

Quality of life in rectal cancer surgery: What do the patient ask?

Giovanni D De Palma, Gaetano Luglio

Giovanni D De Palma, Center of Excellence for Technical Innovation in Surgery, Department of Clinical Medicine and Surgery, University of Naples Federico II, School of Medicine, 80131 Naples, Italy

Gaetano Luglio, Department of Clinical Medicine and Surgery, University of Naples Federico II, School of Medicine, 80131 Naples, Italy

Author contributions: De Palma GD and Luglio G were both responsible for the design, conception, drafting, and final approval of this paper.

Conflict-of-interest statement: None. Giovanni D De Palma and Gaetano Luglio have nothing to disclose.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Correspondence to: Giovanni D De Palma, MD, Director of Center of Excellence for Technical Innovation in Surgery, Department of Clinical Medicine and Surgery, University of Naples Federico II, School of Medicine, via Pansini 5, 80131 Naples, Italy. giovanni.depalma@unina.it
Telephone: +39-81-7462773
Fax: +39-81-7462752

Received: May 24, 2015
Peer-review started: May 25, 2015
First decision: August 16, 2015
Revised: September 13, 2015
Accepted: October 12, 2015
Article in press: October 13, 2015
Published online: December 27, 2015

Abstract

Rectal cancer surgery has dramatically changed with

the introduction of the total mesorectal excision (TME), which has demonstrated to significantly reduce the risk of local recurrence. The combination of TME with radiochemotherapy has led to a reduction of local failure to less than 5%. On the other hand, surgery for rectal cancer is also impaired by the potential for a significant loss in quality of life. This is a new challenge surgeons should think about nowadays: If patients live more, they also want to live better. The fight against cancer cannot only be based on survival, recurrence rate and other oncological endpoints. Patients are also asking for a decent quality of life. Rectal cancer is probably a paradigmatic example: Its treatment is often associated with the loss or severe impairment of faecal function, alteration of body anatomy, urogenital problems and, sometimes, intractable pain. The evolution of laparoscopic colorectal surgery in the last decades is an important example, which emphasizes the importance that themes like scar, recovery, pain and quality of life might play for patients. The attention to quality of life from both patients and surgeons led to several surgical innovations in the treatment of rectal cancer: Sphincter saving procedures, reservoir techniques (pouch and coloplasty) to mitigate postoperative faecal disorders, nerve-sparing techniques to reduce the risk for sexual dysfunction. Even more conservative procedures have been proposed alternatively to the abdominal-perineal resection, like the local excisions or transanal endoscopic microsurgery, till the possibility of a wait and see approach in selected cases after radiation therapy.

Key words: Quality of life; Rectal cancer; Laparoscopic surgery; Sphincter preservation; Nerve-sparing

© **The Author(s) 2015.** Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: Survival and disease-free survival for patients affected by rectal cancer have overall increased, thanks to the advances in surgery, medical treatments, palliative care and multimodal strategies. This editorial will explore how the growing demand for a better quality

of life has in some way favored the development of new practices and new techniques such as sphincter saving procedures, reservoir techniques, minimally invasive surgery, as long as local treatments or even the possibility of a wait and see approach in highly selected cases.

De Palma GD, Luglio G. Quality of life in rectal cancer surgery: What do the patient ask? *World J Gastrointest Surg* 2015; 7(12): 349-355 Available from: URL: <http://www.wjgnet.com/1948-9366/full/v7/i12/349.htm> DOI: <http://dx.doi.org/10.4240/wjgs.v7.i12.349>

INTRODUCTION

Rectal cancer surgery has dramatically changed with the introduction of the total mesorectal excision (TME)^[1-3], which has demonstrated to significantly reduce the risk of local recurrences. Further improvement in local control has been achieved with the implementation of multimodal treatments, specially through the radio-chemotherapy^[4]. Despite a better local control achieved through radiation regimens and proper surgical techniques, the risk for distal failure and systemic disease still represents an issue. Anyway, survival and disease-free survival for patients affected by rectal cancer have overall increased, thanks to the advances in surgery, medical treatments, palliative care and multimodal strategies. This also represents the basis for a new challenge that doctors should face nowadays: If patients live more, they also want to live better. In other words, the fight against cancer cannot be based only on survival, recurrence rate and other oncological endpoints: patients also ask for a decent quality of life. In this regard, rectal cancer is probably a paradigmatic example: We know that its treatment is often associated with the loss or severe impairment of faecal function, alteration of body anatomy, urogenital problems and, sometimes, intractable pain. We also now that post-operative quality of life depends on many factors, some of them related to the disease itself (lower, advanced cancers), some related to the treatments (type of surgery, radiotherapy, stomas, etc.), and all these factors may play a role in reducing the perceived quality of life^[5].

In this effort to improve postoperative short-term outcomes and quality of life-related issues, laparoscopic surgery has rapidly evolved in the last decades, sometimes revolutionizing surgical practice. The role and the dramatic implementation of laparoscopy in the field of colon and rectal surgery also emphasises how the paradigm of cancer treatment is in some way changing: This story tells us about the role that themes like pain, scars, recovery and quality of life might play for patients.

