1 (1.2)	Not reported	Visick grading system Grade 1: 25.6 Grade 2: 35.9 Grade 3: 38.5 Grade 4–5: 0 (at 12 months in 39 pts)	63.8 (at 5 years)	6 (at 5 years)
Olagne [11]	35	0	4 (11.4)	Lyon scale Good/fair 83 Poor/very poor 17 (at 12 months in 29 pts)	72 (at 5 years)	11.4 (at 5 years)
Facy [12]	17	1 (6.3)	Not reported	Lyon scale Good 66.7 Fair 20% Poor 13.3 (at mean 12 months in 15 pts)[a]	43.7 (24–90) months[f]	5.9 (at 3.3 years)
Jarry [13]	100	2 (2)	15 (15)[b]	WCS Very good/good 73 Poor/very poor 27 (at 2 years in 94 pts)	81 (at 5 years)	7 (at median 38.4 months)
Pujahari [14]	8	0	Not reported	No incontinence 100[c]	40 (12–60) months[f,g]	14.3 (at 40 months)[g]
Bianco [15]	8	0	1 (12.5)	WCS[d] 5–12 (at 2 years in 5 pts)	100 (at mean 10.4 months)	0 (at mean 10.4 months)
Xiong [16]	72	0	1 (1.4)	Kirwan grading scale Grade I: 76.4 Grade II: 12.5 Grade III: 11.1 Grade IV: 0 Grade V: 0 (at 12 months in 72 pts)	85.5 (at median 38.5 months)[h]	4.8 (at median 38.5 months)[h]

Table 4 continued

Author	Patients included (nos.)	Need for permanent stoma (%)	Anastomotic stenosis (%)	Fecal continence (%)	Overall survival (%)	Local recurrence rate (%)
Sage [17]	85	23 (27)	22 (25.9)	WCS[e] Very good 39 Good 32 Poor 29	70 (at 5 years)	38.8 (at median 59 months)

The grading systems for fecal incontinence are explained in table footnotes

Visick Grading System: 1 perfect, 2 occasional enema or impossibility to hold flatus, 3 uses drugs or daily enema or need to wear pad or occasional minor leak, 4 frequent major soiling, 5 colostomy

Lyon Scale includes the evaluation of stools per day (*n*), stools at night (*n*), control (min), time for defecation (min), requirement for treatment, soiling, use of pad, stool incontinence, gas incontinence, discrimination stool/gas, solid food diet, normal social life, personal satisfaction; scores: 0–3 good, 4–6 fair, 7–8 poor, ≥9 very poor

Wexner Continence Score (WCS) includes the evaluation of frequency of incontinence to gas, liquid, solid, of need to wear pad and lifestyle changes; scores: 0–5 'very good,' 6–10 'good,' >10 'poor' or 'very poor'

Kirwan Grading Scale: I full continence, II incontinence of gas, III occasional minor soiling, IV frequent major soiling, V incontinence

[a] Data referred to all patients included in the study (cancer and non-cancer) except two patients, one who died and one who had terminal colostomy for necrosis of the exteriorized colon

[b] Late postoperative complication

[c] Scale for functional assessment and follow-up time not reported

[d] Functional data available in five patients

[e] 59 Patients available for functional follow-up at 1 year (excluding 21/80 patients with stoma and five patients, died within 1 year after surgery)

[f] Mean (range)

[g] 7/8 Patients available for follow-up (one post-op death)

[h] 63 pts available for follow-up

otherwise require permanent fecal diversion) or in low rectal cancer after neo-adjuvant treatment in order to reduce complications, while avoiding the stoma [19–22].

In 2014, a previous study reviewed the available literature on DCAA and showed low morbidity with reduced use of stoma and reasonable fecal continence [7]. However, the review included studies on malignant and/or benign disease, with different surgical indications (i.e., primary and/or salvage operation) [7]. In our review, we focused only on studies reporting results of DCAA performed as primary procedure for rectal cancer patients, including mid-term functional and long-term oncological outcomes.

