Functional outcome following restorative rectal cancer surgery

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The trend towards preoperative adjuvant and neoadjuvant therapies in selected patients with rectal cancer has led to increases in sphincter preservation with a limited understanding of the factors governing unsatisfactory functional outcomes. Data would suggest the need for a more selective use of standard radiotherapeutic fields in low- to intermediate-risk cases where there appears to be limited survival or locoregional recurrence benefit and where there is under-reported toxicity. This article discusses the complex factors which impact on functional outcome following open rectal cancer surgery particularly when it is accompanied by adjuvant therapy.

Key words: rectal cancer, neoadjuvant, functional outcome, neorectal reservoir

INTRODUCTION

In the quest for sphincter preservation in low rectal cancer as well as in the delineation of a selective role for neoadjuvant therapy, surgeons have utilized preoperative high-resolution, fine-slice magnetic resonance imaging to support total mesorectal excision as part of a specialized multidisciplinary mode of cancer care. This approach has also informed clinical practice guiding the construction of innovative neorectal reservoirs assisting specific cases which might benefit by extended lymphadenectomy, and more clearly selecting patients suitable for local excision, multivisceral resection and total anorectal reconstruction.

There is currently still a relatively poor understanding of rectal tumor biology, although there is now considerable evidence demonstrating that surgeon-related variables are currently of paramount importance in the main cancer-specific outcome parameters, (notably, cancer-specific survival and locoregional recurrence rates) as well as in patient postoperative quality of life parameters. Modern attempts which preserve the anal sphincter such as preoperative chemoradiation, neorectal reservoir construction, the selective use of wholly laparoscopic, laparoscopic-assisted and robotic-assisted procedures and transanal endoscopic local excision have particularly highlighted the importance of functional outcome and its impact on quality of life parameters in this new era.

This short review analyzes the recent functional outcomes of coloanal anastomosis and its modifications along with the factors which compromise quality of life from a functional standpoint after open restorative rectal cancer surgery.

FUNCTIONAL OUTCOME FOLLOWING COLO-ANAL ANASTOMOSIS: THE PLACE FOR A NEORECTAL RESERVOIR:

Bowel dysfunction following low anterior resection has been well reported, typically consisting of a mixture of increased stool frequency, bowel fragmentation, urgency and faecal incontinence as represented by a definitive "low anterior resection syndrome". This constellation of symptoms has been shown to seriously impact on quality of life specifically in functional terms where it has been shown to equate with both manometric disappearance of the rectoanal inhibitory reflex (RAIR) as a measure of internal anal sphincter (IAS) function and anorectal sampling amounting to early poor discrimination between liquid or gaseous rectal content.
The lessons learned from changes in anorectal physiology for benign diseases may well be applicable in oncologic surgery where our group has reemphasized the importance of the IAS as a major determinant of continence control. Here, RAIR parameters (most notably the speed of inhibitory wave recovery) are linked to preexisting incontinence and in this respect, it has been shown that the external anal sphincter (EAS) component overlapping the termination of the IAS which is deficient in fissure and incontinent patients renders patients more susceptible to postoperative incontinence following internal anal sphincterotomy or anal distraction.

Equally, IAS preservation with seton usage in high trans-sphincteric fistula-in-ano has resulted in improvements in resting anal pressure over conventional non-preserving techniques which have potential implications for its preservation and protect-on in cancer surgery.

The manometric recovery of the RAIR within the first 2 years after rectal resection roughly correlates with clinical functional improvement although the persistence in disturbed rectoanal inhibition and maximal tolerated volumes with rectal balloon distension has shown little correlation with reported stool frequency, reported episodes of incontinence or with a low anastomotic level. This early literature was based on the experience with restorative proctocolectomy and ileal pouch-anal anastomosis, where preservation of the anal transitional zone resulted in improved clinical function with protection of rectoanal inhibition and the anorectal sampling mechanism.

This evidence was supported by less functional disturbance in those undergoing stapled as opposed to hand-sewn low anastomoses where there was less endoanal distraction and was supported by morphological evidence on endosonographic study of both IAS and EAS damage following the insertion of an endoanal stapler.

Much of this data preceded the introduction of validated quality of life determinations or objective reproducible continence instruments. Early data suggested that the functional outcome for patients undergoing restorative low anterior resection could be improved temporarily for 1-2 years after surgery by the utilization of a neorectal reservoir.

Historically to mitigate against such early dysfunction, the operative approach was by the construction of a pouch-anal anastomosis, where over time it was realized that progressive reduction in the size of the pouch (to a side length of 5 cm or less) prevented the problem of postoperative evacuatory difficulty and the need for anal self-intubation.

These initial randomized studies showed some improvement in early nocturnal incontinence and stool frequency where a pouch was used when compared with a straight low coloanal anastomosis, although there was little statistical functional difference between the pouch versus no-pouch groups after the first year of follow-up. Most of the follow-up in these studies is relatively short-term with only a few such studies being either randomized or controlled in format.