It has been clearly demonstrated that laparoscopic surgery can offer benefits in terms of cosmesis, shorter recovery, shorter hospital stay, less pain, etc.; on the

other hand, the application of laparoscopic surgery to oncological resections encountered many difficulties at the beginning: Concerns were raised regarding the oncological adequacy of laparoscopic resections and lymph nodes yield, the fear for the pneumoperitoneum and the risk for tumor cells implantation on surgical wounds. Such oncological concerns have now been addressed, after many years of clinical trials (COST^[6], COLOR^[7], CLASSIC^[8], Barcelona^[9]), which have demonstrated the non inferiority of laparoscopic resections in the treatment of colon cancer and, more recently, of rectal cancer^[10]. It has also been clearly demonstrated that laparoscopic colorectal resections produce high quality specimens, similar to those obtained with proper open resections and similar results can be achieved by supervised trainee in learning curve settings^[11,12]. But the question is: Why have so many patients decided to enter in clinical trials, when laparoscopic surgery was not proven to give the same oncological results? The answer is probably that people are actually scared of surgery, and the possibility to get short term advantages, less pain, shorter hospital stay and better cosmesis turned out to be attractive, despite the risk for worse oncological outcomes. Actually, if we specifically look into quality of life parameters, literature shows a modest benefit from laparoscopic surgery in the field of colorectal cancer; there are basically two randomized trials and a meta-analysis of them^[13], which failed to demonstrate a clear advantage in term of quality of life in the laparoscopic arm, 2 mo after surgery. The COST study^[14], on the other hand, showed a slightly better overall quality of life in the laparoscopic group two weeks after surgery, without any additional benefit after two months. Possible explanations for the modest benefits in quality of life scores in lap groups from trials, may lay on the substantial lack of proper tools to measure quality of life in patients with cancer. Compared with patients undergoing surgery for benign diseases, cancer patients might perceive postoperative pain, recovery and cosmesis differently. More, most analysis are performed on an intention-to-treat basis, and converted cases, being included in the laparoscopic arms, might mask the benefits in quality of life achieved in the cases completed laparoscopically.

Quality of life after rectal cancer surgery has always been a challenge for surgeons^[5]; the acquisition of the safety of 2 cm disease-free margin or even less^[15], specially in radiated patients, led to a significant improvement of sphincter saving procedures. The possibility to restore intestinal continuity, thus preserving fecal continence is generally considered a key factor for a better quality of life^[16]. Other than the issue of a definitive stoma, the abdominal perineal resections is also impaired by a significant rate of perineal wound complications. This aspect has also become prominent, since the introduction of the "extralevator abdominal perineal resection", first described by Holm *et al*^[17]; this is based on performing the perineal dissection, the patient being turned in a prone jackknife position,

outside the levator plane, rather than along its inner aspect. This approach has demonstrated to reduce the circumferential resection margin positivity and intraoperative perforation rate^[18]. Nevertheless, despite a clear reduction in quality of life after extended APR has not been demonstrated, a significant risk for perineal wound complications has been demonstrated^[19], up to 46.6% of cases, including wound infections, breakdown and chronic perineal pain; however, a conservative management is usually required to face such situations.

On the other hand, low anterior resections with coloanal anastomosis, while preserving sphincters, led to the so called "anterior resection syndrome", characterized by high stool frequency, incontinence, urgency and soiling^[20-23]. A low anterior resection syndrome score (LARS score) has also been created and has been internationally validated recently^[24]; it is a self-administered questionnaire which has demonstrated to be a reliable tool in clinical practice, also considering the high correlation between the LARS score and quality of life.

In order to reduce the anterior resection syndrome, Lazorthes *et al.*^[25] and Parc *et al.*^[26] described the colonic J-pouch reconstruction; it is based on fashioning a 6-cm side-to-side anastomosis with the terminal distal colon in order to create a new reservoir, that will be then anastomosed to the anus. After its introduction, several studies have demonstrated the overall superiority of the colonic j-pouch in terms of functional results^[27,28], with lower incidence of soiling, urgency and decreased stool-frequency. On the other hand, some studies have also demonstrated that in case of a "straight" coloanal anastomosis, there is a kind of functional adaptation of the pelvic colon and results tend to become similar to the j-pouch 1 year after surgery^[29,30]. More, in case of pre or postoperative radiotherapy, pouch function seems to be significantly impaired, cause of damage to both nerves and sphincters, with high incidence of incontinence and diarrhoea; in these cases benefits from pouches are even less significant^[31,32]. Another kind of colonic reservoir has also been described, in order to face difficult situations like narrow pelvis, fatty mesentery, diverticulitis or inadequate colon length to fashion a j-pouch: The transverse coloplasty pouch, first described by Z'graggen *et al.*^[33] and Fazio *et al.*^[34]. Several studies have demonstrated that coloplasty may be considered a suitable alternative to j-pouch with similar functional results and a fewer rate of incomplete emptying^[35]. A recent meta-analysis also confirmed that j-pouch or transverse coloplasty allow to achieve better functional results compared to conventional straight anastomosis but this is true only for the first year after surgery^[36].

