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Radiological findings in anastomotic leakage after anterior resection may predict a permanent stoma

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Abstract

Background: Permanent stoma (PS) is common following treatment of anastomotic leakage (AL) after anterior resection (AR) and ways of predicting successful treatment outcome are missing.

Purpose: To explore radiological variables in rectal contrast studies in their relation to end-result of PS following treatment for AL after AR.

Material and Methods: The Swedish Cancer Registry (SCRCR) was explored for AL cases after AR for rectal cancer in patients operated in the region of Skåne from 1 January 2001 to 31 December 2011. Among identified AL cases, patients subjected to radiological imaging consistent with AL were evaluated according to a predetermined set of radiological variables. Information of PS as the end-result after AL treatment were retrieved from medical records.

Results: Thirty-two patients had radiological imaging available for analysis confirming AL after AR; PS rate after a median follow-up of 87 months (range = 21–165) after AR was 62%. Radiological findings compatible with abscess ($P = 0.023$) and a leak size $\leq$6 mm ($P = 0.049$) were significantly associated with PS.

Conclusion: In this limited explorative study, our findings suggest that abscess status and leak size could correspond to outcome of PS in treatment for AL after AR. Additional studies are warranted to further explore this subject.

Keywords

Anastomotic leakage, rectal cancer, contrast enema, anterior resection

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Introduction

In the treatment of rectal cancer, anterior resection (AR) with a colorectal or coloanal anastomosis enables bowel continuity (BC). The anastomosis has an inherent risk of impaired healing resulting in anastomotic leakage (AL). Reported rates of AL after AR are in the range of 3%–27% (1–4), being more common in studies including long-term follow-up (5).

Contrast enema (CE) is a radiological method to demonstrate established criteria for AL (6). CE has been reported as having high specificity and moderate sensitivity for AL with a high correlation to clinical findings (7) and is considered superior to computed tomography (CT) without rectal contrast in evaluating AL (8). CE can be employed to confirm a suspicion of AL or to evaluate anastomotic integrity before defunctioning stoma reversal (7).

Research has provided extensive knowledge on the prevention of AL and reduction of morbidity after AL. Several risk factors have been identified (1,3,4,9), early detection scoring systems have been developed (10) and use of a defunctioning stoma has been proven to reduce

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AL related morbidity after AR (2). Preventive measures can reduce the frequency and morbidity of AL after AR but there is limited knowledge on how to best handle established AL. In terms of treatment outcomes, the reported rate of non-healing AL 12 months postoperatively is 48% (5) with end-result permanent stoma (PS) in 22%–56% (11,12). Some authors report coloanal reanastomosis as feasible to regain BC in selected cases (13,14). More commonly, a conservative approach is implemented wherein an early-on established AL vacuum-assisted drainage can improve healing rates, but with an overall non-healing rate of 34% (15). Non-healing AL, most commonly manifested as a chronic sinus (5), prevents reversal of defunctioning stoma due to risk of subsequent pelvic sepsis, although some authors advocate this risk as tolerable (16). Poor results in bowel function following the restoration of BC (15,17) might also contribute to the high frequency of PS after AL.

Considering the high rate of PS as the end-result of anastomosis-preserving treatment, it would be desirable to distinguish the patients where treatment is futile and who could benefit from a PS or coloanal reanastomosis at an earlier stage.

The aim of this study was to explore radiological variables in CE studies and their relation to the end-result of PS in the treatment of AL after AR.

