Ultra-low Anterior Resection and Coloanal Pouch Reconstruction for Carcinoma of the Distal Rectum

Facilitated by an enhanced appreciation for pelvic anatomy and physiology along with a better understanding of patterns of rectal cancer spread , great advances have been made in our ability to perform restorative resections for an ever - increasing proportion of mid and distal rectal cancers. Whereas oncologic results following a low anterior resection were the principal concern 20 years ago , recent efforts have focused on improving functional results as well. Aspirations for improved function need to be tempered by the realization that improved sphincter - saving rates must follow improved oncologic results rather than jeopardize them. Some crucial questions are addressed in this paper : What are the variables involved in optimizing the oncologic and functional results of a low anterior resection and a coloanal reconstruction? What are the issues involved in selecting a particular coloanal reconstruction (straight versus pouch , stapled versus handsewn , with or without fecal diversion) for a particular patient? Who is not a good candidate for a coloanal reconstruction?

Ultra-low Anterior Resection and Coloanal Pouch Reconstruction for Carcinoma of the Distal RectumJose G. Guillem, M.D., M.P.H. Colorectal Service, Department of Surgery, Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, New York, New York 10021, USA21n7p721World Journal of Surgery21, 7211997 Facilitated by an enhanced appreciation for pelvic anatomy and physiology along with a better understanding of patterns of rectal cancer spread , great advances have been made in our ability to perform restorative resections for an ever - increasing proportion of mid and distal rectal cancers. Whereas oncologic results following a low anterior resection were the principal concern 20 years ago , recent efforts have focused on improving functional results as well. Aspirations for improved function need to be tempered by the realization that improved sphincter - saving rates must follow improved oncologic results rather than jeopardize them. Some crucial questions are addressed in this paper : What are the variables involved in optimizing the oncologic and functional results of a low anterior resection and a coloanal reconstruction? What are the issues involved in selecting a particular coloanal reconstruction (straight versus pouch , stapled versus handsewn , with or without fecal diversion) for a particular patient? Who is not a good candidate for a coloanal reconstruction?**Low Anterior Resection and Coloanal AnastomosisOncologic Outcome**

A number of studies have compared the oncologic results of a low anterior resection (LAR) to an abdominoperineal resection (APR) (Table 1) . Although individual results vary , in summation no significant differences in rates of pelvic recurrence are noted between an APR and an LAR , particularly when 2 cm of distal margin is obtained. However , conclusions from these retrospective comparisons are limited as several studies are restricted to mid - rectal cancers [1] and others include lesions 1 to 20 cm from the anal verge [2] ; still others compare an APR to an anterior resection (AR) rather than an LAR [3 - 5] . Nevertheless , it is generally accepted that in properly selected cases the local results following a properly performed LAR are comparable to those following an APR. Similarly , several retrospective , noncomparative studies have reported local recurrence rates of 3.5% to 22.0% and 5 - year actuarial survival rates of 64% to 81% following an LAR and a coloanal anastomosis [6 - 10] .

Although restorative resection has become the preferred approach for upper and mid - rectal cancers , local recurrence rates vary considerably between 6% and 28% (Table 1) . Factors known to influence outcome include (1) tumor - specific characteristics , such as tumor differentiation , extramural penetration , and lymph node involvement [17] , distance from the anal sphincters [16] , and fixation to surrounding structures [18] ; (2) surgeon - specific characteristics , such as the ability to perform a total mesorectal excision (TME) [19 , 20] along with autonomic nerve preservation (Fig. 1) [21 , 22] , to obtain negative lateral , circumferential [23 - 26] , and distal margins of resection [27] , and to construct a tension - free , well vascularized hand - sewn or stapled anastomosis [28] ; and (3) usage of adjuvant irradiation and chemotherapy [29] .