In this effort to preserve sphincter function, "intersphincteric resection" has also been described for very low rectal cancer instead of the abdominal-perineal resection (APR)^[37,38]. This technique is based on the total or partial resection of the internal sphincter, following the intersphincteric space in order to get a good distal

margin and preserve intestinal continuity, usually through a handsewn coloanal anastomosis. Oncological safety of this procedure has been demonstrated, when proper selection criteria are adopted: No external anal sphincter involvement, no levator plane involvement, at least 1 cm distal margin. When proper selection is obtained, oncological outcome do not differ from APR, in terms of local failure and overall survival^[39]. While the rationale to propose a patient an intersphincteric resection is clearly the possibility to offer him a better quality of life preserving faecal function, some concerns persist cause of the possibility to obtain a poor post-operative continence, specially when a significant portion of the sphincter is resected. Unfortunately a poor faecal function with a high risk of incontinence has been described after the intersphincteric resection, even if an improvement of continence scores is generally registered 12 mo after surgery^[40-42]. Some studies have also specifically looked into the quality of life^[43], showing how a clear deterioration in the faecal incontinence quality of life score is obtained in case of significant impairment of continence; being said, it's a grey zone where surgeons should wonder if a stoma might offer an overall better function. From this standpoint, it should also be argued that colo-anal anastomosis and intersphincteric resections also require the fashioning of a temporary loop ileostomy; this is a further "hot topic" in rectal cancer surgery: It has been demonstrated that ileostomies seem to produce a reduction in quality of life before reversions^[44,45], with decreased social and physical function, cause of the alteration of body anatomy, the risk for peristomal dermatitis, overflow diarrhea and subsequent dehydration, other than for the obvious psychological impact. More, data from literature shows that the ileostomy reversal surgery might be impaired by a significant morbidity, ranging from 9.3% to 45.9%^[46-49] (major morbidity being essentially represented by the risk for postoperative small bowel obstruction and anastomotic leaks). One further problem is that around one third of the ileostomies, intended to be temporary, won't actually be never reverted^[50,51]. Nevertheless, from our experience, loop ileostomy reversal surgery is quite a safe operation, with very low morbidity rate; obviously, adequate selection of patients really needing a diversion is the key point to make it worthwhile to perform the procedure.

Nerve injury during pelvic dissection is another hot topic in rectal cancer surgery, as it may lead to a severe impairment of urinary and sexual function postoperatively^[52]. Nerve-sparing technique is still considered a technical challenge among colorectal surgeons, with no clear consensus on which technique is better to adopt to reduce pelvic nerve injuries. A nerve-preserving technique was first describe by Walsh *et al.*^[53] for radical prostatectomy and then applied to rectal surgery. Hypogastric nerves, inferior hypogastric plexus, pelvic sacral nerves and the "nervi erigentes" are the most commonly nerve structures to be damaged during surgery. Risk for nerve injuries should be avoided

through a perfect knowledge of surgical anatomy and relationship between nerves and pelvic organs^[54]; nevertheless, even if a perfect nerve sparing technique is adopted, a complete functional preservation cannot be ensured at the moment^[55]. More, in locally advanced disease, tumor removal is the priority and pelvic nerves need to be sacrificed if necessary. Causes for sexual dysfunctions, in terms of impotency or ability to ejaculate, are sometimes also difficult to determine, as they can also be related to radiotherapy or surgical tractions, even when nerves are recognized and saved. More, erectile dysfunction might also be related to psychological factors and an overall decreased quality of life due to cancer diagnosis. Lindsey *et al.*^[56] suggested the possibility to perform the TME leaving intact the Denonvillier's fascia on the prostate, thus preserving cavernous nerves; this plane is not generally accepted among colorectal surgeons, and we generally believe that it could be considered safe only in case of early tumors not located on the anterior aspect of rectal wall. The magnified view obtained through laparoscopic surgery may play a significant role to help in nerves identification and preservation, but results are not definitive yet^[57,58]. Robotic surgery might combine the benefits from a magnified view and a highly precise dissection, but randomized data are required. The topic of genito-urinary function becomes also more prominent when TME is associated with extended lateral pelvic lymphnode dissection (ELD); this procedure is usually performed in Japan for stage II and III rectal cancer, due to presumed risk of 6.5%-16% to find positive pelvic nodes^[59]. Extended lymphnode dissection is often associated with a tentative pelvic autonomic nerve preservation, nevertheless both the extension of pelvic dissection and the completeness of nerve preservation may vary, depending on tumor stage, location and technical issues. Akasu *et al.*^[60] have demonstrated that while optimal results on sexual and urinary function can be obtain with TME alone, results get significantly worse if pelvic node dissection is added and the degree of dysfunction is directly associated with the extension of the dissection and the degree of preservation of autonomic nerves.

In order to mitigate the sequelae of rectal surgery, transanal local excision and transanal endoscopic microsurgery^[61] have also been described as alternatives in selected cases. It is a local treatment which will allow to take out a small rectal tumor, through a circumferential, full-thickness resection, without the need to enter the abdomen and resect the whole rectum with its lymphatic drainage, thus not fashioning a stoma and avoiding the anterior resection syndrome and a poor quality of life. On the other hand, big concerns still arise regarding the oncological safety of local excision and no clear guidelines currently exist. The most important aspect of the technique is the "full thickness" resection: All the layers adjacent to the lesion need to be excised till the mesorectal fat: Being said, the specimen needs to be a "total biopsy", for further histological assessment.