Material and Methods

The Swedish ColoRectal Cancer Registry (SCRCR) was explored for cases of AL after AR for rectal cancer in the region of Skåne from 1 January 2001 to 31 December 2011. The cohort was chosen since it is very well characterized and has a long-term follow-up (18,19). In order to identify false-negative registrations, the SCRCR also identified cases of AR subjected to reoperation within 90 days after AR and the regional web-based patient administrative system (PASIS) was explored for all operated patients with rectal cancer with a hospital stay >3 weeks and/or more than readmission within three months after AR. AL was defined as a visible anastomotic defect found during endoscopy, leakage of rectal contrast from bowel lumen through anastomosis evaluated by plain X-ray or CT scan, a postoperative pelvic abscess, a palpable dehiscence on digital examination, a postoperative rectovaginal fistula at gynecological examination as well as postoperative vaginal discharge of gas, pus or feces, or relaparotomy findings of pus or feces in the pelvis or an obvious anastomotic dehiscence. Asymptomatic AL was considered in findings coherent with AL on routine follow- up before defunctioning stoma reversal. A postoperative anastomotic stricture without any other evidence supporting the diagnosis of AL was not regarded as AL.

Further clinical variables with a possible impact on the end-result of PS were retrieved from medical records. Collected clinical variables were: defunctioning stoma at index procedure; anastomotic type (end-end, side-end or reservoir); partial or total mesorectal excision in AR; and postoperative date of AL diagnosis. SCRCR provided information about patient age at the time of AR and administration of neoadjuvant radiotherapy. Furthermore, a statement based on medical records of whether an existing stoma was accepted as permanent or not was made by an appointed surgeon at each hospital.

Radiological set of variables characterizing anastomotic leakage

Patients subjected to water-soluble rectal CE where AL was confirmed were reviewed according to a predetermined set of radiological variables characterizing the AL. The protocol incorporated all rectal CE studies, with both plain X-rays and CT scans included. The selection of radiological variables to be evaluated was based on plausible reproducibility as well as plausible consistency regardless of CE modality used. The radiological variables characterizing the anastomotic leakage were:

1. Leakage location in anastomosis: assessing location of anastomotic leakage, classified as "from circular anastomosis" or in cases of side-to end-reconstruction "from transverse line in colonic stump";
2. Direction of initial contrast leakage: assessing direction in the horizontal plane of the initial portion of rectal contrast leaving the bowel lumen, classified as "dorsal" or "ventral" or "lateral";
3. Orientation of major fistula or leakage cavity: assessing orientation in the horizontal plane of the major contrast-filled fistula or cavity, classified as" Dorsal" or" Ventral" or" Lateral".
4. Size of major fistula or leakage cavity: assessing the major contrast filled fistula or leakage cavity, measured in maximum diameter in millimeters;
5. Size of anastomotic defect: assessing width of contrast stream exiting the bowel lumen from the anastomosis in the bowel wall, measured in maximum diameter in millimeters perpendicular to the direction of the intestinal lumen;
6. Abscess formation: assessing presence of radiologically detectable abscess in the pelvic cavity. An abscess was considered when radiological findings of a fistula or fluid collection in the pelvic cavity containing air bubbles and/or a contrast-uploading

encapsulation around the fistula or fluid were described.

Image interpretation and evaluation of radiological variables were conducted by a senior radiologist.

The study was approved by the ethics committee at Lund University and informed consent was received before retrieving clinical data from medical records.

Statistical analysis

Radiological variables and clinical variables were analyzed in their relation to the end-result of PS. To facilitate categorical relation to treatment outcome of PS, "size of major fistula or leakage cavity" and "size of anastomotic defect" were dichotomized into "large" or "small" according to median diameter. Categorical variables were analyzed with Fisher's exact test or Chi-square test when appropriate. Continuous variables were analyzed with the Kruskal–Wallis test. In all statistical calculations, a P value <0.05 was considered statistically significant.

Results

Out of 1010 patients operated on with AR for rectal cancer from 1 January 2001 to 31 December 2011, 94 cases of AL were identified (9.3%). Patients evaluated radiologically without CE as well as patients where AL was established without radiology were excluded, leaving 38 AL cases subjected to CE studies. Out of these, the image material was inaccessible at the completion of the study in six cases and in one case AL could not be confirmed in radiological imaging, leaving 32 AL cases included in the study.

