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Can a Local Drainage Salvage a Failed Colorectal or Coloanal Anastomosis? A Prospective Cohort of 54 Patients

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► **To cite this version:**

Alexandre Chaline, Jeremie Lefèvre, Ben Creavin, Olivier Benoit, Najim Chafai, et al.. Can a Local Drainage Salvage a Failed Colorectal or Coloanal Anastomosis? A Prospective Cohort of 54 Patients. *Diseases of the Colon & Rectum*, 2020, 63 (1), pp.93-100. 10.1097/DCR.0000000000001516 . hal-02962329

HAL Id: hal-02962329

<https://hal.sorbonne-universite.fr/hal-02962329v1>

Submitted on 9 Oct 2020

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2 **Does a local drainage can maintain a failed colo-rectal or colo-anal anastomosis? A prospective**
3 **cohort of 49 patients.**
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5 *Short running head:* Drainage of failed low anastomosis
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25 *Original article*

26 *No Funding to declare*

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42 **Conflict of interest:** none to report

43 **Funding:** no funding to report
44

45 **Word count:** 2323

46
47 **Abstract word count:** 293
48

49 This work has been presented as poster's communication in the European society of
50 coloproctology congress in 2018 and in the National French congress of digestive surgery in
51 2018.
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56 If the manuscript is provisionally accepted, a video abstract will be required prior to final
57 acceptance.
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STRUCTURED ABSTRACT

Background: Local drainages can be used to manage leakage in selected patients without peritonitis.

Objective: The aim of this study was to evaluate the efficacy of drainage procedures in maintaining a primary low anastomosis following anastomotic leakage.

Design: A retrospective observational study was performed on a prospectively maintained database.

Settings: The study was done between 2014 and 2017 in a tertiary referral center.

Patients: Patients undergoing rectal resections with either a colorectal or coloanal anastomosis (CR-CAA) with diverting stoma were identified. Anastomotic leakages requiring a radiological or trans-anal drainage without peritonitis were included.

Main Outcome Measures: The primary outcome was the maintenance of the primary CR-CAA after local drainage of an anastomotic leakage and stoma reversal.

Results: A low CR-CAA for rectal cancer with diverting stoma was performed in 326 patients. 77 (23.6%) anastomotic leakages occurred, of which, 11 (3.4%) required abdominal surgery, 17 (5.2%) were treated conservatively (medical management) and 49 (15.0%) were managed by drainage without emergency abdominal surgery.

Surgical transanal drainage was performed in 18 patients (37%), with radiological drainage procedures in 31 patients (65%). The median interval between surgery and drainage was 15 days [9-24].

24 (49%) patients did not require any further intervention following drainage procedure with 20 patients (41%) undergoing redo anastomotic surgery. 39 patients (80%) had no stoma at the end of follow up.

Failure to maintain the primary anastomosis was associated with a drainage duration >10 days ($p=0.005$), the time between surgery and drainage > 15 days ($p=0.03$) and side to end or J-pouch anastomosis ($p=0.02$) and surgical trans-anal drainage ($p=0.05$).

Limitations: The small sample size of the study due to incidence of drainage is the main limit of the study.

Conclusion: Local drainage procedures maintained primary anastomosis in 50% of cases following an anastomotic leakage.

Keywords: coloanal anastomosis; anastomotic leakage; anastomotic drainage; outcome

INTRODUCTION

1
2 Indications for sphincter sparing rectal cancer resections have increased due to the
3
4 reduction in the distal margin distance ^{1,2} and the downsizing effects of neoadjuvant therapy ³.

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7 However, the rate of anastomotic leakage still ranges around 20% ⁴⁻⁶. Consequences of
8
9 a leakage are severe and can lead to septic shock or death ⁷. The use of a diverting ileostomy
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11 does not prevent all anastomotic leakage; however, the severity of the sepsis related morbidity
12
13 can be reduced ^{8,9}. Leakages can be graded by the clinical outcomes of patients ¹⁰. The most
14
15 severe leakages (Grade C) are those who need a re-laparotomy for peritonitis. In such cases,
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17 the anastomosis is often taken down and an end stoma is created. For grade B leakage, medical
18
19 treatment including antibiotics and local treatments are needed to treat a pelvic abscess. Finally,
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21 asymptomatic leakage can occur (A-grade) up to 6 months after bowel continuity ¹¹.

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23
24 Recently, the endo-SPONGE[®] has been used to treat leakage but currently there are few
25
26 studies with small sample sizes describing **this procedure ¹²⁻¹⁹**. Stoma reversal rates following
27
28 this procedure vary between 37-90%. **This technique requires several procedures in order to**
29
30 **change the endo-SPONGE[®] but can be performed in an outpatient setting and sometimes**
31
32 **without sedation**. The majority of grade B leakages are drained either by a surgical trans-anal
33
34 approach or a radiological approach.