Functional Outcome

Analogous to oncologic results , long - term functional results following an LAR and coloanal anastomosis also vary considerably from 0.3 to 15 bowel movements per day [9 , 30 , 31] . Poor function refers not only to excessive stool frequency , soiling , and urgency but to stool `` clustering , " `` fragmentation , " and incomplete evacuation [32] . Soiling may be attributable to diminished anorectal sphincter resting pressures , whereas frequency and urgency are believed to be due to diminished reservoir capacity [33 , 34] , which is directly proportional to the amount of rectum removed and the level of the anastomosis [35 , 36] .

In an effort to increase reservoir capacity , Lazorthes et al. [7] in 1986 proposed creation of a colonic reservoir in conjunction with a coloanal anastomosis constructed via a posterior transsphincteric approach. At the 1 - year follow - up , 86% of patients with a reservoir (6 - and 12 - cm stapled J - pouches) had fewer than three stools per day compared to 33% of patients without a reservoir. They noted an inverse relation between the frequency of defecation and the maximal tolerated volume of the neorectum , supporting the hypothesis that improved function was at least in part due to increased maximum tolerated volume.

Parc and coworkers utilized an 8 - cm pouch created from the mid to upper sigmoid colon [37] . Following a mucosectomy from 5 mm above the dentate line to the level of the levator - anorectal junction , the pouch was delivered into the muscular sleeve and hand - sewn to the dentate line. Three months after takedown of a temporary loop transverse colostomy , the mean number of bowel movements was 1.1 per day , although 25% of patients required a daily enema to elicit pouch evacuation of accumulated feces.

Nicholls and coworkers [38] compared the clinical and physiologic results of a straight versus a 10 - cm hand - sewn pouch created from the terminal proximal colon hand - sewn to the anal canal as described by Parks and Percy [34] . At a mean 7 months after closure of the stoma , the mean stool frequency in the pouch group was 1.4 per day. These results fared favorably compared to the straight - pouch coloanal group with a mean stool frequency of 2.3 per day at a mean follow - up of 4 years. Physiologic studies demonstrated an association between improved functional results and a significant

increase in rectal sensitivity , volume , and capacitance.

A study by Kusunoki and colleagues [39] demonstrated that creation of a 8 - to 10 - cm sigmoid colon J - pouch resulted in a significant decrease in mean stool frequency and daytime soiling particularly during the early postoperative period. Similar to other studies , improvements were thought to be due principally to increases in the maximum tolerable capacity. Because of improved results with the pouch , the trial was discontinued. Pelissier and coworkers [31] compared the functional results of patients with a colonic J - pouch stapled to the `` rectal stump '' with those of healthy nonoperated controls. Although no significant differences were noted in stool frequency and continence at a median 16 months of follow - up , approximately 50% of pouch cases experienced difficulties with complete evacuation , or `` split defecation. '' Overall , difficulties with evacuation , noted in 25% of cases [9] , have been attributed to pouches constructed from the sigmoid colon [9] and large (> 10 cm) pouches [38] .

To determine the optimal pouch size for coloanal anastomosis , Hida and colleagues [40] randomized 40 patients to either a 5 - cm J - pouch or a 10 - cm J - pouch. At 1 year after operation although the reservoir function in the 5 - cm J group was inferior , their evacuation function was superior. Overall , function was perceived as `` comparable '' in the two groups.

A study by Ho and colleagues [33] has demonstrated that decreased stool frequency with an 8 - cm J - pouch is not associated with improved rectal reservoir function , suggesting that the noted functional improvement may be due in part to reversal of propulsive movements in the J - segment. Although `` frequency '' was more common in patients with a straight anastomosis , there were fewer patients with incomplete defecation in this group. No statistical differences in rectal physiology (volume of initial sensation , maximum tolerable volume , compliance) were noted between the two groups.

Similarly , Ramirez and colleagues [41] compared functional results in 10 patients with colonic J - pouch anal anastomosis with 10 matched patients undergoing a high anterior resection. The addition of a colon J - pouch neorectum led to functional results comparable to those seen in patients with a high anastomosis and a near - intact rectum.