Table 1 illustrates patient demographic data and treatment factors regarding AL cases with a radiological finding consistent with AL compared to cases where AL was diagnosed using other methods or where image material was inaccessible, no significant differences could be established. Table 1 also illustrates demographic data and treatment factors among radiologically confirmed AL in their relation to outcome of AL treatment in BC and PS, respectively. The following were significantly associated with PS: age $\geq$70 years ($P = 0.004$); side-end reconstruction of anastomosis ($P = 0.05$); and AL established $\geq$30 days after anterior resection ($P = 0.01$).

Table 2 illustrates the distribution of radiological variables characterizing the ALs in their relation to PS or BC, respectively. Radiological findings consistent with an abscess ($P = 0.02$) and diameter $\leq$6 mm in anastomotic defect ($P = 0.05$) were significantly associated to PS as the end-result of AL treatment (Figure 1 and 2).

Table 1. Clinical variables for patients with AL after AR separated into patients subjected to radiological imaging and other methods to establish AL.

	All AL (n = 94)	Radiological leakage verified with contrast enema (RL) (n = 32)	Other method to establish AL after AR (OM) (n = 62)	P	Radiological leakage verified with contrast enema—bowel continuity (RL BC) (n = 12)	Radiological leakage verified with contrast enema—permanent stoma (RL PS) (n = 20)	P
BC	35 (37)	12 (37)	23 (37)	1.0*			–
Tumor <5 cm from anal verge	7 (7)	0 (0)	7 (11)	0.09*	0	0	–
Age >70 years	35 (37)	10 (31)	25 (40)	0.50*	0 (0)	10 (50)	0.004*
Male gender	62 (67)	22 (60)	40 (67)	0.82*	10 (83)	12 (60)	0.25*
Neoadjuvant radiotherapy	56 (60)	17 (53)	39 (63)	0.38*	4 (33)	13 (65)	0.15*
Defunctioning stoma from AR	53 (56)	19 (59)	34 (55)	0.82*	6 (50)	13 (65)	0.47*
Anastomosis reconstruction type†							
• End-end	25 (27)	9 (28)	16 (26)	1.0*	6 (50)	3 (15)	0.05*
• Side-end/reservoir	67 (68)	23 (72)	44 (66)		6 (50)	17 (85)	
Asymptomatic AL	8 (9)	4 (13)	4 (6)	0.44*	0 (0)	4 (20)	0.27*
TME	68 (72)	22 (69)	46 (74)	0.63*	6 (50)	16 (80)	0.12*
POD to AL diagnosis	14 (2–663)	16.5 (3–663)	11 (2–455)	0.24‡	10.5 (4–29)	20.5 (3–663)	0.06‡
LL POD ≥30	18 (19)	8 (25)	10 (16)	0.41*	0 (0)	8 (40)	0.01*

Values are presented as n (%) or median (range).

Patients subjected to radiological imaging were further separated into an end-result of BC and permanent stoma, respectively.

*Fisher's exact test.

†Missing data: all AL: n = 2; other method to establish anastomotic leakage: n = 2.

‡Kruskal–Wallis test.

AL, anastomotic leakage; AR, anterior resection; BC, bowel continuity; LL POD ≥30, late leakage established 30 or more days after anterior resection; POD, postoperative days after AR; TME, total mesorectal excision.

Table 2. Overview of radiological variables by bowel continuity.

