

## ORIGINAL STUDIES

### ORIGINALNI NAUČNI RADOVI

University of Novi Sad, Faculty of Medicine<sup>1</sup>  
 Institute for Child and Youth Health Care of Vojvodina, Novi Sad  
 Department of Pediatric Surgery<sup>2</sup>  
 Institute for Oncology of Vojvodina, Department of Surgical Oncology<sup>3</sup>

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## VALUE OF PROTECTIVE STOMA IN RECTAL CANCER SURGERY

### ZNAČAJ PROTEKTIVNE STOME U HIRURGIJI KARCINOMA REKTUMA

Ivana FRATRIĆ<sup>1,2</sup>, Zoran RADOVANOVIĆ<sup>1,3</sup>, Dragana RADOVANOVIĆ<sup>1,3</sup>, Ferenc VICKO<sup>1,3</sup>,  
 Tomislav PETROVIĆ<sup>1,3</sup> and Zoran NIKIN<sup>1,3</sup>

#### Summary

**Introduction.** Anastomotic leakage is the most serious surgical complication in rectal surgery. The aim of this study was to find out whether a protective stoma was capable of lowering the rate of clinical anastomotic leakage and to evaluate the rate of anastomotic leakages requiring re-surgery. **Material and Methods.** A retrospective study included a sample of 149 consecutive patients with rectal cancer who had undergone elective rectal resection with primary anastomosis. After total mesorectal excision, the anastomosis was created using either the single stapling or double stapling anastomotic technique. Anastomotic integrity was verified by transanal air insufflations with the pelvis filled with saline. A protective covering colostomy was added in selected cases and according to the surgeon's preference. **Results.** A protective stoma was created in 31% of patients. Clinical anastomotic leakage occurred in 6.7% of patients (10/149). Anastomotic leakage occurred in 8.5% of the patients with a protective stoma (4/47) and in 5.9% of those without a protective stoma (6/102), which was not statistically significant. Surgery lasted significantly longer when a stoma had to be created than in case when it was not needed ( $p=0.024$ ). The overall rate of re-surgery due to postoperative surgical complications was 5.3% and in three cases this happened because of anastomotic leakage. All patients with a protective stoma and clinical anastomotic leakage were treated conservatively, compared to 50% of patients without a protective stoma who suffered anastomotic leakage and had to be operated. **Conclusion.** A stoma cannot prevent but it can surely minimize surgical complications related to anastomotic leakage and it does reduce the rate of re-surgery.

**Key words:** Rectal surgery; Anastomotic leakage; Protective stoma.

#### Sažetak

**Uvod.** Popuštanje anastomoze predstavlja najozbiljniju hiruršku komplikaciju u hirurgiji rektuma. Cilj naše studije bio je da utvrdimo da li protektivna stoma smanjuje učestalost klinički manifestnog popuštanja anastomoze i učestalost reoperacija usled popuštanja anastomoze. **Materijal i metode.** Sprovedena je retrospektivna studija sa 149 bolesnika sa karcinomom rektuma kod kojih je načinjena elektivna resekcija rektuma sa primarnom anastomozom. Nakon totalne mezorektalne ekscizije, kreirana je anastomoza korišćenjem jednostaplerske i dvostruke staplerske tehnike. Integritet anastomoze je proveravan pomoću transanalne insuflacije vazduha sa karlicom ispunjenom fiziološkim rastvorom. Protektivna kolostoma je kreirana u odabranim slučajevima u skladu sa mišljenjem hirurga. **Rezultati.** Protektivna stoma je kreirana kod 31% bolesnika. Klinički manifestno popuštanje anastomoze potvrđeno je kod 6,7% (10/149) bolesnika. Kod bolesnika sa protektivnom stomom popuštanje anastomoze utvrđeno je kod 8,5% (4/47) u poređenju sa 5,9% (6/102) kod bolesnika kod kojih nije kreirana protektivna stoma, te nije utvrđena statistički značajna razlika. Vreme operacije je bilo statistički značajno duže kod bolesnika kod kojih je kreirana protektivna stoma u poređenju sa operacijama kod kojih stoma nije kreirana ( $p = 0,024$ ). Ukupna stopa reoperacija zbog postoperativnih komplikacija bila je 5,3% i u tri slučaja uzrok je bilo popuštanje anastomoze. Svi bolesnici sa protektivnom stomom i kliničkim popuštanjem anastomoze tretirani su konzervativno u poređenju sa 50% bolesnika bez protektivne stome kod kojih je utvrđeno popuštanje anastomoze i koji su morali biti operisani. **Zaključak.** Stoma ne može da prevenira, ali sigurno može da smanji rizik od hirurških komplikacija koje su u vezi sa popuštanjem anastomoze i može da smanji učestalost reoperacija.