The major drawback of this technique is the lack of mesorectal lymphnodes clearance; for this reasons a big effort has been made to predict those situations in which the risk to find metastatic mesorectal nodes is high. Several criteria have been described to discriminate "low" and "high risk" rectal tumor. Nascimbeni *et al.*^[62] show a different depth of invasion of the submucosal layer (upper, middle or lower third), correlates with a different risk of finding nodes in the mesorectum (from 3% to 23%); other high risk factors are the grading of the lesion, lymphovascular invasion, the size and a lower location of the tumor. When these high risk factors are identified at the total biopsy, the patient should probably undergo a radical resection within one month from local excision, thus not compromising the prognosis^[63]. Some trials are also investigating the oncological safety of local excision after radiochemotherapy, also in T2 patients^[64]; this latter option, at the moment, should probably be reserved to elderly patients, unfit for surgery or absolutely determined to refuse the risk for a stoma. In this effort to preserve function, quality of life and avoid a mutilating surgery, a "wait and see" approach after preoperative radiotherapy has also been proposed in patients with a complete clinical response; nevertheless, this is still a really debating issue and we should probably look very carefully at this data, at the moment^[65].

Robotic and natural-orifice transluminal surgery are getting more popularity nowadays and probably represent future prospects in rectal cancer surgery. A recent, single institution experience from Park *et al.*^[66], concluded that robotic surgery for rectal cancer failed to offer oncological or clinical benefits over conventional laparoscopy, despite a significant increase in costs. Transanal total mesorectal excision seems to be a promising approach, based on a "bottom-up" dissection to deal with low rectal cancers, specially in narrow pelvis, when traditional laparoscopy may be technically challenging^[67,68]; anyway long-term outcomes, clinical advantages or impact on patients' quality of have not been provided yet.

Randomised, high quality data are still necessary, but new realities are probably not as far, if we consider the development of rectal surgery in the last decades, the new technologies and the importance that patients nowadays give to theme like cosmesis, recovery and quality of life.

REFERENCES

- 1 **Heald RJ**, Husband EM, Ryall RD. The mesorectum in rectal cancer surgery--the clue to pelvic recurrence? *Br J Surg* 1982; **69**: 613-616 [PMID: 6751457 DOI: 10.1002/bjs.1800691019]
- 2 **Heald RJ**, Ryall RD. Recurrence and survival after total mesorectal excision for rectal cancer. *Lancet* 1986; **1**: 1479-1482 [PMID: 2425199 DOI: 10.1016/S0140-6736(86)91510-2]
- 3 **Quirke P**, Durdey P, Dixon MF, Williams NS. Local recurrence of rectal adenocarcinoma due to inadequate surgical resection. Histopathological study of lateral tumour spread and surgical excision. *Lancet* 1986; **2**: 996-999 [PMID: 2430152]
- 4 **Sauer R**, Becker H, Hohenberger W, Rödel C, Wittekind C, Fietkau R, Martus P, Tschmelitsch J, Hager E, Hess CF, Karstens