Hallbook and colleagues [42] randomized patients to a straight or a 6 - to 8 - cm colonic J - pouch anastomosis following an LAR. Pouch patients were noted to have a low incidence of anastomotic leakage. Although intuitively the leak rate from a multisuture line pouch anastomosis would be expected to be greater than a single suture line straight anastomosis , Doppler studies have demonstrated that the microcirculation at the apex of the pouch is better preserved than at the end of a straight colon anastomosis [43] . The overall well - being was thought to be superior for pouch patients , who had fewer bowel movements and less nocturnal evacuation , urgency , and incontinence compared to straight coloanal anastomosis patients.

Although well designed , this study assumed that all patients deemed suitable for a pouch coloanal reconstruction preoperatively would be so also at exploration. It randomized patients to a straight or pouch anastomosis preoperatively in contrast to intraoperatively after complete splenic flexure

mobilization , high inferior mesenteric artery (IMA) and inferior mesenteric vein (IMV) ligation , and determination of the adequacy of the descending colon for pouch construction and anastomosis (supple , well vascularized , and free of diverticular disease) . Such a study would have demonstrated if , given similar circumstances , a pouch truly provides superior function relative to a straight coloanal anastomosis.

Other investigators have reported similar superior postoperative function in patients undergoing pouch - anal anastomosis [44 - 46] . An analysis of functional outcome reveals overall comparable rates of urgency and incontinence 1 year after a J - pouch or straight coloanal anastomosis (Table 2) . There appears to be a uniform , significant reduction in the number of stools per day in patients with a J - pouch versus a straight coloanal anastomosis.

Preoperative Radiotherapy and Enhanced Sphincter Salvage

Several randomized studies have shown a reduction in local recurrence rate following preoperative radiotherapy (RT) compared to surgery alone [47 , 48] or surgery plus postoperative RT [49] . Although these studies did not demonstrate any survival advantage of preoperative RT , a randomized study from the Stockholm Colorectal Cancer Study Group reported not only improved locoregional control but also improved 5 - year survival rates following preoperative 2500 cGy when compared to surgery alone [50] . The survival advantage was noted only in the subset of patients who underwent a `` curative '' operation , not the entire group who underwent preoperative RT. In contrast , the Swedish Rectal Cancer Trial demonstrated improved local control as well as overall 5 - year survival for the entire irradiated group [51] .

Because the ability of preoperative RT to eradicate local disease is improved with the addition of chemotherapy (see ref. 29 for review) and the noted survival advantage of postoperative RT depends on the addition of 5 - fluorouracil (5 - FU) - based chemotherapy , preoperative RT and chemotherapy have also been used to reduce tumor burden and enable an ultra - low LAR in patients who would have otherwise undergone an APR. In the Memorial Sloan - Kettering Cancer Center (MSKCC) initial experience , preoperative 4680 cGy to the whole pelvis and 360 cGy boost to the primary tumor bed were used on patients with resectable , primary distal rectal cancers that were believed , prior to preoperative RT , to require an APR. After resection 10% were noted to have had a complete pathologic response , and 90% were able to undergo a successful coloanal reconstruction. The crude incidence of local failure was 23% , and the 4 - year actuarial survival was 61%. Eighty-nine percent had a good to excellent functional result. Similar results have been reported by Marks and colleagues [52] . Preliminary results from MSKCC using preoperative 5 - FU , low - dose leucovorin , and concurrent RT for clinically resectable rectal cancer - a regimen similar to that being used in the Intergroup 0147 Trial - demonstrated a 22% complete response rate and an 85% sphincter - saving rate with no local recurrences at a median follow - up of 22 months and a 60% actuarial 3 - year survival [53] . Preliminary results from the National Surgical Adjuvant Breast and Bowel Project Protocol (NSABP) R-03 Trial [54] using a similar preoperative combined therapy approach , also indicate an improved sphincter - saving rate. Currently , the standard adjuvant therapy for T3 or higher lesions and N1 rectal cancers is combined pelvic RT and 5 - FU-based chemotherapy [55] .