**Glavne reči:** Hirurgija rektuma; Popuštanje anastomoze; Protektivna stoma

#### Introduction

During the last two decades there was an increased proportion of sphincter-saving procedures in rectal cancer surgery due to better staging, surgical tech-

nique, introduction of staplers and preoperative irradiation [1–4]. However, this has resulted in an increased number of patients exposed to the risk of anastomotic leakage (AL). AL is the most serious surgical complication in rectal surgery with incidence ranging from

**Abbreviations**

|     |                                         |
|-----|-----------------------------------------|
| AL  | – anastomotic leakage                   |
| CSA | – circular single stapled anastomosis   |
| DSA | – double stapled anastomosis            |
| ASA | – American Society of Anesthesiologists |
| CRT | – chemoradiotherapy                     |

1.5 to 23%. Most studies give leakage rates in the range of 9% to 12% [5–8] and the associated risk of postoperative mortality is between 6% and 22% [5]. Since morbidity and mortality resulting from AL are considerable, the routine use of defunctioning stomas has been suggested for high-risk anastomosis. The aim of our study was to find out whether a protective stoma was capable of lowering the rate of clinical AL and to evaluate the rate of AL requiring re-surgery.

**Material and Methods**

All the procedures followed were in accordance with the ethical standards of the responsible com-

mittee on human experimentation (institutional and national) and with the 7<sup>th</sup> Revision of the Declaration of Helsinki from 2008.

This retrospective study included 149 consecutive patients with rectal cancer (within 15 cm from anal verge), who had undergone elective rectal resection with primary anastomosis between 2006 and 2010 at the Institute for Oncology of Vojvodina, Department of Surgical Oncology. Data on age, gender, stage of tumor, distance from the anal verge, histological grade, neoadjuvant treatment, type of anastomosis technique (single stapling vs. double stapling), complications, anastomotic leakage rate, duration of operation and hospital stay were collected.

Rectal cancer was defined as a tumor located within 15 cm of the anal verge. The distal resection margin was defined as the distance from the lowest border of the tumor to the distal mucosal end of the fixed specimen.

The patients with locally advanced rectal cancer were referred for neoadjuvant chemoradiation con-