35
36
37 Radiologic trans-gluteal drainage is a safe **with rare complications reported as**
38
39 **hemorrhage or creation of a fistula tract ²⁰** and effective approach with successful management
40
41 of abscess without recurrence being reported around 96% ^{11, 20}. However, the functional
42
43 outcomes of the anastomosis after radiological drainage is unknown. This too is true with regard
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45 to the trans-anal approach, with a lack of data currently in the literature. ^{21, 22} The need for a
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47 further drainage with this approach is reported to be 38% without abdominal surgery, however,
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49 stoma reversal rates are above 90% ²².

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Definitive stoma rates following failed sphincter sparing surgery is close to 20% for all rectal cancer patients²³. Maggiori et al. found the rate of definitive stoma increases after a non-conservative approach for grade C leakage²⁴. Redo surgery to create a new anastomosis is challenging, with a high morbidity and risk of injury to the genitourinary system^{25,26}.

The aim of this study was to evaluate the efficacy of drainage procedures in maintaining a primary low anastomosis following anastomotic leakage

MATERIAL AND METHODS

Study design and settings

A retrospective observational study was performed on a prospectively maintained database of patients undergoing rectal resections with either a colorectal or coloanal anastomosis (CR-CAA) with diverting stoma between 2014-2017. Patients medical records were reviewed for patient characteristics, co-morbidities, surgical and histological characteristics, date of drain, duration of drain, the need for redo coloanal anastomosis and stoma closure rates.

Population and follow-up

Patients who had an anastomotic leakage diagnosed by imaging (CT scan) or local examination under general anesthesia and requiring a radiologic or trans anal surgical drainage during their post-operative courses were analyzed. Patients were excluded if they presented with peritonitis requiring emergency surgery by abdominal approach.

Follow-up included clinical examination and C-Reactive Protein (CRP) levels at 1, 3 and 5 postoperative days²⁷. In case of any deviation in the post-operative clinical course, a CT scan was performed. When a pelvic abscess occurred, 2 types of pelvic drainage were utilized: a radiologic drain (usually done under CT guidance) by a trans gluteal approach or by a trans anal approach under a general anesthetic. Drains were flushed with 10cc of sterile saline 3 times a day by a specialized nurse. Drains were removed when outputs remained low (<20cc a day)

1 or when a repeat CT scan showed good resolution of the collection. When patients were
2 discharged home with a drain, outpatient consultations occurred weekly. A consultation 1
3 month after discharge was performed to repeat a CT scan to assess resolution of the leakage
4 and plan the stoma closure. Before stoma closure, integrity of anastomosis was tested with
5 radiological assessment and clinical local exam. In case of persisting leakage with chronic
6 sepsis or stricture, a redo surgery and new CAA was performed. The follow-up was stopped on
7 October the first 2018.

17 *Outcome and variables*

19 The primary outcome was maintenance of the primary CR-CAA after a local drainage
20 and the closure of the diverting stoma. The secondary outcome was the rate of definitive stoma.

24 *Statistical analysis*

26 The R software was used (R Development Core Team (2005). R: A language and
27 environment for statistical computing. R Foundation for Statistical Computing, Vienna,
28 Austria. ISBN 3-900051-07-0, URL: <http://www.R-project.org>). Descriptive analysis was
29 performed using percentages, means, medians and proportion, with standard deviation and
30 interquartile ranges reported. Univariate analysis was performed on the primary binary
31 outcomes with general linear models with the *univariateTable* function of the R-Package
32 *Publish*. A p-value lower than 0.05 was considered as significant. (software version 9.3; SAS
33 Institute Inc., Cary, NC, USA).

47 **RESULTS**

50 *Participants and incidence of leakage*

52 The flowchart of the study is presented in the figure 1. A total of 326 patients underwent
53 a low anastomosis with diverting stoma for rectal cancer in the present study, of which, 77
54 (23.6%) anastomotic leakages occurred. 11 (3.4%) anastomotic leakages needed an emergency
55 abdominal surgery (Grade C). Among the remaining 66 B-grade leakages, 17 (5.2%) were

1 treated medically with antibiotics alone and 49 (15.0%) were managed by drainage. The
2 evolution of our practice is illustrated in figure 2. There was no difference in the rate of leakage
3 per year ($p=0.41$), or number requiring drainage ($p=0.30$), however, abdominal re-intervention
4 for new coloanal anastomosis rates were lower ($p<0.001$).
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8 9 10 *Characteristics of drained patients*

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12 49 patients underwent pelvic drainage, with the majority diagnosed by fever in the post-
13 operative course. 43 patients (96%) had a CRP at post-operative day (POD) 3 or 5 >100 . Patient
14 characteristics are detailed in table 1. The mean age was 62 ± 13 years, of which, 29 (59.2%)
15 were male. A total of 34 patients (69%) underwent neoadjuvant therapy.
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22 47 (96%) patients had resections for low or mid rectal tumors. All patients had a
23 diverting ileostomy. A laparoscopic approach was the most frequent approach used ($n=40$,
24 82%). The majority of patients had a J-pouch or side to end anastomosis ($n=40$, 82%).
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29 30 *Drainage description*