The physiologic data pertaining to the use of the J pouch in rectal reconstruction shows that pouch volume increases progressively with time. In this setting, low initial mean resting anal pressure (MRAP) values correlate with reported episodes of incontinence in the early postoperative period. Since there are no fundamental differences in functional outcome between pouch and non-pouch cases, it has been assumed that functional activity (particularly after some years), is not therefore a measure of neorectal capacity, but rather one of propulsive activity within the pouch itself.

In this regard there is observable retrograde peristalsis and motility changes within the efferent loop of side-to-end anastomoses which would explain these clinical findings.

The converse appears to also be relevant for evacuatory difficulty with pouches (as well as with pouch outlet ends) which actually does correlate with both pouch size and outlet spout length as well as with any segment of retained rectum above the anastomosis.

The development of incontinence following low coloanal anastomosis is a complex issue. There is evidence to suggest some degree of sensory adaptation in neorectal reservoirs where increasing pouch pressures over time may occur with smaller pouch distension volumes and that this phenomenon may predate reported episodes of leakage.

This would represent a sensory alteration within the pouch where incontinence episodes appear more to be associated with physical sphincter disruption and where high pressure waves generated within the pouch itself are only of clinical relevance if they meet a weakened sphincter apparatus. The presence of an endosonographic sphincter defect, however, following insertion of a stapler for a coloanal anastomosis does not result in universally reported incontinence. This effect, however, is likely to be multifactorial and may also involve the effects of attendant neuropathy where both short- and longer-term overall worse functional outcome is dependent upon low anastomotic level, male gender and the presence of significant pelvic sepsis secondary to partial anastomotic dehiscence compromising the compliance of any neo-rectal reservoir.
Novel techniques for neorectal reservoir reconstruction have been relatively recently introduced, including the use of a longitudinal to transverse coloplasty\(^{51,52}\) and a low wholly trans-abdominal stapled side-to-end anastomosis\(^{54}\).

The end-to-side anastomosis for rectal reconstruction was first proposed by Baker in 1950\(^{55}\) and is technically easier to perform, wholly abdominal (if necessary) where there is a reduced incidence of anastomotic stricture with greater feasibility for its performance in the narrow pelvis.

With the colonic J-pouch, the side-to-end anastomosis is thought to function by retroperistalsis in the side limb with segment reversal altering the passage of stool rather than functioning as a true reservoir. In this regard, it has been shown that there are only minor changes in anastomotic volumetry where in pouch cases by comparison there is minimal functional advantage with a faster return to normal stool frequency and less postoperative use of antidiarrhoeal medication. This is accompanied by a more rapid recovery of urge and maximal tolerable volumes to rectal distension.

The theoretical advantage of this anastomosis might be more in evacuation rather than in any effect on incontinence although there is little to choose in stool frequency between the side-to-end anastomosis and a 6 cm colonic J-pouch over time\(^{56}\). There is not much to choose between these techniques with regard to evacuation although there have been only a few comparisons of functional or manometric outcome between pouches and the coloplasty procedure\(^{57,58}\). Clinical data has shown that the coloplasty is associated with better evacuation than the colonic J-pouch and that postoperative urgency and incontinence correlates more with disturbances in pelvic floor movement on defaeco-graphy rather than with either pouch size or sphincter integrity\(^{59,60}\).

**FUNCTIONAL EFFECTS OF CHEMORADIATION:**

There is considerable evidence to show that postoperative radiotherapy (RT) for rectal cancer has significant effects on anorectal function, where most regimes are delivered as long-course external megavoltage therapy (MVT) over a 4-6 week period in the prone position with small bowel contrast evaluation and the use of anatomical blocks to diminish extraneous radiation\(^{61}\).

There has been an increase in reported defaecation frequency and bowel clustering following RT as well as a generally detrimental effect on reported continence\(^{62,63}\) along with a deleterious effect on rectal reservoir compliance, capacity and evacuation pattern\(^{64-66}\). The arguments in favour of preoperative RT strategies include an improved long-term functional outcome, improved RT tolerance, increased rates of sphincter preservation, diminished acute phase small bowel toxicity, reduced locoregional recurrence rates and possible advantageous effects on overall cancer-specific survival\(^{67-72}\). The push towards sphincter preservation with a general acceptance of reduced distal resection margins\(^{73,74}\), however, definitely results in some functional cost. The advantages of preoperative over postoperative RT include reduced locoregional recurrence (even with increased postoperative dosing) and a short-term anorectal functional benefit with relatively late toxicity. It is currently unclear, however, whether neorectal reservoirs designed to increase neorectal capacity may abrogate the detrimental effects of preoperative RT where there is some evidence for impaired function in J-pouch anastomoses following adjuvant RT\(^{75}\). Survival benefit with preoperative RT has been achieved in only one trial\(^{76}\) suggesting the need for more data randomizing patient subgroups receiving preoperative treatment. The brachytherapy approach in rectal cancer is not commonly used, although RT doses are typically quite high (up to 80cGy) with reported effects on maximal resting anal pressure (MRAP), maximal squeeze pressure (MSP) and maximal tolerable volumes (MTV) on rectal distension. In one study by Gervaz et al.\(^{65}\) comparing preoperative and postoperative RT, there was a differential effect on MRAP and the RAIR, (both essentially IAS functions) but no effect on MSP, (essentially an EAS function) or upon MTV. Hence, differences are going to occur with different RT modalities and RT/chemotherapy sequencing, length of follow-up and parameters assessed\(^{77}\).