**Table 1.** Patients' characteristics**Tabela 1.** Karakteristike bolesnika

|                                                                                                                                                                     | Total<br><i>Ukupno</i> | With protective stoma<br><i>Sa protektivnom stomom</i> | No stoma<br><i>Bez stome</i> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------|------------------------------|
| Number of patients operated on/ <i>Broj operisanih bolesnika</i>                                                                                                    | 149                    | 47                                                     | 102                          |
| Mean age (range)/ <i>Srednja vrednost godina (rang)</i>                                                                                                             | 65 (39-88)             | 65 (40-82)                                             | 64 (39-88)                   |
| Gender/ <i>Pol</i>                                                                                                                                                  |                        |                                                        |                              |
| male/ <i>muški</i>                                                                                                                                                  | 86 (57.7%)             | 30 (64%)                                               | 56 (55%)                     |
| female/ <i>ženski</i>                                                                                                                                               | 63 (42.3%)             | 17 (36%)                                               | 46 (45%)                     |
| ASA/ <i>Američko udruženje anesteziologa</i>                                                                                                                        |                        |                                                        |                              |
| 1                                                                                                                                                                   | 8 (5.4%)               | 2 (4%)                                                 | 6 (6%)                       |
| 2                                                                                                                                                                   | 81 (54.4%)             | 28 (60%)                                               | 53 (52%)                     |
| 3                                                                                                                                                                   | 60 (40.3%)             | 17 (36%)                                               | 43 (42%)                     |
| Number of patients with preoperative CRT<br><i>Broj bolesnika sa preoperativnom hemioradioterapijom</i>                                                             | 54 (36%)               | 26 (55.4%)                                             | 28 (27.5%)                   |
| Number of patients with complete pathological response after CRT/ <i>Broj bolesnika sa kompletnom histološkom regresijom nakon hemioradioterapije</i>               | 4 (2.7%)               | 1 (2.1%)                                               | 3 (2.9%)                     |
| Stage/ <i>Stadijum</i>                                                                                                                                              |                        |                                                        |                              |
| 0 ( <i>Tis</i> )                                                                                                                                                    | 2 (1.3%)               | 1 (2.1%)                                               | 1 (2.1%)                     |
| I                                                                                                                                                                   | 45 (30.2%)             | 16 (34%)                                               | 29 (28.4%)                   |
| IIa                                                                                                                                                                 | 25 (16.8%)             | 8 (17%)                                                | 17 (16.7%)                   |
| IIb                                                                                                                                                                 | 2 (1.3%)               | 1 (2.1%)                                               | 1 (1.0%)                     |
| IIIa                                                                                                                                                                | 9 (6%)                 | 4 (8.5%)                                               | 5 (4.9%)                     |
| IIIb                                                                                                                                                                | 30 (20.1%)             | 7 (14.9%)                                              | 23 (22.5%)                   |
| IIIc                                                                                                                                                                | 20 (13.4%)             | 8 (17%)                                                | 12 (11.8%)                   |
| IV                                                                                                                                                                  | 12 (8.1%)              | 1 (2.1%)                                               | 11 (10.8%)                   |
| Length of procedure – mean, range (min)<br><i>Dužina trajanja procedure – srednja vrednost, rang (min)</i>                                                          | 132 (60-250 min)       | 140 (90-250 min)                                       | 128 (60-185 min)             |
| Tumor distance from anal verge, mean/range)<br><i>Udaljenost tumora od analne linije, srednja vrednost, rang</i>                                                    | 8.2 (2-14 cm)          | 6.6 (2-12)                                             | 8.9 (2-14 cm)                |
| Clinical AL/ <i>Klinički znaci popuštanja anastomoze</i>                                                                                                            | 10 (6.7%)              | 4 (8.5%)                                               | 6 (5.9%)                     |
| Re-surgeries due to AL/ <i>Reoperacije usled popuštanja anastomoze</i>                                                                                              | 3/10 (30%)             | 0/4 (0%)                                               | 3/6 (50%)                    |
| Re-surgeries (in hospital or <30 days) (due to AL and other complications)/ <i>Reoperacije (unutar 30 dana) usled popuštanja anastomoze ili drugih komplikacija</i> | 8/149 (5.3%)           | 2/47 (4.25%)                                           | 6/102 (5.9%)                 |
| Mortality in hospital/ <i>Mortalitet tokom bolničkog lečenja</i>                                                                                                    | 1 (0.7%)               | 0                                                      | 1 (1%)                       |

**Table 2.** Relationship between type of anastomosis and complications in anastomotic integrity  
**Tabela 2.** Povezanost tipa anastomoze i komplikacija integriteta anastomoze

|                                                     |                                                | Complications in anastomotic integrity<br><i>Komplikacija integriteta anastomoze</i> |                                                |                                                                    | Total<br><i>Ukupno</i> |
|-----------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------|------------------------|
|                                                     |                                                | No complications<br><i>Bez komplikacija</i>                                          | Incomplete rings<br><i>Nepotpuni prstenovi</i> | Air test positive<br><i>Pozitivan test<br/>insuflacije vazduha</i> |                        |
| Type of<br>anastomosis<br><i>Tip<br/>anastomoze</i> | CSA/JSA<br><i>(jednostaplerska anastomoza)</i> | 47                                                                                   | 4                                              | 4                                                                  | 55                     |
|                                                     | DSA/DSA<br><i>(dvostaplerska anastomoza)</i>   | 89                                                                                   | 1                                              | 4                                                                  | 94                     |
|                                                     | Total/Ukupno                                   | 136                                                                                  | 5                                              | 8                                                                  | 149                    |