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32 Characteristics of drain management are described in table 2. A surgical trans-anal
33 approach under general anesthetic was performed for 18 (37%) patients while 31 (63%) patients
34 underwent a radiological transgluteal approach. Surgical trans-anal drainage was more likely
35 used for purulent flowing and radiological drainage for fever ($p=0.01$). The median interval
36 between surgery and drainage was 15 days [9-24]. *Escherichia coli* was found in 19 (73%)
37 available cases while 2 (10%) had extended spectrum Beta Lactamase. Drainage duration more
38 than 10 days was more frequent for surgical drainage ($p<0.001$). 14 (28%) patients needed a
39 second drainage to treat a recurrent abscess (median time interval between drainages of 44 days
40 [22-66]). The length of stay (LOS) for surgery and drain management was 24 ± 10 days. LOS
41 was lower for radiologic drainage (22 ± 10 vs. 28 ± 10 , $p=0.02$). 12 (26%) patients were
42 discharged with a drain.
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Follow-up

Maintenance of the anastomosis was achieved in 24 (49%) patients, with stoma reversals after a mean interval of 5.0 ± 2.7 months.

20 (41%) patients needed a new procedure to treat a chronic leakage (n=18, 90%) or a stenosis (n=2, 10%). Among those 20, 14 (70%) patients required a new coloanal or ileoanal anastomosis, 4 (20%) required a new delayed coloanal anastomosis, and 2 (10%) had an end-stoma performed.

39 on the 49 patients (80%) had no stoma at the end of follow up (22 ± 14 months) with stoma closure interval of 7 ± 4 months and 15 ± 12 months of follow-up after stoma reversal.

On those 10 patients who had a definitive stoma (20%), 5 had a redo-procedure, with 2 patients who had an end stoma during the redosurgery, 3 presented a recurrence of leakage after their redo coloanal anastomosis. 5 patients had not redosurgery and no stoma reversal (1 lost of follow-up, 2 for chronic leakages, 2 for patient's refusal).

Risk factor of failure to maintain the anastomosis

In univariate analysis (table 3), a surgical drainage (p=0.05), a drainage duration > 10 days (p=0.005), the interval between surgery and drainage > 15 days (0.03), side to end or J-pouch anastomosis (p=0.02) and year of surgery were associated with failure to maintain the CR-CA anastomosis.

DISCUSSION

This study reports a single centers experience of drainage procedures following anastomotic leakage for low colorectal/coloanal anastomosis for rectal cancer. Maintenance of the anastomosis was achieved in 50% of the cohort undergoing local drainage, however, the rate of definitive end stoma was 20%. The present study found that a short drainage duration was associated with maintenance of the primary anastomosis in univariate and multivariate analysis. Furthermore, the implementation of a more conservative management (drainage) over

1 the years, decreased the rate of redo-surgery, increasing the likelihood of maintaining the
2 anastomosis.
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4 *Local drainage*

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7 Only 5 patients, excluded from the analysis, needed an emergency abdominal surgery after a
8
9 local drainage for peritonitis. The choice of the drainage procedure is not clear in the literature.
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11 In our study, we found a benefit to maintain for the radiological drainage in univariate analysis.
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13 A recent review reported quite the same rate of definitive stoma of 25% after vacuum-assisted
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15 therapy.¹⁹ Bortslap et al. found also the same efficacy to heal leakage at 6 months with only
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17 the half of anastomosis healed.¹⁷ However, utilizing a local drainage as a first approach in the
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19 management of grade B leakages is feasible based on the results reported in the present study.
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24 *Definitive stoma rate and leakage rate*

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27 The end-stoma rate in this study is in line with previous reported literature (>20%)^{4, 23}
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29 although, the results in the present study are based on grade B leakages with longer follow up.
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31 Overall symptomatic leakage rate was 24% with 3% classified as grade C leakage and 20% as
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33 grade B. These rates are in accordance with previous reported studies, with rates varying
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35 between 8-28%^{4, 5, 28}. Our rate of leakage is high, but the inclusion of patient is highly selective
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37 with 96% of patients had a low or a mid tumors and consequently had a total mesorectal
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39 excision.²⁹ Near 70% of patients had neoadjuvant therapy. Even if neoadjuvant irradiation did
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41 not seem increase the rate of leakage, literature is not clear about the outcome of a leakage
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43 occurring after radiotherapy.^{30, 31} It could increase the rate of definitive stoma. At least, rate of
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45 leakage varies based on definition of leakage³², and our definition of leakage included all pelvic
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47 collection and peritonitis.
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53 *Risk factors*