Radiological variables	Total (n = 32)	Without bowel continuity (n = 20)	With bowel continuity (n = 12)
Abscess formation	11 (34)	10 (50)	1 (8)
Multiple cavities	5 (16)	4 (20)	1 (8)
Leak orientation			
Dorsal	21 (66)	13 (65)	8 (66)
Ventral	5 (16)	2 (10)	3 (252)
Lateral	6 (19)	5 (25)	1 (8)
Leak origin[2] *(n = 23)*			
Anastomosis	16/23 (70)	11/17 (65)	5/6 (83)
Stump	7/23 (30)	6/17 (35)	1/6 (7)
Defect diameter (mm)	5 (4–7)	5 (4–5)	6 (4–10)
Cavity size (mm)	70 (50–88)	65 (40–88)	75 (57–110)
Cavity orientation			
Dorsal	27 (84)	18 (90)	9 (75)
Ventral	2 (6)	0 (0)	2 (16)
Lateral	3 (9)	2 (10)	1 (8)

Values are given as n (%) or median (range).
Radiological measurement variables for 32 patients with AL after AR during 2001–2011 listed by bowel continuity.
*For patients with side to end anastomosis (n = 23).
AL, anastomotic leakage; AR, anterior resection.

Discussion

AL is a common adverse event after AR (1–5), leading to significant morbidity (20,21), reduced survival (22), and healthcare costs (23). While AL prevention has been extensively studied (1–4,9,10), there is a gap in knowledge regarding treatment for manifest AL, mainly to improve poor treatment outcomes in terms of BC (5) but also in treatment prediction to avoid unnecessary morbidity. This study explores the hypothesis of correlations between morphological radiological findings to BC as the end-result of anastomosis salvage treatment in AL after AR, to enable outcome prediction and avoid futile treatments. The principal findings in a cohort of patients with radiologically confirmed AL was a relation of abscess and diameter $\leq$6 mm in anastomotic defect to an end-result of PS, suggesting that these factors may coincide with PS as the end-result of treatment. Despite awareness that a small cohort might not be able to demonstrate strong correlation between morphology in radiology and treatment outcomes, the study has been conducted for exploratory purposes as a basis for future work.

The general value of CE in diagnosing AL after AR has previously been challenged, primarily regarding its use as a routine investigation before reversal of defunctioning stoma (7,24,25). The location of AL after side-to-end anastomosis, i.e. from the circular stapling line or from the transverse stapler line in the colonic stump, established with CE was not shown to be associated with morbidity, low anterior resection syndrome, or rate of PS (26). Radiological morphology has previously been explored in relation to non-closure of defunctioning stoma. During follow-up after treatment of clinical as well as asymptomatic AL on routine evaluation before reversal of defunctioning stoma, the presence of cavity and stricture was suggested as unfavorable features associated with non-healing (27,28). The purpose of our study was to evaluate potential radiological variables to predict outcome of BC before initiating treatment rather than being an evaluation instrument after anastomosis salvage treatment, therefore including investigations on establishment of the AL diagnosis rather than from follow-up. When confirming AL, CE has been reported to be superior to a CT scan omitting rectal contrast in evaluating anastomotic integrity (8), thus this is the reason why we only included CE studies. The rationale for selecting certain radiological variables in this exploratory work was based on putative reproducibility and consistency rather than visual interpretations of morphological appearance as applied in one study (28). Our chosen radiological variables do not assume a hypothesis reflecting an underlying biological process. However, a radiologically detected abscess might correspond to the severity of AL reflecting inability to spontaneous drainage. Furthermore, lack of necessary drainage with subsequent healing impairment might also serve as an explanation for a poorer outcome in cases of a detected small anastomotic defect.

A strength of this study is the long-term follow-up of a median 87 months, enabling a reliable evaluation of end-results in terms of PS, this being most relevant when deciding on whether to start anastomotic salvage