As the optimal roles of irradiation and chemotherapy for rectal cancer are defined , it is important to emphasize that preoperative RT enhances the likelihood of performing a sphincter - sparing ultra - low LAR by tumor bulk reduction and not by increasing the distal margin of clearance. If distal surgical margins are in fact thought to be inadequate prior to RT , sphincter preservation should be aborted regardless of an enhanced distal margin after RT , as we are currently unable to distinguish reliably between post - RT residual cancer and RT fibrosis. This point is of particular importance with poorly differentiated lesions , which are more likely to have greater distal mural spread [27] .

A J - pouch coloanal anastomosis should not be abandoned simply because the patient will likely require postoperative RT , as J - pouch patients who receive postoperative chemotherapy , RT , or both continue to have superior function compared to patients with a straight coloanal anastomosis. However , if T3 or N1 disease is documented , RT / chemotherapy should be given preoperatively. A clear advantage of preoperative RT is that most if not all of the neorectum is usually not irradiated , and therefore function is less likely to be affected [49] .

Type of Reconstruction

The straight double - stapled technique is the most common type of anastomosis following an LAR. Great caution must be exercised when performing a low stapled anastomosis , as anastomotic leaks may be both technical and physiologic in origin.

After transection of the `` surgically created '' lateral stalks and accompanying branches of the middle hemorrhoidal arteries , perfusion of the distal half of the anastomoses , principally via the inferior hemorrhoidal arteries , should increase with lower anastomoses that approach the inferior hemorrhoidal arteries. Therefore although oncologic principles require only 2 cm of distal margin of clearance , to ensure perfusion of the distal half of the anastomoses following a total mesorectal excision (TME) , the rectum should be transected at the inferior - most border of the mesorectum. This usually results in a 2 cm muscular tube adequate for an ultra - low colorectal anastomosis or a coloanal anastomosis.

Increased leak rates with low stapled anastomoses may be due to tension at the anastomoses. To reduce the likelihood of this problem , full splenic flexure mobilization along with a high IMA (proximal to the takeoff of the left colic artery) and IMV (high at the inferior border of the pancreas) ligations are essential. Sacralization of the neorectum in a tension - free manner is thus ensured. Care must be exercised when tailoring the length of bowel used for sacralization , as redundant colonic loops proximal to the anastomoses are likely to lead to problems of angulation and incomplete evacuation. If the descending rather than the sigmoid colon is used for anastomoses , redundancy is less likely and evacuation is improved , as transverse or descending colonic pouches appear to be more compliant than those created from a muscular , spastic sigmoid colon [9 , 33] . Furthermore , a fatty sigmoid mesentery may occupy a significant proportion of a narrow pelvis , thereby limiting subsequent pouch expansion. This point is important to remember when operating on individuals with significant mesenteric fat , since a capacious , supple descending pouch may also be fraught with limited expansion , limited

compliance , and ultimately evacuation problems when placed in a narrow pelvis. These individuals are probably best managed with a straight rather than a J - pouch coloanal anastomosis.

As with ilioanal pouch reconstructions , it is sometimes difficult , particularly in a narrow , deep male pelvis , to get a wide enough (55 - 60 mm) vertical linear stapler down to the appropriate level to ensure an adequate distal surgical margin. In these cases , although it is possible to place a narrower (30 mm) stapler in the pelvis , the distal rectum at the anorectal ring sometimes remains wider than 30 mm and therefore is not likely to be encompassed by a 30 - mm staple line. In these circumstances , a distal mucosectomy along with a hand - sewn coloanal reconstruction within the anal canal is indicated before resorting to an APR or persisting with a stapled approach likely to yield an inadequate distal margin or a tenuous anastomosis. An alternative of course is to transect above the anorectal ring and purse - string suture the anorectal stump. In difficult cases (narrow , deep pelvis with a large prostate) a transabdominal approach may not be feasible. A perianal anastomosis to the apex of the anorectal ring , although technically feasible , requires undue sphincter stretch , particularly in a male patient with a long anorectal canal. Hence a `` sleeve - like " anastomosis within the anal canal following distal mucosectomy , as originally described by Parks and Percy [34] , is less likely to lead to major sphincter stretch and anastomotic complications when compared to a straight end - to - end anastomosis to the apex of the anorectal ring. It must be emphasized that the purpose of the distal mucosectomy in the case of sphincter preservation for rectal cancer is to facilitate an intracanal anastomosis rather than to remove potentially premalignant anal mucosa , as done during pouch surgery for ulcerative colitis and familial adenomatous polyposis cases. Therefore the mucosectomy does not need to include the anal transitional zone nor does the coloanal anastomosis need to be to the dentate line. Determination of an adequate distal margin must be full - thickness rather than mucosa - submucosa alone.