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56 The present study reported that an early and short duration drainage was associated with
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58 maintenance of the anastomosis. However, this should be interpreted with caution and could be
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1 influenced by leakage and drainage characteristics. For example, a leakage with high output is
2 associated with worse outcomes and may require a longer drainage period especially if there is
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4 a longer interval between surgery and drainage. Previous studies report similar result with
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6 improved stoma reversal rates after an early drainage^{13,15}. As showed in several studies on the
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8 vacuum therapy, leakages with an early drainage have a better prognostic than others.^{13,17} It is
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10 probably explained by the fibrosis which is more frequent after a chronic leakage found during
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12 the redo-surgery. Influenced by previous reports in the literature, the management of
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14 anastomotic leakage in our center has evolved, which has resulted in a reduction in the number
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16 of re-do surgeries^{6, 24, 33}. This evolution was significantly associated with maintaining the
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18 anastomosis on univariate and multivariate analysis. Furthermore, and end-to-end anastomosis
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20 was associated with maintenance of the anastomosis compared to a side-to-end or J-pouch
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22 anastomosis. We did not have the details of the leakage location in patients with side-to end of
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24 J pouch. Interestingly, Hain et al. found no difference in terms of definitive stoma rates based
25
26 on the location of leakage in side to end or J-pouch anastomosis³⁴. The functional outcome is
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28 significantly better when an alternative anastomosis to an end to end is used. We believe that
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30 an end-to-end should be not systematically performed in regards of our results to improve the
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32 functional results and quality of life. However, it may be of interest in high-risk patient as recent
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34 randomized control trials have questioned this finding³⁵. Finally, after comparison of type of
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36 local drainage, radiological drainage was associated with the success to maintain the primary
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38 anastomosis.
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48 *Limitations*

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51 Firstly, the retrospective design of the present study does not allow the authors to
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53 standardize the indication for drainage. The majority of drainages in this study were performed
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55 for sepsis, however, some drainages were performed for asymptomatic leakage, elevated CRP
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57 levels and following radiological assessment. Surgical trans-anal drainage was commonly
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1 utilized for purulent leakage. There was no significant difference regarding the maintenance of
2 anastomosis, but all 6 patients drained for purulent flowing did not kept their initial
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4 anastomosis. Characteristics of each drainage influenced the length of stay and the feasibility
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6 of outpatient management for the drain. The use of CT scans to diagnose anastomotic leakage
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8 has increased over the years, mainly due to the improved access to scanners and imaging
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10 quality. Bias in this study was minimized by adjusting for time on multivariate analysis.
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12 However, data collection on drain output, microbiology and length of drainage was limited due
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14 to the retrospective nature of the study.
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19 Furthermore, the small size of patients undergoing drainage was small, limiting the
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21 results of the study and the strength of the association interpretation. However, to the authors
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23 knowledge, this is the first and largest study to assess risk factor for failing to maintain a
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25 colorectal anastomosis.
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29 *Conclusion*

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31 Local drainage avoided re-do anastomosis in 50% of patients who had a grade B leakage
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33 for low colorectal/coloanal anastomosis for rectal cancer. An end-to-end anastomosis, a shorter
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35 length of drainage and radiological drainage were associated with maintenance of the primary
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37 anastomosis.
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REFERENCES

1. Moore HG, Riedel E, Minsky BD, et al. Adequacy of 1-cm distal margin after restorative rectal cancer resection with sharp mesorectal excision and preoperative combined-modality therapy. *Ann Surg Oncol*. 2003;10:80-5.
2. Pahlman L, Bujko K, Rutkowski A, Michalski W. Altering the therapeutic paradigm towards a distal bowel margin of < 1 cm in patients with low-lying rectal cancer: a systematic review and commentary. *Colorectal Dis*. 2013;15:e166-74.
3. Appelt AL, Ploen J, Vogelius IR, Bentzen SM, Jakobsen A. Radiation dose-response model for locally advanced rectal cancer after preoperative chemoradiation therapy. *Int J Radiat Oncol Biol Phys*. 2013;85:74-80.
4. Denost Q, Rouanet P, Faucheron JL, et al. To Drain or Not to Drain Infraperitoneal Anastomosis After Rectal Excision for Cancer: The GRECCAR 5 Randomized Trial. *Ann Surg*. 2017;265:474-80.
5. Lefevre JH, Mineur L, Kotti S, et al. Effect of Interval (7 or 11 weeks) Between Neoadjuvant Radiochemotherapy and Surgery on Complete Pathologic Response in Rectal Cancer: A Multicenter, Randomized, Controlled Trial (GRECCAR-6). *J Clin Oncol*. 2016;34:3773-80.
6. Hain E, Maggiori L, Manceau G, Zappa M, Prost a la Denise J, Panis Y. Persistent Asymptomatic Anastomotic Leakage After Laparoscopic Sphincter-Saving Surgery for Rectal Cancer: Can Diverting Stoma Be Reversed Safely at 6 Months? *Dis Colon Rectum*. 2016;59:369-76.
7. Peeters KC, Tollenaar RA, Marijnen CA, et al. Risk factors for anastomotic failure after total mesorectal excision of rectal cancer. *Br J Surg*. 2005;92:211-6.
8. Matthiessen P, Hallbook O, Rutegard J, Simert G, Sjudahl R. Defunctioning stoma reduces symptomatic anastomotic leakage after low anterior resection of the rectum for cancer: a randomized multicenter trial. *Ann Surg*. 2007;246:207-14.
9. Wong NY, Eu KW. A defunctioning ileostomy does not prevent clinical anastomotic leak after a low anterior resection: a prospective, comparative study. *Dis Colon Rectum*. 2005;48:2076-9.
10. Rahbari NN, Weitz J, Hohenberger W, et al. Definition and grading of anastomotic leakage following anterior resection of the rectum: a proposal by the International Study Group of Rectal Cancer. *Surgery*. 2010;147:339-51.