- JH, Liersch T, Schmidberger H, Raab R. Preoperative versus postoperative chemoradiotherapy for rectal cancer. *N Engl J Med* 2004; **351**: 1731-1740 [PMID: 15496622 DOI: 10.1056/NEJMoa040694]
- 5 **Hoerske C**, Weber K, Goehl J, Hohenberger W, Merkel S. Long-term outcomes and quality of life after rectal carcinoma surgery. *Br J Surg* 2010; **97**: 1295-1303 [PMID: 20602501 DOI: 10.1002/bjs.7105]
 - 6 **Fleshman J**, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW, Hellinger M, Flanagan R, Peters W, Nelson H. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. *Ann Surg* 2007; **246**: 655-662; discussion 662-664 [PMID: 17893502 DOI: 10.1097/SLA.0b013e318155a762]
 - 7 **Colon Cancer Laparoscopic or Open Resection Study Group**; Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, Haglind E, Pahlman L, Cuesta MA, Msika S, Morino M, Lacy A, Bonjer HJ. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. *Lancet Oncol* 2009; **10**: 44-52 [PMID: 19071061 DOI: 10.1016/S1470-2045(08)70310-3]
 - 8 **Jayne DG**, Guillou PJ, Thorpe H, Quirke P, Copeland J, Smith AM, Heath RM, Brown JM. Randomized trial of laparoscopic-assisted resection of colorectal carcinoma: 3-year results of the UK MRC CLASICC Trial Group. *J Clin Oncol* 2007; **25**: 3061-3068 [PMID: 17634484 DOI: 10.1200/JCO.2006.09.7758]
 - 9 **Lacy AM**, Delgado S, Castells A, Prins HA, Arroyo V, Ibarzabal A, Pique JM. The long-term results of a randomized clinical trial of laparoscopy-assisted versus open surgery for colon cancer. *Ann Surg* 2008; **248**: 1-7 [PMID: 18580199 DOI: 10.1097/SLA.0b013e31816a9d65]
 - 10 **Bonjer HJ**, Deijen CL, Abis GA, Cuesta MA, van der Pas MH, de Lange-de Klerk ES, Lacy AM, Bemelman WA, Andersson J, Angenete E, Rosenberg J, Fuerst A, Haglind E. A randomized trial of laparoscopic versus open surgery for rectal cancer. *N Engl J Med* 2015; **372**: 1324-1332 [PMID: 25830422 DOI: 10.1056/NEJMoa1414882]
 - 11 **West NP**, Kennedy RH, Magro T, Luglio G, Sala S, Jenkins JT, Quirke P. Morphometric analysis and lymph node yield in laparoscopic complete mesocolic excision performed by supervised trainees. *Br J Surg* 2014; **101**: 1460-1467 [PMID: 25139143 DOI: 10.1002/bjs.9602]
 - 12 **Luglio G**, De Palma GD, Tarquini R, Giglio MC, Sollazzo V, Esposito E, Spadarella E, Peltrini R, Liccardo F, Bucci L. Laparoscopic colorectal surgery in learning curve: Role of implementation of a standardized technique and recovery protocol. A cohort study. *Ann Med Surg (Lond)* 2015; **4**: 89-94 [PMID: 25859386 DOI: 10.1016/j.amsu.2015.03.003]
 - 13 **Schwenk W**, Haase O, Neudecker J, Müller JM. Short term benefits for laparoscopic colorectal resection. *Cochrane Database Syst Rev* 2005; **(3)**: CD003145 [PMID: 16034888 DOI: 10.1002/14651858.CD003145.pub2]
 - 14 **Weeks JC**, Nelson H, Gelber S, Sargent D, Schroeder G; Clinical Outcomes of Surgical Therapy (COST) Study Group. Short-term quality-of-life outcomes following laparoscopic-assisted colectomy vs open colectomy for colon cancer: a randomized trial. *JAMA* 2002; **287**: 321-328 [PMID: 11790211 DOI: 10.1001/jama.287.3.321]
 - 15 **Vernava AM**, Moran M, Rothenberger DA, Wong WD. A prospective evaluation of distal margins in carcinoma of the rectum. *Surg Gynecol Obstet* 1992; **175**: 333-336 [PMID: 1329243]
 - 16 **Sprangers MA**, Taal BG, Aaronson NK, te Velde A. Quality of life in colorectal cancer. Stoma vs. nonstoma patients. *Dis Colon Rectum* 1995; **38**: 361-369 [PMID: 7720441 DOI: 10.1007/BF02054222]
 - 17 **Holm T**, Ljung A, Häggmark T, Jurell G, Lagergren J. Extended abdominoperineal resection with gluteus maximus flap reconstruction of the pelvic floor for rectal cancer. *Br J Surg* 2007; **94**: 232-238 [PMID: 17143848 DOI: 10.1002/bjs.5489]
 - 18 **West NP**, Anderin C, Smith KJ, Holm T, Quirke P; European Extralevator Abdominoperineal Excision Study Group. Multicentre experience with extralevator abdominoperineal excision for low rectal cancer. *Br J Surg* 2010; **97**: 588-599 [PMID: 20186891 DOI: 10.1002/bjs.6916]
 - 19 **Welsch T**, Mategakis V, Contin P, Kulu Y, Büchler MW, Ulrich A. Results of extralevator abdominoperineal resection for low rectal cancer including quality of life and long-term wound complications. *Int J Colorectal Dis* 2013; **28**: 503-510 [PMID: 23178992 DOI: 10.1007/s00384-012-1611-7]
 - 20 **Seow-Choen F**, Goh HS. Prospective randomized trial comparing J colonic pouch-anal anastomosis and straight coloanal reconstruction. *Br J Surg* 1995; **82**: 608-610 [PMID: 7613927 DOI: 10.1002/bjs.1800820511]
 - 21 **Lazorthes F**, Chiotasso P, Gamagami RA, Istvan G, Chevreau P. Late clinical outcome in a randomized prospective comparison of colonic J pouch and straight coloanal anastomosis. *Br J Surg* 1997; **84**: 1449-1451 [PMID: 9361611 DOI: 10.1002/bjs.1800841030]
 - 22 **Dehni N**, Tiret E, Singland JD, Cunningham C, Schlegel RD, Guiguet M, Parc R. Long-term functional outcome after low anterior resection: comparison of low colorectal anastomosis and colonic J-pouch-anal anastomosis. *Dis Colon Rectum* 1998; **41**: 817-822; discussion 822-823 [PMID: 9678365 DOI: 10.1007/BF02235358]
 - 23 **Hallböök O**, Sjö Dahl R. Comparison between the colonic J pouch-anal anastomosis and healthy rectum: clinical and physiological function. *Br J Surg* 1997; **84**: 1437-1441 [PMID: 9361608 DOI: 10.1002/bjs.1800841027]
 - 24 **Juul T**, Ahlberg M, Biondo S, Emmertsen KJ, Espin E, Jimenez LM, Matzel KE, Palmer G, Sauermann A, Trenti L, Zhang W, Laurberg S, Christensen P. International validation of the low anterior resection syndrome score. *Ann Surg* 2014; **259**: 728-734 [PMID: 23598379 DOI: 10.1097/SLA.0b013e31828fac0b]
 - 25 **Lazorthes F**, Fages P, Chiotasso P, Lemozy J, Bloom E. Resection of the rectum with construction of a colonic reservoir and coloanal anastomosis for carcinoma of the rectum. *Br J Surg* 1986; **73**: 136-138 [PMID: 3947904 DOI: 10.1002/bjs.1800730222]
 - 26 **Parc R**, Tiret E, Frileux P, Moszkowski E, Loygue J. Resection and colo-anal anastomosis with colonic reservoir for rectal carcinoma. *Br J Surg* 1986; **73**: 139-141 [PMID: 3947905 DOI: 10.1002/bjs.1800730223]
 - 27 **Hallböök O**, Pahlman L, Krog M, Wexner SD, Sjö Dahl R. Randomized comparison of straight and colonic J pouch anastomosis after low anterior resection. *Ann Surg* 1996; **224**: 58-65 [PMID: 8678619 DOI: 10.1097/00000658-199607000-00009]
 - 28 **Ho YH**, Tan M, Seow-Choen F. Prospective randomized controlled study of clinical function and anorectal physiology after low anterior resection: comparison of straight and colonic J pouch anastomoses. *Br J Surg* 1996; **83**: 978-980 [PMID: 8813791 DOI: 10.1002/bjs.1800830729]
 - 29 **Cavaliere F**, Pemberton JH, Cosimelli M, Fazio VW, Beart RW. Coloanal anastomosis for rectal cancer. Long-term results at the Mayo and Cleveland Clinics. *Dis Colon Rectum* 1995; **38**: 807-812 [PMID: 7634975 DOI: 10.1007/BF02049837]
 - 30 **Ho YH**, Seow-Choen F, Tan M. Colonic J-pouch function at six months versus straight coloanal anastomosis at two years: randomized controlled trial. *World J Surg* 2001; **25**: 876-881 [PMID: 11572027 DOI: 10.1007/s00268-001-0044-1]
 - 31 **Dehni N**, McNamara DA, Schlegel RD, Guiguet M, Tiret E, Parc R. Clinical effects of preoperative radiation therapy on anorectal function after proctectomy and colonic J-pouch-anal anastomosis. *Dis Colon Rectum* 2002; **45**: 1635-1640 [PMID: 12473887 DOI: 10.1097/01.DCR.0000034498.82344.20]
 - 32 **Luglio G**, Masone S, Quarto G, Benassai G, Sollazzo V, Tarquini R, Celentano V, Giglio M, Bucci L. Functional results after TME: J-pouch vs straight coloanal anastomosis and role of neoadjuvant radiochemotherapy. *Ann Ital Chir* 2013; **84**: 571-574 [PMID: 24141027]
 - 33 **Z'graggen K**, Maurer CA, Büchler MW. Transverse coloplasty pouch. A novel neorectal reservoir. *Dig Surg* 1999; **16**: 363-366 [PMID: 10567793 DOI: 10.1159/000018747]
 - 34 **Fazio VW**, Mantyh CR, Hull TL. Colonic "coloplasty": novel