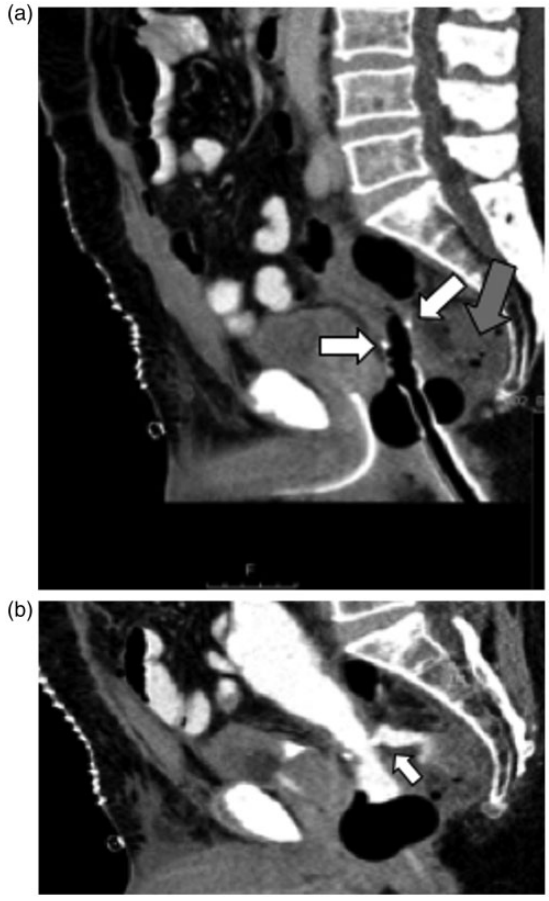

Fig. 1. A 62-year-old patient with anastomotic leakage after anterior resection. (a) Sagittal image of plain abdominal CT demonstrating fluid and gas dorsal of the rectum (gray arrow). Catheter with inflated balloon in the rectum. White arrows pointing at the anastomotic staple line. (b) Sagittal image off following contrast enema at computed tomography shows a 4-mm leak size dorsally (white arrow) with contrast fluid partly filling the cavity behind rectum.

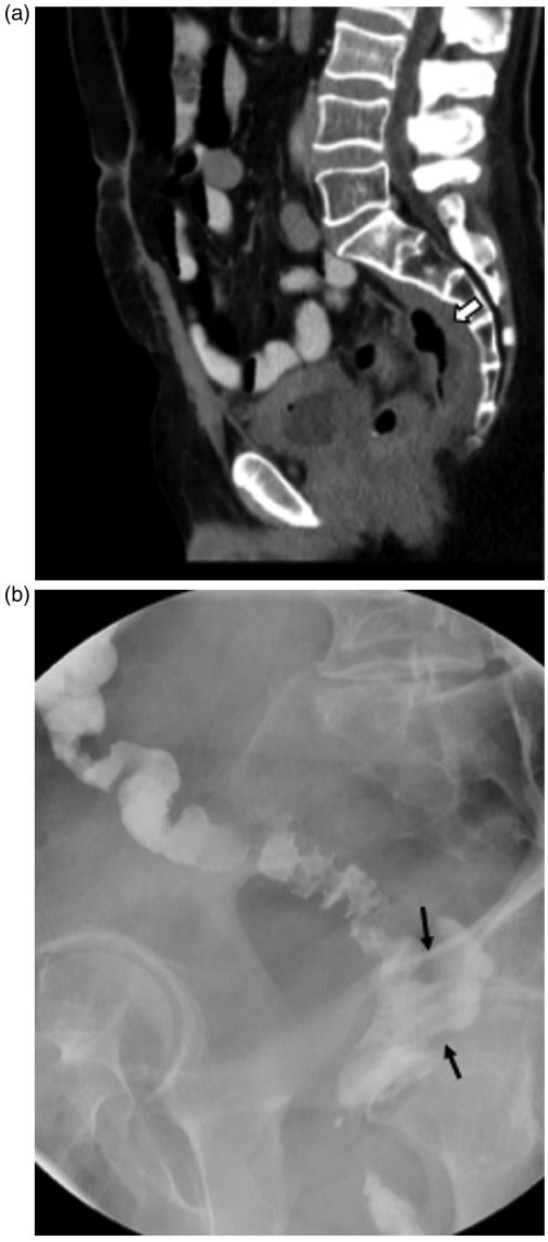

Fig. 2. A 78-year-old patient with anastomotic leakage after anterior resection. Sagittal image of plain CT visualizing a dorsal cavity with gas and fluid (white arrow) (a) and contrast enema on plain radiography visualizing a wide anastomotic leak size (black arrows) (b).

treatment or not. Other strengths are that other presumed relevant clinical factors have been considered when examining the value of radiological variables. We have also dismissed a divergent distribution of these clinical factors among excluded patients by analyzing all AL patients from the time period. We also believe that the selected radiological variables are reproducible, enabling future studies, although this must be confirmed in forthcoming studies.