sisting of three field external beam radiation therapy in the total dose of 50.4 Gy in 25 fractions along with bolus infusion sensitizing chemotherapy 5-Fluorouracil (25 mg/m<sup>2</sup>/day) with leucovorin (20 mg/m<sup>2</sup>/day) administered on the 1<sup>st</sup>, 2<sup>nd</sup>, 10<sup>th</sup>, 11<sup>th</sup>, 20<sup>th</sup> and 21<sup>st</sup> day of irradiation. Surgery was conducted 8 to 12 weeks after completion of chemoradiation.

All rectal resections were performed by three trained colorectal surgeons who applied an open procedure and according to the principles of rectal cancer surgery as described in details elsewhere [8, 9]. The circular staplers used for the circular single stapled anastomosis (CSA) were Premium Plus CEEA<sup>TM</sup> Stapler 29, 31 and 34 mm (Covidien). In the double stapled anastomosis (DSA), the rectal stump was closed with Contour<sup>TM</sup> Curved Cutter Stapler (Ethicon Endo-Surgery) and the anastomosis was created with the same circular staplers as in the CSA group. The doughnuts were always inspected for completeness. Anastomotic integrity was verified by transanal air insufflations with the pelvis filled with saline. Additional suturing of the "dog ear" or line of anastomosis was done only in cases with verified anastomotic defect. A pelvic drain was always used.

A protective covering colostomy was added in selected cases and according to the surgeon's preference. No differentiation of the stoma (e.g., ileostomy or colostomy) was undertaken. The usefulness of a protective stoma, in terms of the rate and severity of anastomotic leakage, was examined by comparing the early postoperative results of surgery with and without covering the stoma.

The definition of anastomotic leakage adopted in this study included the following: 1) lower abdominal pain with fever, leucocytosis, tenderness, tachycardia, increased white cell count and/or prolonged ileus after operation with pelvic collection adjacent to the anastomosis with demonstration of anastomotic leakage - by rectal examination, rectoscopy or imaging study; 2) gas, pus or fecal discharge from the drainage site or discharge of pus from the rectum. Anastomotic leakage requiring surgery was defined as a clinical leakage needing an unplanned re-surgery for anastomotic dehiscence.

The association of leakage and the protective stoma as an independent variable was studied by

univariate analysis. The target criteria were anastomotic leakage requiring surgery and leakage overall. The following parameters were examined: continuous parameters (distance of the tumor from the anal verge, age, duration of operation), dichotomous parameters (gender, type of anastomosis (CSA vs. DSA) and provision of protective stoma) and ordinal parameters (American Society of Anesthesiologists (ASA), tumor stage). For the selection of the parameters, a stepwise approach was applied. P values less than 0.05 were considered statistically significant.

The SPSS for Windows version 16.0 software program was used for the statistical analyses.

## Results

A protective stoma was created in 47 (31%) patients out of 149 who were enrolled in this study. A stoma was created more frequently in males, i.e. 35% of the males (30/86) and 27% of the females (17/63) received a stoma ( $p=0.356$ ). The patients' characteristics are summarized in **Table 1**.

After total mesorectal excision, the anastomosis was created using CSA or DSA technique. The preferred method for creation of rectal anastomosis was DSA, which was performed in 89 patients (60%). The incidence of incomplete anastomotic rings and/or positive air test and their relation to anastomotic technique are presented in **Table 2**.

Clinical AL occurred in 6.7% of patients (10/149). AL occurred in 8.5% of the patients with a protective stoma (4/47) and in 5.9% of those without a protective stoma (6/102), which was not statistically significant (**Table 3**).