11. Robert B, Chivot C, Rebibo L, Sabbagh C, Regimbeau JM, Yzet T. Percutaneous transgluteal drainage of pelvic abscesses in interventional radiology: A safe alternative to surgery. *J Visc Surg.* 2016;153:3-7.
12. Mussetto A, Arena R, Buzzi A, et al. Long-term efficacy of vacuum-assisted therapy (Endo-SPONGE((R))) in large anastomotic leakages following anterior rectal resection. *Ann Gastroenterol.* 2017;30:649-53.
13. van Koperen PJ, van Berge Henegouwen MI, Rosman C, et al. The Dutch multicenter experience of the endo-sponge treatment for anastomotic leakage after colorectal surgery. *Surg Endosc.* 2009;23:1379-83.
14. Arezzo A, Verra M, Passera R, Bullano A, Rapetti L, Morino M. Long-term efficacy of endoscopic vacuum therapy for the treatment of colorectal anastomotic leaks. *Dig Liver Dis.* 2015;47:342-5.
15. Jimenez-Rodriguez RM, Araujo-Miguez A, Sobrino-Rodriguez S, et al. A New Perspective on Vacuum-Assisted Closure for the Treatment of Anastomotic Leak Following Low Anterior Resection for Rectal Cancer, Is It Worthy? *Surg Innov.* 2018;25:350-6.
16. Strangio G, Zullo A, Ferrara EC, et al. Endo-sponge therapy for management of anastomotic leakages after colorectal surgery: A case series and review of literature. *Dig Liver Dis.* 2015;47:465-9.
17. Borstlap WAA, Musters GD, Stassen LPS, et al. Vacuum-assisted early transanal closure of leaking low colorectal anastomoses: the CLEAN study. *Surg Endosc.* 2018;32:315-27.
18. Gardenbroek TJ, Musters GD, Buskens CJ, et al. Early reconstruction of the leaking ileal pouch-anal anastomosis: a novel solution to an old problem. *Colorectal Dis.* 2015;17:426-32.
19. Shalaby M, Emile S, Elfeki H, Sakr A, Wexner SD, Sileri P. Systematic review of endoluminal vacuum-assisted therapy as salvage treatment for rectal anastomotic leakage. *BJS Open.* 2018;79 (Suppl 7):555-8.
20. Harisinghani MG, Gervais DA, Maher MM, et al. Transgluteal approach for percutaneous drainage of deep pelvic abscesses: 154 cases. *Radiology.* 2003;228:701-5.
21. Okoshi K, Masano Y, Hasegawa S, et al. Efficacy of transanal drainage for anastomotic leakage after laparoscopic low anterior resection of the rectum. *Asian J Endosc Surg.* 2013;6:90-5.

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22. Sirois-Giguere E, Boulanger-Gobeil C, Bouchard A, et al. Transanal drainage to treat anastomotic leaks after low anterior resection for rectal cancer: a valuable option. *Dis Colon Rectum*. 2013;56:586-92.
 23. den Dulk M, Smit M, Peeters KC, et al. A multivariate analysis of limiting factors for stoma reversal in patients with rectal cancer entered into the total mesorectal excision (TME) trial: a retrospective study. *Lancet Oncol*. 2007;8:297-303.
 24. Maggiori L, Bretagnol F, Lefevre JH, Ferron M, Vicaut E, Panis Y. Conservative management is associated with a decreased risk of definitive stoma after anastomotic leakage complicating sphincter-saving resection for rectal cancer. *Colorectal Dis*. 2011;13:632-7.
 25. Pitel S, Lefevre JH, Tiret E, Chafai N, Parc Y. Redo coloanal anastomosis: a retrospective study of 66 patients. *Ann Surg*. 2012;256:806-10; discussion 10-1.
 26. Lefevre JH, Bretagnol F, Maggiori L, Ferron M, Alves A, Panis Y. Redo surgery for failed colorectal or coloanal anastomosis: a valuable surgical challenge. *Surgery*. 2011;149:65-71.
 27. Benoit O, Faron M, Margot N, et al. C-Reactive Protein Values After Colorectal Resection: Can We Discharge a Patient With a C-Reactive Protein Value >100? A Retrospective Cohort Study. *Dis Colon Rectum*. 2019;62:88-96.
 28. Detering R, Roodbeen SX, van Oostendorp SE, et al. Three-Year Nationwide Experience with Transanal Total Mesorectal Excision for Rectal Cancer in the Netherlands: A Propensity Score Matched Comparison with Conventional Laparoscopic Total Mesorectal Excision. *J Am Coll Surg*. 2019.
 29. Matthiessen P, Hallbook O, Andersson M, Rutegard J, Sjudahl R. Risk factors for anastomotic leakage after anterior resection of the rectum. *Colorectal Dis*. 2004;6:462-9.
 30. Chang JS, Keum KC, Kim NK, et al. Preoperative chemoradiotherapy effects on anastomotic leakage after rectal cancer resection: a propensity score matching analysis. *Ann Surg*. 2014;259:516-21.
 31. Hu MH, Huang RK, Zhao RS, Yang KL, Wang H. Does neoadjuvant therapy increase the incidence of anastomotic leakage after anterior resection for mid and low rectal cancer? A systematic review and meta-analysis. *Colorectal Dis*. 2017;19:16-26.
 32. Olsen BC, Sakkestad ST, Pfeffer F, Karliczek A. Rate of anastomotic leakage after rectal anastomosis depends on the definition: Pelvic abscesses are significant. *Scand J Surg*. 2018:1457496918812223.
 33. Fong SS, Chen K, Sim R. Chronic anastomotic sinus after low anterior resection: when can the defunctioning stoma be reversed? *Colorectal Dis*. 2011;13:644-9.