Studies have shown a minimal effect of preoperative RT in those patients having a neorectal pouch despite a short-term period of nocturnal urgency in this group\(^{78,79}\), but the effects of RT are dose-dependent with a principal effect on rectal musculature, innervation\(^{80-83}\) and direct effects on sphincter morphology\(^{84}\) and function\(^{75}\). The correlation of functional changes after preoperative RT and chemoradiation may occur in the absence of recognizable alterations in manometry suggesting in some cases a radiotherapeutic small bowel toxicity as well as a distinct pelvic radioneuropathy.

The latter effect may occur as an isolated pudendal nerve damage\(^{85}\) or as a lumbar plexopathy\(^{86}\). The functional changes induced by RT may progress with time\(^{87}\) and will probably become more prevalent with an increasing use of RT in this setting. In the study of the manometric effects of preoperative RT by Yeoh and colleagues\(^{88}\) there is some correlation between an altered mucosal sensitivity and symptoms, where impedance planimetry, (a physiological examination of functional compliance), equates with post-radiotherapeutic symptoms. This has suggested a generally stiffer,
The increasing utility of pre-operative adjuvant and neoadjuvant strategies for rectal cancer has altered our approach towards the construction of either a straight coloanal or reservoir anastomosis necessitating newer reconstructive techniques in the armamentarium of the coloproctologist.

These considerations are more dependent upon the primary rectal cancer level and whether it is anticipated that the sphincter apparatus will be more likely to be incorporated within the radiation field. This will be compounded by an attendant postprocedural neuropathy and autonomic plexopathy which may be partly operative and partly radiotherapeutic. These latter adverse predicted functional results are expected to diminish in the future as a result of better field orientations and improvements in postoperative dose delivery and sequencing capable of inducing radiation enteritis particularly when there are extensive intraabdominal adhesions.

In summary, functional outcome after total mesorectal excision (and ancillary therapy) depends on the quality of the primary surgery, the technique of its reconstruction, the functional state of the pelvic floor and the sphincter apparatus and the presence or absence of immediate postoperative septic complications. Recent data would suggest that there is minimal benefit for preoperative adjuvant radiotherapy in terms of reduced locoregional recurrence rates for low- or intermediate-risk cases (T1-2 N+ or T3N0) with a significant radiotherapeutic toxicity regardless of age.

This effect can be compounded with the addition of preoperative chemoradiotherapy when there is a definitive plan for sphincter preservation. Although there clearly is a distinct "anterior resection syndrome" with some reported improvement of incontinence over time, persistent (sometimes disabling) symptoms after low coloanal anastomosis will have a cumulative effect on quality of life; an effect typically amplified in elderly cases. The utilization of a neorectal reservoir has complex effects on function but most studies show little reported functional advantage over straight coloanal or reservoir anastomosis necessitating our approach towards the construction of either a coloplasty or by a wholly abdominal side-to-end anastomosis where feasible; both options which could be of advantage in the narrow pelvis or where sufficient anastomotic tension is avoided.

**SUMMARY**

**FUNCTIONAL OUTCOME FOLLOWING RESTORATIVE RECTAL CANCER SURGERY**

Trend preoperative adjuvantne i neoadjuvantne terapije kod odredjenih pacijenata sa karcinomom rek- tuma se kreće ka češćem očuvanju sfinktera, ali uz nedovoljno razumevanje faktora koji doprinose lošim funkcionalnim rezultatima. Podaci treba da ukažu na potrebu za selektivnijom upotrebom standardnog radioterapeutetskog polja kod nisko- i srednje rizičnih slučajeva gde se čini da postoji mali efekat u smislu boljeg preživljavanja i manjeg broja lokalnih recidiva, gde se na toksičnost terapije ne obraća pažnja. Ovaj rad razmatra kompleksne faktore koji utiču na funkcionalni ishod klasične operacije karcinoma rectum, posebno ako je praćena adjuvantnom terapijom.

Ključne reči: karcinoma rectum, neodjuvantna terapija, neorektalni rezervoar

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