- technique to enhance low colorectal or coloanal anastomosis. *Dis Colon Rectum* 2000; **43**: 1448-1450 [PMID: 11052525 DOI: 10.1007/BF02236645]
- 35 **Remzi FH**, Fazio VW, Gorgun E, Zutshi M, Church JM, Lavery IC, Hull TL. Quality of life, functional outcome, and complications of coloplasty pouch after low anterior resection. *Dis Colon Rectum* 2005; **48**: 735-743 [PMID: 15785900 DOI: 10.1007/s10350-004-0862-y]
 - 36 **Hüttner FJ**, Tenckhoff S, Jensen K, Uhlmann L, Kulu Y, Büchler MW, Diener MK, Ulrich A. Meta-analysis of reconstruction techniques after low anterior resection for rectal cancer. *Br J Surg* 2015; **102**: 735-745 [PMID: 25833333 DOI: 10.1002/bjs.9782]
 - 37 **Braun J**, Treutner KH, Winkeltau G, Heidenreich U, Lerch MM, Schumpelick V. Results of intersphincteric resection of the rectum with direct coloanal anastomosis for rectal carcinoma. *Am J Surg* 1992; **163**: 407-412 [PMID: 1532699]
 - 38 **Rullier E**, Zerbib F, Laurent C, Bonnel C, Caudry M, Saric J, Parneix M. Intersphincteric resection with excision of internal anal sphincter for conservative treatment of very low rectal cancer. *Dis Colon Rectum* 1999; **42**: 1168-1175 [PMID: 10496557]
 - 39 **Akasu T**, Takawa M, Yamamoto S, Fujita S, Moriya Y. Incidence and patterns of recurrence after intersphincteric resection for very low rectal adenocarcinoma. *J Am Coll Surg* 2007; **205**: 642-647 [PMID: 17964439 DOI: 10.1016/j.jamcollsurg.2007.05.036]
 - 40 **Bretagnol F**, Rullier E, Laurent C, Zerbib F, Gontier R, Saric J. Comparison of functional results and quality of life between intersphincteric resection and conventional coloanal anastomosis for low rectal cancer. *Dis Colon Rectum* 2004; **47**: 832-838 [PMID: 15108027 DOI: 10.1007/s10350-004-0523-1]
 - 41 **Bittorf B**, Stadelmaier U, Göhl J, Hohenberger W, Matzel KE. Functional outcome after intersphincteric resection of the rectum with coloanal anastomosis in low rectal cancer. *Eur J Surg Oncol* 2004; **30**: 260-265 [PMID: 15028306 DOI: 10.1016/j.ejso.2003.11.011]
 - 42 **Giglio MC**, Persico M, Quarto G, Benassai G, Luglio G, Tarquini R, Celentano V, Sollazzo V, Bucci L. Intersphincteric resection for rectal cancer: role in fecal continence and Quality of Life. *Ann Ital Chir* 2013; **84**: 287-290 [PMID: 23856629]
 - 43 **Park JG**, Lee MR, Lim SB, Hong CW, Yoon SN, Kang SB, Heo SC, Jeong SY, Park KJ. Colonic J-pouch anal anastomosis after ultralow anterior resection with upper sphincter excision for low-lying rectal cancer. *World J Gastroenterol* 2005; **11**: 2570-2573 [PMID: 15849813 DOI: 10.3748/wjg.v11.i17.2570]
 - 44 **O'Leary DP**, Fide CJ, Foy C, Lucarotti ME. Quality of life after low anterior resection with total mesorectal excision and temporary loop ileostomy for rectal carcinoma. *Br J Surg* 2001; **88**: 1216-1220 [PMID: 11531870 DOI: 10.1046/j.0007-1323.2001.01862.x]
 - 45 **Tsunoda A**, Tsunoda Y, Narita K, Watanabe M, Nakao K, Kusano M. Quality of life after low anterior resection and temporary loop ileostomy. *Dis Colon Rectum* 2008; **51**: 218-222 [PMID: 18172730 DOI: 10.1007/s10350-007-9101-7]
 - 46 **Wong KS**, Remzi FH, Gorgun E, Arrigain S, Church JM, Preen M, Fazio VW. Loop ileostomy closure after restorative proctocolectomy: outcome in 1,504 patients. *Dis Colon Rectum* 2005; **48**: 243-250 [PMID: 15714246 DOI: 10.1007/s10350-004-0771-0]
 - 47 **Perez RO**, Habr-Gama A, Seid VE, Proscurshim I, Sousa AH, Kiss DR, Linhares M, Sapucahy M, Gama-Rodrigues J. Loop ileostomy morbidity: timing of closure matters. *Dis Colon Rectum* 2006; **49**: 1539-1545 [PMID: 16897328 DOI: 10.1007/s10350-006-0645-8]
 - 48 **Sharma A**, Deeb AP, Rickles AS, Iannuzzi JC, Monson JR, Fleming FJ. Closure of defunctioning loop ileostomy is associated with considerable morbidity. *Colorectal Dis* 2013; **15**: 458-462 [PMID: 22974343 DOI: 10.1111/codi.12029]
 - 49 **Pokorny H**, Herkner H, Jakesz R, Herbst F. Mortality and complications after stoma closure. *Arch Surg* 2005; **140**: 956-960, discussion 960 [PMID: 16230545 DOI: 10.1001/archsurg.140.10.956]