The median tumor level above the anal verge for the patients having AL was 7 cm (ranging from 5 to 10 cm). ASA score was 2 for five out of ten patients with AL (50%) and 3 for the remaining 50% of patients. Three patients did not have comorbidity and were otherwise healthy, while six had cardiovascular pathology and one had diabetes and cardiovascular pathology. Preoperative radiotherapy was performed in 70% of patients who later suffered from AL (7/10).

Nine patients who developed AL did not have any complications related to creation of anastomosis, whi-

**Table 3.** The rate of AL and the need for re-surgery in those patients  
**Tabela 3.** Učestalost popuštanja anastomoze i neophodnost reoperacije

|                                              |                                                  | Protective stoma/Protektivna stoma |        |              |
|----------------------------------------------|--------------------------------------------------|------------------------------------|--------|--------------|
|                                              |                                                  | No/Ne                              | Yes/Da | Total/Ukupno |
| Anastomotic leakage<br>Popuštanje anastomoze | No/Ne                                            | 96                                 | 43     | 139          |
|                                              | Yes – without re-surgery<br>Da – bez reoperacije | 3                                  | 4      | 7            |
|                                              | Yes – with re-surgery/Da – sa reoperacijom       | 3                                  | 0      | 3            |
|                                              | Total/Ukupno                                     | 102                                | 47     | 149          |

le air test was positive in one patient. Surgery lasted significantly longer when a stoma had to be created than in case when it was not needed ( $p=0.024$ ).

The overall rate of re-surgery due to postoperative surgical complications was 5.3% (8/149) and in three cases this happened because of AL. All patients with a protective stoma and clinical anastomotic leakage were treated conservatively (0/4), compared to 50% of patients without a protective stoma who suffered anastomotic leakage and had to be reoperated (3/6).

The mean hospital stay in patients without AL was 9 days, while those who suffered an anastomotic leakage were discharged from hospital on the median day 14.5 ( $p=0.056$ ).

The patients without a stoma stayed in hospital for 10 days (range 7-43) while the mean hospital stay for the patients with a stoma was 12 days (range 7-39),  $p=0.14$ .

The 30-day mortality rate was 0.7% (1/149).

## Discussion

The routine use of protective stoma in rectal cancer surgery is still under debate. First of all, there are no clear indications for creating a stoma after rectal resections. Secondly, what is better: colostomy or ileostomy?

There is no risk-free anastomosis and according to literature there are some factors that may cause a higher rate of AL. These are preoperative irradiation, male sex, obesity and level of anastomosis [10–12]. In these cases, the surgeon should always consider creating a protective stoma.

Other risk factors may be a low preoperative serum albumin level (lower than 3.5 g/dL), steroid use, intraoperative blood loss of 200 mL or more, comorbidity, increased duration of surgery (operative time of 200 minutes or more) and/or intraoperative transfusion requirement [13]. No significant difference in the leakage rate between anastomosis created by single or double stapling technique was found by Radovanović et al. in a randomized study [14].

A stoma does not prevent leakage, but it is capable of minimizing anastomotic complications and the rate of re-surgery [15, 16]. It is associated with better clinical outcome or even the absence of clinical signs of dehiscence. In our study, there were 4 patients with a protective stoma who developed clinical AL and all were treated conservatively, while

50% of patients (3/6) with AL without a stoma had to be reoperated. Karanjia et al. found in their retrospective study that the percentage of anastomotic leakage was 8.3% if protective colostomy was created and 17.7% in patients without a stoma [16]. Poon et al. described an anastomotic leakage of 3.3% in the patients with a protective stoma and 12.6% in the patients without a protective stoma. In this study, 148 colorectal anastomosis were performed by using stapling technique [17]. One of the most important randomized multicenter studies in this field is Norwegian RECTODES which has shown that a protective stoma significantly decreases the incidence of clinically significant anastomotic leakage [18]. Unlike other studies, in this randomized multicenter study the surgeon was not the one who decided whether a protective stoma should be performed or not. Our study is observational, not a randomized trial, and there were no significant differences in the leakage rate between the groups of patients with and without a stoma but the rate of re-surgeries was largely different.