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2 34. Hain E, Maggiori L, Zappa M, Prost AIDJ, Panis Y. Anastomotic leakage after side-to-
end anastomosis for rectal cancer: does leakage location matter? *Colorectal Dis.* 2018.

3
4 35. Marti WR, Curti G, Wehrli H, et al. Clinical Outcome After Rectal Replacement With
5 Side-to-End, Colon-J-Pouch, or Straight Colorectal Anastomosis Following Total Mesorectal
6 Excision: A Swiss Prospective, Randomized, Multicenter Trial (SAKK 40/04). *Ann Surg.* 2018.
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11 **Figure Legend:**

12
13 **Figure 1.** Flow chart of the study
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17 **Figure 2.** Representation of the evolution of the rates of conservation, leakage, drainage and
18 new anastomosis by years.
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Table 1. Characteristics of patient treated by local drainage.

Type	n = 49
	Age in year (mean±sd) 62.1 ± 13.1
	BMI in kg/m² (mean±sd) 24.9 ± 4.1
	Male 29 (59.2)
Comorbidity of patient	ASA score
	1 19 (38.8)
	2 28 (57.1)
	3 2 (4.1)
	Use of anticoagulant 3 (6.1)
	Diabetes 4 (8.2)
	Cardiovascular disease 6 (12.2)
Tumor characteristics	Local excision before surgery 5 (10.2)
	Neoadjuvant treatment 34 (69.4)
	Location of tumor
	High 2 (4.1)
	Mid 23 (46.9)
	Low 24 (49.0)
Surgical characteristics	Laparoscopy 40 (81.6)
	Mechanical anastomosis 23 (47.9)
	Type of anastomosis
	J-pouch 17 (34.7)
	Side to end 23 (46.9)
	End to end 9 (18.4)
	Pelvic drainage 32 (65.3)
Additional procedure 10 (20.4)	
Histological characteristics	T stage
	0 5 (10.2)
	1 5 (10.2)
	2 9 (18.4)
	3 24 (49.0)
	4 6 (12.2)
	N stage
	0 29 (59.2)
	1 14 (28.6)
	2 6 (12.2)
	M stage 1 3 (6.1)
R1 resection 5 (10.2)	

Table 2. Characteristics of drainage

		Total (n=49)
Clinical diagnostic	Fever	28 (57.1)
	Purulent discharge	6 (12.2)
	Pelvic pain	5 (10.2)
	Clinical assessment	6 (12.2)
	Others	4 (8.2)
C reactive protein	POD 3	237.5 ± 130.7
	POD 5	212.3 ± 128.2
	before drainage	188.5 ± 115.2
Type of drainage	Radiological	31 (63.3)
	Surgical	18 (36.7)
Time between surgery and drainage >15 days		25 (51.0)
Duration of drainage > 10 days		19 (38.8)
Output per day		90.8 ± 72.3
Need for second drainage		14 (28.6)
Type of second drainage	Radiological	35.7 (n=5)
	Surgical	64.3 (n=9)
Time between first and second drainage in days		44.5 [22.2 66.0]
LOS in days		24.1 ± 10.1
Imaging Prior to Drain removal		26 (54.2)
Discharged with drain		12 (26.1)

Table 3. univariate analysis: risk factors of a failure to maintain the CR-ACA anastomosis