This retrospective study has limitations in possible selection bias: all investigations and treatment choices were made at the discretion of the responsible surgeon without uniform criteria. There is a possible selection bias in opting for CE as a diagnostic method, in the timing of radiology, and in the decision for accepting a PS. The limited cohort size does not allow multivariate analysis. We believe that relevant clinical factors must be considered when evaluating the meaning of radiological variables. Regarding this as a hypothesis generating study, univariate associations are of interest and should be considered when planning for future research.

In conclusion, this study suggests the predictive properties in CE be used as a tool in evaluating AL after AR with indications that radiological abscess status and smaller defects in anastomotic integrity are

associated to PS as an end-result of AL treatment, independently of medical or surgical treatment given. It is possible that CE could be used as an additional instrument to guide doctors and patients to an informed decision on how to handle an AL after AR. The final answer on how to best predict future BC after AL, using clinical factors or radiological markers, has yet to be established. Associations of radiologically verifiable abscess and smaller healing defects in anastomotic integrity to PS should be further explored in future research.

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References

1. Peeters K, Tollenaar R, Marijnen C, et al. Risk factors for anastomotic failure after total mesorectal excision of rectal cancer. Br J Surg 2005;92:211–216.
2. Wu SW, Ma CC, Yang Y. Role of protective stoma in low anterior resection for rectal cancer: a meta-analysis. World J Gastroenterol 2014;20:18031–18037.
3. Yeh CY, Changchien CR, Wang J, et al. Pelvic drainage and other risk factors for leakage after elective anterior resection in rectal cancer patients: a prospective study of 978 patients. Ann Surg 2005;241:9–13.
4. Trencheva K, Morrissey KP, Wells M, et al. Identifying important predictors for anastomotic leak after colon and rectal resection: prospective study on 616 patients. Ann Surg 2013;257:108–113.
5. Borstlap WAA, Westerduin E, Aukema TS, et al. Anastomotic leakage and chronic presacral sinus formation after low anterior resection: results from a large cross-sectional study. Ann Surg 2017;266:870–877.
6. Kulu Y, Ulrich A, Bruckner T, et al. Validation of the international study group of rectal cancer definition and severity grading of anastomotic leakage. Surgery 2013;153:753–61.
7. Habib K, Gupta A, White D, et al. Utility of contrast enema to assess anastomotic integrity and the natural history of radiological leaks after low rectal surgery: systematic review and meta-analysis. Int J Colorectal Dis 2015;30:1007–14.
8. Kauv P, Benadjaoud S, Curis E, et al. Anastomotic leakage after colorectal surgery: diagnostic accuracy of CT. Eur Radiol 2015;25:3543–3551.
9. McDermott FD, Heeney A, Kelly ME, et al. Systematic review of preoperative, intraoperative and postoperative risk factors for colorectal anastomotic leaks. Br J Surg 2015;102:462–479.
10. den Dulk M, Witvliet MJ, Kortram K, et al. The DULK (Dutch leakage) and modified DULK score compared: actively seek the leak. Colorectal Dis 2015;15: e528–533.
11. Lindgren R, Hallböök O, Rutegård J, et al. What is the risk for a permanent stoma after low anterior resection of the rectum for cancer? A six-year follow-up of a multicenter trial. Dis Colon Rectum 2011;54:41–47.
