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Review Article

Functional Outcome and Evaluation After Open Rectal Cancer Surgery

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Introduction

In seeking sphincter preservation in low rectal cancer, surgeons have used preoperative high-resolution, fine-slice magnetic resonance imaging to define those patients better suited to neoadjuvant therapy,[1,2] the formation of innovative neorectal reservoirs,[3] extended lymphadenectomy,[4] laparoscopic-assisted resections,[5] tranasanal endoscopic microsurgical technology[6] and total anorectal reconstruction[7] to provide a functionally efficient and competent natural evacuation for their patients. Given our relatively poor understanding of rectal tumor biology,[8] there is considerable evidence to demonstrate that surgeon-related variables are currently of paramount importance in the main cancer-specific outcome parameters, (survival and locoregional recurrence rates) as well as in patient postoperative quality of life.[9-11] This 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 rectal cancer surgery. Modern attempts which preserve the anal sphincter such as preoperative chemoradiation, neorectal reservoir construction and endoscopic local excision have particularly highlighted the importance of functional outcome and its impact on quality of life parameters in this new era.

Functional outcome following coloanal 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 frank fecal incontinence. This "low anterior resection syndrome" as it has become known, initially equated poor functional outcome after rectal resection with both manometric disappearance of the rectoanal inhibitory reflex - RAIR [12] as well as with lower level (coloanal) anastomoses.[13-14]

In the first instance, the suggestion was that manometric recovery of the RAIR, within the first 2 years after surgery, correlates with clinical improvement in function although the persistence seen by others in disturbed rectoanal inhibition and maximal tolerated volumes on rectal balloon distension has shown little correlation with reported stool frequency,[15] episodes of incontinence[16] or with anastomotic level.[17] This early literature took credence from the experience with restorative proctectomy for colitis or familial polyposis, where preservation of the anal transitional zone resulted in improved clinical function with protection of rectoanal inhibition and the anorectal sampling mechanism of the rectoanal pres-

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sure gradient.[18] 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.[19-20] This was somewhat supported by reported disturbances in the maximal resting anal pressure (MRAP) for prolonged periods as well as morphological evidence on endoanal sonography of both internal and external anal sphincter damage after the insertion of an endoanal stapler.[21-22]

Much of this data preceded the introduction of validated quality of life determinations or objective reproducible continence instruments.[23-24] Given this background, it had been suggested that the functional outcome for patients undergoing restorative low anterior resection might be aided at least in the first 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,[25] where over time it was realized that progressive reduction in the size of the pouch (to a side length of 5cm or less) prevented the problem of postoperative evacuatory difficulty and the need for anal self-intubation.[26-28] These initial randomized studies showed some improvement in early nocturnal incontinence and stool frequency as well as the need for a pad 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.[29] Most of the follow-up in these studies is relatively small[30-32] with only a few such studies being randomized or controlled and of some follow-up duration.[33-34]

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 MRAP values correlate with reported episodes of incontinence in the early postoperative period.[29, 35-36] Since there are no fundamental differences in functional outcome between pouch and no-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 are observable retrograde peristalsis and motility changes within the efferent loop of side-to-end anastomosis which would explain these clinical findings.[37] The converse appears to also be relevant for evacuatory difficulty[38] with pouches (as well as with pouch outlet ends) which actually does correlate both with pouch size and outlet spout length as well as with any segment of retained rectum above the anastomosis.[39] The issue is a little complex here, since there is only a loose correlation between pouch compliance and volume measurements with functional outcome.

The problem of frank incontinence after low coloanal anastomosis is also different, with evidence for sensory adaptation in the pouch so that progressively higher pressures occur with smaller faecal distending volumes which fail to produce urge symptoms. This represents a sensory alteration within the pouch where faecal 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.[20-21,40-41] In this respect, Farouk and colleagues have shown an 18% incidence of injury to the internal anal sphincter using an endoanal stapler with an incidence of external anal sphincter damage which was dependent upon the stapler size.[21] Much of this injury remained evident endosonographically at 2 years with similar findings reported by Ho et al.[20] where they showed a manometric effect both on MRAP and functional anal canal length which persisted at 6 months of follow-up. In this latter study, however, only 40% of the patients with endosonographically demonstrable sphincter injuries reported clinical episodes of incontinence.

The data on functional clinical outcome between stapled and hand-sewn anastomoses have been conflicting, with some studies reporting essentially unchanged or only temporarily decreased MRAP values after the stapled technique[42] whereas others have shown a sustained reduction in resting pressure values over time.[12, 15, 43-45] This effect, however, is likely to be multifactorial and may also involve the effects of attendant neuropathy.[46-47] Moreover, both short- and long-term functional outcome will also be dependent upon the anastomotic level,[17,48] gender (with males having a worse overall functional outcome) and the presence of pelvic sepsis secondary to partial anastomotic dehiscence.[49] Significant sepsis as a consequence of anastomotic separation will seriously compromise neorectal reservoir compliance.[50]