Variable		Success (n=24)	Failure (n=25)	p value
Age		59.1 ± 13.4	65.0 ± 12.5	0.11
BMI		25.1 ± 4.4	24.8 ± 3.8	0.82
% of male		17 (70.8)	12 (48.0)	0.18
ASA score	1	10 (41.7)	9 (36.0)	0.92
	2	13 (54.2)	15 (60.0)	
	3	1 (4.2)	1 (4.0)	
Local resection before LARS		3 (12.5)	2 (8.0)	0.96
Neoadjuvant Treatment		14 (58.3)	20 (80.0)	0.18
Length between anal sphincter and tumor	1-3 cm	13 (54.2)	11 (44.0)	0.2
	3-8 cm	9 (37.5)	14 (56.0)	
	8-13 cm	2 (8.3)	0 (0.0)	
Laparoscopy		20 (83.3)	20 (80.0)	1
Mechanical anastomosis		13 (56.5)	10 (40.0)	0.39
Type of anastomosis	End to end	8 (33.3)	1 (4.0)	0.02
	Others	16 (66.7)	24 (96.0)	
Pelvic drainage		12 (50.0)	20 (80.0)	0.06
T	0-2	11 (45.8)	8 (32.0)	0.48
	3-4	13 (54.2)	17 (68.0)	
N	0	17 (70.8)	12 (48.0)	0.18
	+	7 (29.2)	13 (52.0)	
M	1	1 (4.2)	2 (8.0)	1
R	1	1 (4.2)	4 (16.0)	0.37
Adjuvant treatment		6 (25.0)	13 (54.2)	0.08
Septic leakage		16 (66.7)	12 (48.0)	0.3
Type of drain	Surgical	5 (20.8)	13 (52.0)	0.05
	Radiological	19 (79.2)	12 (48.0)	
Time between surgery and drainage > 15 days		8 (33.3)	17 (68.0)	0.03
Duration of drainage > 10 days		4 (16.7)	15 (60.0)	0.005
Need for 2 nd drainage		4 (16.7)	10 (40.0)	0.14
Year of surgery	2014-2015	7 (29.2)	19 (76.0)	0.003
	2016-2017	17 (70.8)	6 (24.0)	