12. Maggiori L, Bretagnol F, Lefèvre JH, et al. Conservative management is associated with a decreased risk of definitive stoma after anastomotic leakage complicating sphincter-saving resection for rectal cancer. Colorectal Dis 2011;13:632–637.
13. Westerduin E, Borstlap WA, Musters GD, et al. Redo coloanal anastomosis for anastomotic leakage after low anterior resection for rectal cancer; an analysis of 59 cases. Colorectal Dis 2018;20:35–43.
14. Genser L, Manceau G, Karoui M, et al. Postoperative and long-term outcomes after redo surgery for failed colorectal or coloanal anastomosis: retrospective analysis of 50 patients and review of the literature. Dis Colon Rectum 2013;56:747–755.
15. Borstlap WAA, Musters GD, Stassen LPS, et al. Vacuum-assisted early transanal closure of leaking low colorectal anastomoses: the CLEAN study. Surg Endoscopy 2018;32:315–327.
16. Hain E, Maggiori L, Manceau G, et al. Persistent anastomotic leakage after laparoscopic sphincter-saving surgery for rectal cancer: can diverting stoma be reversed safely at 6 months? Dis Colon Rectum 2016;5:369–376.
17. Hain E, Manceau G, Maggiori L, et al. Bowel dysfunction after anastomotic leakage in laparoscopic sphincter-saving operative intervention for rectal cancer: a case-matched study in 46 patients using the low anterior resection score. Surgery 2017;161:1028–1039.
18. Jutesten H, Draus J, Frey J, Neovius G, et al. Late leakage after anterior resection: a defunctioning stoma alters the clinical course of anastomotic leakage. Colorectal Dis 2018;2:150–159.
19. Jutesten H, Draus J, Frey J, Neovius G, et al. High risk of permanent stoma after anastomotic leakage in anterior resection for rectal cancer. Colorectal Dis 2019; 2:174–182.
20. Buchs NC, Gervaz P, Secic M, et al. Incidence, consequences, and risk factors for anastomotic dehiscence after colorectal surgery: a prospective monocentric study. Int J Colorectal Dis 2007;23:265–270.
21. Snijders HS, Wouters MW, van Leersum NJ, et al. Meta-analysis of the risk for anastomotic leakage, the postoperative mortality caused by leakage in relation to the overall postoperative mortality. Eur J Surg Oncol 2012;38:1013–1019.
22. Mirnezami A, Mirnezami R, Chandrakumaran K, et al. Increased local recurrence and reduced survival from

colorectal cancer following anastomotic leak: systematic review and meta-analysis. Ann Surg 2011;253:890–899.
23. Ashraf SQ, Burns EM, Jani A, et al. The economic impact of anastomotic leakage after anterior resections in English NHS hospitals: are we adequately remunerating them? Colorectal Dis 2013;15:e190–e198.
24. Zhou X, Wang B, Li F, et al. Risk factors associated with nonclosure of defunctioning stomas after sphincter-preserving low anterior resection of rectal cancer: a meta-analysis. Dis Colon Rectum 2017;60:544–554.
25. Larsson A, Lindmark G, Syk I et al. Water soluble contrast enema examination of the integrity of the rectal anastomosis prior to loop ileostomy reversal may be superfluous. Int J Colorectal Dis 2015;30:381–384.
26. Hain E, Maggiori L, Zappa M, et al. Anastomotic leakage after side-to-end anastomosis for rectal cancer: does leakage location matter? Colorectal Dis 2018;20:55–60.
27. Lim M, Akhtar S, Sasapu K, et al. Clinical and subclinical leaks after low colorectal anastomosis: a clinical and radiologic study. Dis Colon Rectum 2006;49:1611–1619.
28. Seok SI, Lee JL, Park SH, et al. Assessment by using a water-soluble contrast enema study of radiologic leakage in lower rectal cancer patients with sphincter-saving Surgery. Ann Coloproctol 2015;31:131–137.