Creating a protective stoma itself may carry possible complications. In addition, it prolongs operative time as we have shown in our study. After the surgery, the patient needs to adjust to the new quality of life. Another possible outcome is stenosis of the anastomosis.

Branagan et al. included 1839 patients who had radical resection of colorectal cancer in their large retrospective study. There were 633 resections of rectum with 6.3% of AL in this group, the early postoperative mortality being 10% in the group with AL and 2% in the group without AL ( $p=0.014$ ). They also showed a statistically significant difference in the local recurrences and 5-year overall survival rates between the patients with and without AL [19]. This effect of creating a protective stoma and its influence on the local recurrence and 5-year overall survival was reported in several studies published during the last decades [20–22].

However, creating a protective stoma requires another surgery which carries significant risks of morbidity and mortality and it may involve the use of considerable medical and economic resources [23, 24]. The stoma closure-related mortality rate is around 0.5% [25, 26]. The stoma carries morbidity risk from its creation until the moment of its closure [27].

When creating ileostomy, the surgeon should be well aware of its complications, such as increased

loss of electrolytes and liquid, irritation of the skin, and prolapse. In their meta-analysis with 1204 patients from 7 studies, Tilney et al. compared protective ileo and transversostomy [28]. A statistically increased level of electrolyte loss was found when creating ileostomy, while the wound infection and postoperative hernia were detected in closing colostomy more often than ileostomy. Some differences were observed in other compared parameters, such as AL, operative time, duration of hospital stay, prolapse, quality of life, etc. but they were not statistically significant. Edwards et al. also showed in their study that there were no statistically significant differences in creating and closing ileo and colostomy; however, according to the surgeon's opinion, ileostomy closure carries a greater risk [29, 30]. To summarize, there are no big differences between

protective ileo and colostomy, so the hospital protocol and the preference of the surgeon are crucial when deciding which stoma should be created.

## Conclusion

Although it is the surgeon's preference whether to create a protective stoma after rectal resection, there are obvious high risk factors for anastomotic leakage in which a stoma should be placed. This includes preoperative irradiation, low anastomosis (below 7 cm from the anal verge), in the patients with serious comorbidities and in cases of incomplete stapler's rings or positive air test. A stoma cannot prevent but it can surely minimize surgical complications related to anastomotic leakage and it does reduce the rate of re-surgeries.