Figure 1

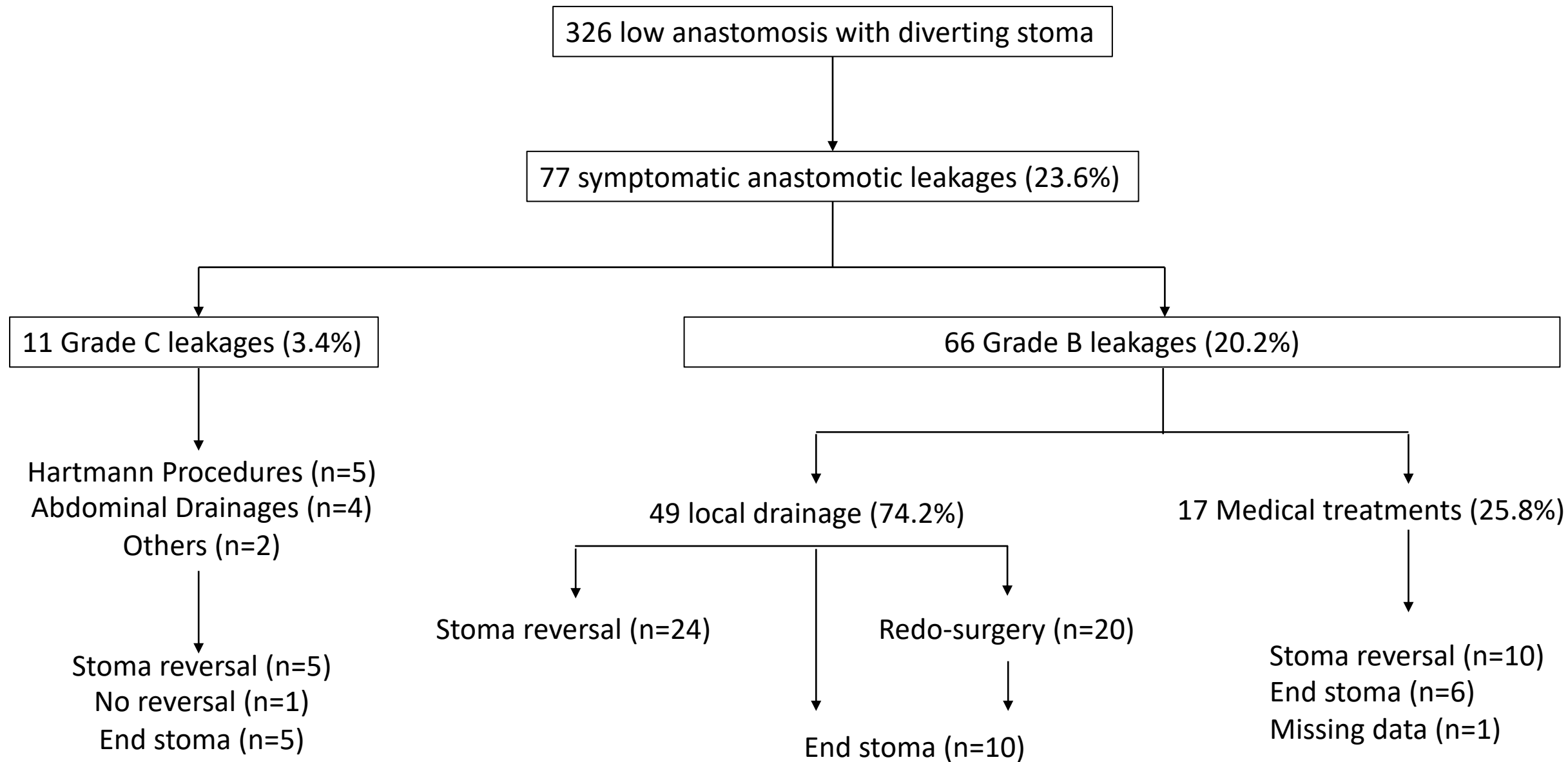
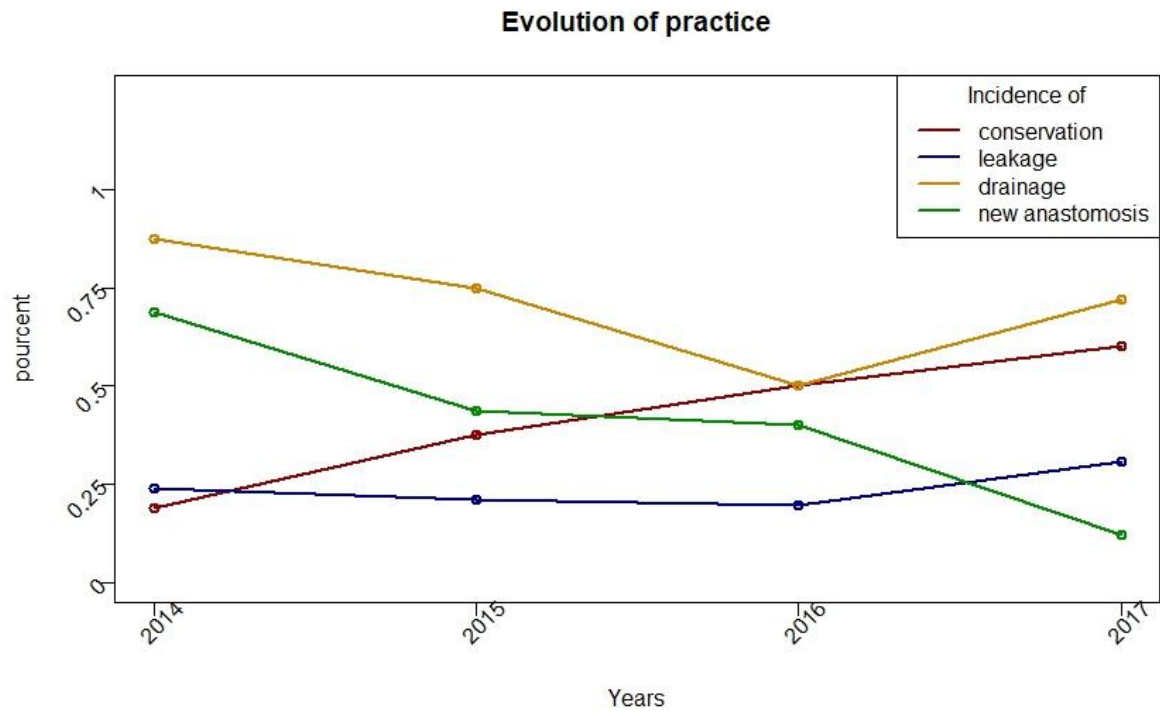


Figure 2. Representation of the evolution of the rates of conservation, leakage, drainage and new anastomosis by years.



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract page 1 (b) Provide in the abstract an informative and balanced summary of what was done and what was found page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported page 3
Objectives	3	State specific objectives, including any prespecified hypotheses page 4
Methods		
Study design	4	Present key elements of study design early in the paper page 4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection pages 4-5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up page 4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group page 5
Bias	9	Describe any efforts to address potential sources of bias page 5
Study size	10	Explain how the study size was arrived at page 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why page 5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding page 5 (b) Describe any methods used to examine subgroups and interactions page 5 (c) Explain how missing data were addressed NA (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed NA <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses page 5

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed page 5 (b) Give reasons for non-participation at each stage NA (c) Consider use of a flow diagram NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders pages 5-6 (b) Indicate number of participants with missing data for each variable of interest NA (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount) page 6
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time page 5-6 <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure NA <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures NA
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included pages 6-7 (b) Report category boundaries when continuous variables were categorized pages 6-7 (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses page 7
Discussion		
Key results	18	Summarise key results with reference to study objectives page 7
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias page 8-9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence page 7-8
Generalisability	21	Discuss the generalisability (external validity) of the study results pages 8-9
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based page 1

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.