 - 50 **David GG**, Slavin JP, Willmott S, Corless DJ, Khan AU, Selvasekar CR. Loop ileostomy following anterior resection: is it really temporary? *Colorectal Dis* 2010; **12**: 428-432 [PMID: 19226365 DOI: 10.1111/j.1463-1318.2009.01815.x]
 - 51 **Lordan JT**, Heywood R, Shirol S, Edwards DP. Following anterior resection for rectal cancer, defunctioning ileostomy closure may be significantly delayed by adjuvant chemotherapy: a retrospective study. *Colorectal Dis* 2007; **9**: 420-422 [PMID: 17504338 DOI: 10.1111/j.1463-1318.2006.01178.x]
 - 52 **Hendren SK**, O'Connor BI, Liu M, Asano T, Cohen Z, Swallow CJ, Macrae HM, Gryfe R, McLeod RS. Prevalence of male and female sexual dysfunction is high following surgery for rectal cancer. *Ann Surg* 2005; **242**: 212-223 [PMID: 16041212 DOI: 10.1097/01.sla.0000171299.43954.ce]
 - 53 **Walsh PC**, Lepor H, Eggleston JC. Radical prostatectomy with preservation of sexual function: anatomical and pathological considerations. *Prostate* 1983; **4**: 473-485 [PMID: 6889192 DOI: 10.1002/pros.2990040506]
 - 54 **Havenga K**, DeRuiter MC, Enker WE, Welvaart K. Anatomical basis of autonomic nerve-preserving total mesorectal excision for rectal cancer. *Br J Surg* 1996; **83**: 384-388 [PMID: 8665201 DOI: 10.1002/bjs.1800830329]
 - 55 **Celentano V**, Fabbrocio G, Luglio G, Antonelli G, Tarquini R, Bucci L. Prospective study of sexual dysfunction in men with rectal cancer: feasibility and results of nerve sparing surgery. *Int J Colorectal Dis* 2010; **25**: 1441-1445 [PMID: 20582547 DOI: 10.1007/s00384-010-0995-5]
 - 56 **Lindsey I**, Guy RJ, Warren BF, Mortensen NJ. Anatomy of Denonvilliers' fascia and pelvic nerves, impotence, and implications for the colorectal surgeon. *Br J Surg* 2000; **87**: 1288-1299 [PMID: 11044153 DOI: 10.1046/j.1365-2168.2000.01542.x]
 - 57 **Jayne DG**, Brown JM, Thorpe H, Walker J, Quirke P, Guillou PJ. Bladder and sexual function following resection for rectal cancer in a randomized clinical trial of laparoscopic versus open technique. *Br J Surg* 2005; **92**: 1124-1132 [PMID: 15997446 DOI: 10.1002/bjs.4989]
 - 58 **Guillou PJ**, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, Heath RM, Brown JM; MRC CLASICC trial group. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. *Lancet* 2005; **365**: 1718-1726 [PMID: 15894098 DOI: 10.1016/S0140-6736(05)66545-2]
 - 59 **Sugihara K**, Kobayashi H, Kato T, Mori T, Mochizuki H, Kameoka S, Shirouzu K, Muto T. Indication and benefit of pelvic sidewall dissection for rectal cancer. *Dis Colon Rectum* 2006; **49**: 1663-1672 [PMID: 17041749 DOI: 10.1007/s10350-006-0714-z]
 - 60 **Akasu T**, Sugihara K, Moriya Y. Male urinary and sexual functions after mesorectal excision alone or in combination with extended lateral pelvic lymph node dissection for rectal cancer. *Ann Surg Oncol* 2009; **16**: 2779-2786 [PMID: 19626377 DOI: 10.1245/s10434-009-0546-x]
 - 61 **Buess G**, Theiss R, Günther M, Hutterer F, Pichlmaier H. [Transanal endoscopic microsurgery]. *Leber Magen Darm* 1985; **15**: 271-279 [PMID: 4079630]
 - 62 **Nascimbeni R**, Burgart LJ, Nivatvongs S, Larson DR. Risk of lymph node metastasis in T1 carcinoma of the colon and rectum. *Dis Colon Rectum* 2002; **45**: 200-206 [PMID: 11852333]
 - 63 **Hahnloser D**, Wolff BG, Larson DW, Ping J, Nivatvongs S. Immediate radical resection after local excision of rectal cancer: an oncologic compromise? *Dis Colon Rectum* 2005; **48**: 429-437 [PMID: 15747069 DOI: 10.1007/s10350-004-0900-9]
 - 64 **Ota DM**, Nelson H. Local excision of rectal cancer revisited: ACOSOG protocol Z6041. *Ann Surg Oncol* 2007; **14**: 271 [PMID: 17103255 DOI: 10.1245/s10434-006-9213-7]
 - 65 **Habr-Gama A**, Sabbaga J, Gama-Rodrigues J, São Julião GP, Proscurshim I, Bailão Aguiar P, Nadalin W, Perez RO. Watch and wait approach following extended neoadjuvant chemoradiation for distal rectal cancer: are we getting closer to anal cancer management? *Dis Colon Rectum* 2013; **56**: 1109-1117 [PMID: 24022527 DOI: 10.1097/DCR.0b013e3182a25c4e]
 - 66 **Park EJ**, Cho MS, Baek SJ, Hur H, Min BS, Baik SH, Lee KY, Kim NK. Long-term oncologic outcomes of robotic low anterior