Our synthesis indicated low postoperative mortality and pelvic morbidity, as anastomotic leak rate was nil in six out of eight studies and pelvic sepsis/abscess rate was below 10% in all but two studies. The need for permanent stoma was very low (2% or less in six out of eight studies). Patients with mid- or low rectal cancer, who often receive neo-adjuvant treatment and are at high risk of pelvic complications (including invasion of adjacent organs as vagina, bladder, seminal vesicles or edema of the colonic wall due to the effects of preoperative radiotherapy), can benefit from the advantages of DCAA as nicely described by Jarry et al. [13]. First, there is no anastomotic tension at the end of the first procedure, since there is no anastomosis. Moreover, even if the pelvic floor rises up at the end of the operation (with end of curarization), the pulled-through colon is free to move in the anal sphincter. Second, delaying the step in which the anastomosis is created allows enough time for adhesions between the descending colon and the anus, before a true and definitive anastomosis is fashioned. These adhesions contribute to limit the risk of potential leak. The surgeon has the chance to inspect daily the status of the pulled-through segment, therefore avoiding delay in diagnosis of necrosis of the colonic segment. In patients undergoing total mesorectal excision with straight colo-anal anastomosis for low or ultra-low rectal cancer, protective loop ileostomy is used to reduce the risk of anastomotic failure and to limit the consequences of pelvic sepsis such as postoperative morbidity, impaired quality of life and higher recurrence rate [3, 4, 23, 24]. However, defunctioning stoma is burdened by a not negligible rate of complications (up to 35%), impairs patient's quality of life and requires a second readmission for stoma closure [25, 26]. The latter brings additional costs from hospitalization and potential complications (up to 20%) including leakage and need for a new ileostomy [27, 28]. On the other hand, patients with DCAA do not need any protective stoma and avoid the risks related to the creation and subsequently reversal of the stoma. It should be noted that reoperation rate was not negligible in three out of eight studies included in our review. However, reoperation rate after DCAA was lower than the literature data regarding straight colo-anal anastomosis, protected by a stoma, including also subsequent reversal of the stoma [29, 30].

Two important aspects should be evaluated when considering an alternative technique for surgical treatment of cancer patients: functional results and oncological outcome. Data from this review revealed that fecal continent function was preserved in the vast majority of the patients, with need for permanent stoma in only few cases and anastomotic stenosis in some patients, but usually requiring only few dilatations to resolve. Patients with straight colo-anal anastomosis may benefit from a colonic J-pouch, in order to limit the sequelae of the so-called anterior resection syndrome, including frequency and fragmentation of stools, fecal incontinence or urgency and emptying difficulties [31, 32]. The J-pouch reservoir is technically not possible in case of DCAA, given the need to pull a colonic segment straight through the anal canal. However, the J-pouch requires a longer operative time and the functional benefit in J-pouch patients compared with those with straight colo-anal anastomosis tends to reduce or even vanish over time [33–35], thus limiting its use among surgeons.

Respect of oncological principles in rectal cancer patients undergoing DCAA is warranted, as complete tumor removal with negative circumferential and distal margins and a properly performed TME still apply and remain the milestone for oncological cure. In fact, the only change concerns the timing in fashioning the anastomosis, immediately or after a delay of 5–10 days. Further, patients undergoing DCAA might—*theoretically*—benefit from an oncological 'plus,' avoiding the detrimental effects of anastomotic leaks on long-term survival. Our review indicated a 5-year survival (up to 80%) after DCAA that was in line with current data on rectal cancer surgery (5-year survival 67%) [36].

Our study is the first systematic review reporting the results of DCAA specifically focusing on patients operated for rectal cancer. Our synthesis nearly doubles the number of rectal cancer patients included in a 2014 review on DCAA in malignant or benign colorectal patients. While showing comparable rates of anastomotic leak, pelvic abscess, reoperation and 30-day mortality, our synthesis adds a large number of patients operated with minimally invasive technique, giving an updated picture of the results of this technique. Rectal cancer patients can benefit from the advantages of DCAA performed as primary procedure, and there is a growing interest on this topic as shown by two ongoing randomized controlled trials (NCT01766661, NCT01876901) [37]. However, the findings of our study should be interpreted within its limitations. First, the quality of included studies was limited by the retrospective nature of all studies and by the unclear stated aim and the loss of patients during follow-up in some studies. Second,

reporting of outcomes of interest was heterogeneous, as functional results were assessed with four different scales and oncological outcomes were evaluated at different time intervals. Third, the small sample size of some studies affected the reported rates of outcomes of interest. Fourth, we excluded some studies because data on rectal cancer patients only could not be retrieved.

In conclusion, DCAA can be considered as a valid alternative to primary straight colo-anal anastomosis for low rectal cancer. The benefits include: (1) the possibility to perform a cancer resection with sphincter preservation while avoiding the need for a protective stoma; (2) the possibility to perform neo-adjuvant treatments, including chemoradiotherapy or radiotherapy, with a low rate of anastomotic leakage and pelvic related morbidity; (3) the functional (in terms of continence and quality of life) and oncologic (survival) results comparable to those obtained with a standard approach (LAR + loop ileostomy or colostomy). Results of ongoing randomized controlled trials comparing DCAA with straight colo-anal anastomosis and protective stoma are awaited in order to draw definitive conclusions.

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