## References

1. Miucin-Vukadinovic I, Kozic D, Adjic O, Radovanovic Z, Breberina M, Borkov B. Rectal cancer: possibilities of MRI in detection of local recurrence. *Med Pregl*. 2008;59(3-4):157-63.
2. Radovanovic Z, Radovanovic D, Breberina M, Petrovic T, Golubovic A, Borkov B. The value of endorectal ultrasonography in rectal cancer staging. *Med Pregl*. 2008;59(11-12):557-61.
3. Lukic D, Radovanovic Z, Petrovic T, Breberina M, Golubovic A, Skoric-Jokic S. Oncologic superiority of extralevator abdominoperineal excision for low rectal cancer. *Arch Oncol*. 2013;21(1):11-3.
4. Radovanovic Z, Petrovic T, Radovanovic D, Breberina M, Golubovic A, Lukic D. Single versus double stapling anastomotic technique in rectal cancer surgery. *Surg Today*. 2014;44(6):1026-31.
5. Karanjia ND, Corder AP, Bearn P, Heald RJ. Leakage from stapled low anastomosis after total mesorectal excision for carcinoma of the rectum. *Br J Surg*. 1994;81(8):1224-6.
6. Law WI, Chu KW, Ho JW, Chan CW. Risk factors for anastomotic leakage after low anterior resection with total mesorectal excision. *Am J Surg*. 2000;179(2):92-6.
7. Averbach AM, Chang D, Koslowe P, Sugarbaker PH. Anastomotic leak after double-stapled low colorectal resection. *Dis Colon Rectum*. 1996;39(7):780-7.
8. Heald RJ. Rectal cancer: the surgical options. *Eur J Cancer*. 1995;31A(7-8):1189-92.
9. Murty M, Enker WE, Martz J. Current status of total mesorectal excision and autonomic nerve preservation in rectal cancer. *Semin Surg Oncol*. 2000;19(4):321-8.
10. Telem DA, Chin EH, Nguyen SQ, Divino CM. Risk factors for anastomotic leak following colorectal surgery: a case-control study. *Arch Surg*. 2010;145(4):371-6.
11. Vignali A, Fazio VW, Lavery IC, et al. Factors associated with the occurrence of leaks in stapled rectal anastomoses: a review of 1,014 patients. *J Am Coll Surg*. 1997;185:105-13.
12. Pakkaste TE, Luukkonen PE, Jarvinen HJ. Anastomotic leakage after anterior resection of the rectum. *Eur J Surg*. 1994;160:293-7.
13. 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.
14. Radovanovic Z, Petrovic T, Radovanovic D, et al. Single versus double stapling anastomotic technique in rectal cancer surgery. *Surg Today*. DOI 10.1007/s00595-013-0646-x, 2013. (Epub ahead of print)
15. Mealy K, Burke P, Hyland J. Anterior resection without a defunctioning colostomy: questions of safety. *Br J Surg*. 1992;79:305-7.
16. Karanjia ND, Corder AP, Bearn P, Heald RJ. Leakage from stapled low anastomosis after total mesorectal excision for carcinoma of the rectum. *Br J Surg*. 1994;81:1224.
17. Poon RT, Chu KW, Ho JW, et al. Prospective evaluation of selective defunctioning stoma for low anterior resection with total mesorectal excision. *World J Surg*. 1999;23:463-7.
18. Matthiessen P, Hallböök O, Rutegård J, Simer G, Sjö-dahl 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.
19. Branagan G, Finnis D. Wessex Colorectal Cancer Audit Working Group. Prognosis after anastomotic leakage in colorectal surgery. *Dis Colon Rectum*. 2005;48(5):1021-6.
20. Walker KG, Bell SW, Rickard MJ, et al. Anastomotic leakage is predictive of diminished survival after potentially curative resection for colorectal cancer. *Ann Surg*. 2004;240:255-9.
21. Bell SW, Walker KG, Rickard MJ, et al. Anastomotic leakage after curative anterior resection results in a higher prevalence of local recurrence. *Br J Surg*. 2003;90:1261-6.
22. Fujita S, Teramoto T, Watanabe M, Kodaira S, Kitajima M. Anastomotic leakage after colorectal cancer surgery: a risk factor for recurrence and poor prognosis. *Jpn J Clin Oncol*. 1993;23:299-302.
23. Camilleri-Brennan J, Steele RJ. Prospective analysis of quality of life after reversal of a defunctioning loop ileostomy. *Colorectal Dis*. 2002;4:167-71.
24. Remzi FH, Fazio VW, Gorgun E. The outcome after restorative proctocolectomy with or without defunctioning ileostomy. *Dis Colon Rectum*. 2006;49:470-7.
25. Hallböök O, Matthiessen P, Leinskold T. Safety of the temporary loop ileostomy. *Colorectal Dis*. 2002;4:361-4.
26. Gastinger I, Marusch F, Steinert R. Protective defunctioning stoma in low anterior resection for rectal carcinoma. *Br J Surg*. 2005;92:1137-42.
27. Chen F, Stuart M. The morbidity of defunctioning stomata. *ANZ J Surg*. 1996;66:218-21.

28. Tilney HS, Sains PS, Lovegrove RE, et al. Comparison of outcomes following ileostomy versus colostomy for defunctioning colorectal anastomoses. *World J Surg.* 2007;31:1142-51.

29. Edwards DP, Leppington-Clarke A, Sexton R. Stoma-related complications are more frequent after transverse colo-

stomy than loop ileostomy: a prospective randomized clinical trial. *Br J Surg.* 2001;88:360-3.

30. Huh JW, Park YA, Sohn SKA. Diverting stoma is not necessary when performing a handsewn coloanal anastomosis for lower rectal cancer. *Dis Colon Rectum.* 2007;50:1040-6.

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