resection for rectal cancer: a comparative study with laparoscopic surgery. *Ann Surg* 2015; **261**: 129-137 [PMID: 24662411 DOI: 10.1097/SLA.0000000000000613]

- 67 **Fernández-Hevia M**, Delgado S, Castells A, Tasende M, Momblan D, Díaz del Gobbo G, DeLacy B, Balust J, Lacy AM. Transanal total mesorectal excision in rectal cancer: short-term outcomes in comparison with laparoscopic surgery. *Ann Surg* 2015;

261: 221-227 [PMID: 25185463 DOI: 10.1097/SLA.00000000000000865]

- 68 **Lacy AM**, Tasende MM, Delgado S, Fernandez-Hevia M, Jimenez M, De Lacy B, Castells A, Bravo R, Wexner SD, Heald RJ. Transanal Total Mesorectal Excision for Rectal Cancer: Outcomes after 140 Patients. *J Am Coll Surg* 2015; **221**: 415-423 [PMID: 26206640 DOI: 10.1016/j.jamcollsurg.2015.03.046]

P- Reviewer: Fu W, Lee FYJ **S- Editor:** Gong XM

L- Editor: A **E- Editor:** Liu SQ





Published by **Baishideng Publishing Group Inc**

8226 Regency Drive, Pleasanton, CA 94588, USA

Telephone: +1-925-223-8242

Fax: +1-925-223-8243

E-mail: bpgoffice@wjgnet.com

Help Desk: <http://www.wjgnet.com/esps/helpdesk.aspx>

<http://www.wjgnet.com>