Novel techniques for neorectal reservoir reconstruction have been relatively recently introduced, including the use of a longitudinal to transverse coloplasty,[51] a side-to-end rectoanal anastomosis[52] and a low wholly transabdominal stapled side-to-end anastomosis.[53] The end-to-side anastomosis for rectal reconstruction was first proposed by Baker in 1950[54] and it may be advantageous because it is technically easier to perform, wholly

abdominal (if necessary), and there is a reduced incidence of anastomotic stricture with greater feasibility for its performance in the narrow pelvis.[55] As with the colonic J-pouch, the side-to-end anastomosis is thought to function by retroperistalsis in the side limb with segment reversal and to affect the motility of stool passage rather than function 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 more normal stool frequency and less postoperative use of anti-diarrhoeals. This is accompanied by a more rapid recovery of urge and maximal tolerable volumes to rectal distension which correlates with functional outcome. 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 6cm colonic J-pouch.[52,56] There is not much to choose between these techniques with regard to evacuation where as already stated it is more the size of the pouch that governs postoperative evacuatory difficulty[26] and there is some debate concerning the extent of upstream colonic resection and its motility effect on the anastomosis.[57] There have been few comparisons of functional or manometric outcome between pouches and the coloplasty procedure[37,58-59] where the original work on coloplasty in pigs using marker analysis showed improved colonic transit.[60] Clinical data has shown that coloplasty is associated with better evacuation than colonic J pouch and that postoperative urgency and incontinence correlates more with disturbances in pelvic floor movement on defaecography rather than on pouch size or sphincter integrity.[38]

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 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 [60]. Increased bowel clustering and defaecation frequency after RT, as well as a generally detrimental effect on reported continence have been noted[61-62] along with a differential effect on rectal reservoir function, evacuation pattern and continence.[63-65] Some of this data report small numbers and has unusually compared anorectal function in patients receiving preoperative RT with postoperative non-irradiated cases. Clearly small bowel damage will be limited by the preoperative RT approach with further avoidance of irradiation of the reconstructed rectum. In the latter circumstance, there appears to be reduced compliance and capacity in the neorectum which is irradiated in the postoperative period.[16,66]

The arguments in favor of preoperative RT strategies include an improved long-term functional outcome, improved RT tolerance, increased rates of sphincter preservation, as well as diminished acute phase enteric toxicity,[67-68] reduced locoregional recurrence[69] and possible advantageous effects on overall cancer-specific survival.[70] The push towards sphincter preservation with a general acceptance of reduced distal resection margins,[71] however, definitely results in some functional cost.[72-75] The advantages of pre- vs. postoperative RT include reduced locoregional recurrence (even with increased postoperative dosing;[69] and a short-term anorectal functional benefit with relatively late toxicity. It is little known, 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 [64]. Survival benefit with preoperative RT has been achieved in only one trial[76] and suggests a need for better patient selection.[77-79]

Locoregional recurrence reported after total mesorectal excision (TME) is about 2-7%[80] with an improvement in survival using preoperative RT as shown by a number of studies.[81-82] Some of these studies are difficult to interpret because there are different operations compared,[64] different RT protocols[83] and different timings and techniques of anorectal assessment.[64,84] In the brachytherapy approach, where RT doses are typically quite high (up to 80cGy) there are reported effects on MRAP, maximal squeeze pressure (MSP) and maximal tolerable volumes (MTV) on rectal distension; in one study by Gervaz et al.[64] comparing preoperative and postoperative RT, there was a differential effect on MRAP and RAIR (both essentially internal anal sphincter functions) but no effect on MSP, (essentially an external anal sphincter 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.

Studies have shown a minimal effect of preoperative RT in patients having a neorectal pouch despite a short-term period of nocturnal urgency in this group,[85-86] but the effects of RT are dose-dependent with a principal effect on rectal musculature, innervation[87-89] and direct effects on sphincter morphology[90] and function.[91] 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 [92-93] as well as a distinct pelvic radioneuropathy. The latter effect may occur as an isolated pudendal nerve damage[94] or as a lumbar plexopathy.[95]

The functional changes induced by RT may progress with time[96] 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[96] 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, smaller rectum after RT even in situations where anastomosis is relatively high and where there is both a normal demonstrated gastrointestinal transit and the anorectal sphincter is outside the radiation field. This implies that complex changes in the compliance, emptying and viscoelastic properties of the neorectum may clinically affect post-treatment function independently of the level of the anastomosis and of inherent sphincter damage.

The severity of post-RT changes has diminished over the past few years because of better definition of the clinical radiation target with improved dose delivery, representing a change from earlier trials where the sphincters were routinely incorporated in the irradiation field.[63] It is, however, recognized that functional damage may occur even when the sphincter is routinely excluded from the RT field, (as in the Dutch TME trial), for some of the reasons outlined above.[97]

In summary, functional outcome after TME (and ancillary therapy) depends on the quality of the primary surgery, the technique of its reconstruction and the functional state of the pelvic floor and sphincter apparatus. There clearly is a distinct "anterior resection syndrome" with a reported improvement of incontinence over time. Persistent symptoms after low coloanal anastomosis have a cumulative effect on quality of life and these effects are typically amplified in elderly cases;[98] an effect which is also dependent upon the presence of perioperative pelvic sepsis and partial anastomotic dehiscence in both straight coloanal anastomoses and pouch procedures.[37] The use of a neorectal reservoir has complex effects on function but most studies show little functional advantage over straight low anastomosis during prolonged follow-up. Early changes in resting pressures and sensory thresholds correlate with avoidance of sphincter distraction and maintenance of sphincter integrity as well as upon initial volume of the reservoir and its sensory adaptation. Later function of the reservoir is more related to the creation of an anisoperistaltic segment which acts as a brake towards forward propulsive activity and which is less reliant on reservoir capacity; a parameter which is more relevant in the prevention of both early and late postoperative evacuatory difficulty. The best compromise may possibly be represented by the coloplasty or by a wholly abdominal side-to-end anastomosis where feasible. The increasing utilization of preoperative adjuvant and neoadjuvant strategies for rectal cancer has altered our approach towards the construction of either a straight coloanal or reservoir anastomosis which is dependent upon whether the sphincter apparatus is likely to be incorporated into the radiation field. This effect is compounded by an attendant post-procedural neuropathy which may be operative[99] or as part of the effects of the radiation itself. These adverse functional results of RT are expected to diminish in the future as a result of better field orientations and improvements in dose delivery and sequencing.[100]

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