The length of the surgical anal canal (defined from the anorectal ring to the anal verge) varies from 3.0 to 5.3 cm and is longer in men than in women [56] . In addition to gender differences , racial differences are well recognized. In a series from Japan the mean length of the internal anal sphincter was 3.1 cm [57] . Manometrically determined sphincter lengths at the Lahey Clinic on healthy volunteers ranged from 3.6 to 5.8 cm at rest and from 3.7 to 7.2 cm at squeeze , with men on average having longer sphincters (John Coller , personal communication) . It is important to recognize this point when describing the location of a lesion relative to the anal verge. Clearly , a lesion located 6 cm from the anal verge is amenable to an LAR and a coloanal reconstruction in a woman with a 3 - cm surgical anal canal , whereas the same lesion at the same distance from the anal verge in a man with a 5 cm surgical anal canal could not be resected without accepting less than a 2 cm distal margin of resection. Therefore preoperative determination of sphincter preservation is most accurately determined by measuring the distance at rest and following squeeze between the inferiormost border of the lesion and the superiormost border of the anorectal ring.

Selective Approach to Fecal Diversion

In the original series on LAR and J - pouch coloanal anastomosis [7 , 37 , 38] , a diverting colostomy was routinely performed for fear of anastomotic disruption , pelvic sepsis , and subsequent poor function secondary to pouch fibrosis , rigidity , and noncompliance. In carefully selected cases , a coloanal J -

pouch anastomosis may not require fecal diversion. In Cohen's series , although 21 of 23 patients did not require a diverting colostomy [58] , there were no pouch or coloanal anastomotic leaks. A report on 30 consecutive stapled colonic J - pouch anal anastomoses without a diverting colostomy noted two (6.7%) leaks , which were managed successfully via right lateral transverse abdominal incisions [59] . Therefore although fecal diversion does not appear to be necessary in all cases , careful patient selection is required. To divert chemotherapy - related liquid stools and reduce the likelihood of perianal excoriation and suppurative disease , as well as allow time for the sphincter apparatus to regain strength , elderly patients scheduled to undergo postoperative chemotherapy for nodal disease are likely to benefit from fecal diversion.

Contraindications to Coloanal Anastomosis

Although distal rectal cancers can be oncologically managed with a total mesorectal and total rectal excision , not every patient is suitable for coloanal reconstruction. Clearly , diminished preoperative anal tone and squeeze are unlikely to improve after surgery , as sphincter function is often diminished following a double - stapled and a hand - sewn coloanal anastomosis. Therefore patients with limited preoperative sphincter function may be crippled by chronic seepage , perineal excoriation , and accidents characteristic of a `` perineal colostomy. " Although function continues to improve up to a year [34 , 38] , patients with significantly diminished preoperative sphincter function are unlikely ever to have adequate control.

Miller and coworkers have identified several parameters , including female gender , that adversely influence functional outcome after coloanal anastomosis , suggesting that careful preoperative evaluation may enhance patient selection by detecting occult sphincter damage [60] . Whether every preoperative evaluation requires manometry and endoanal ultrasonography remains to be demonstrated.

In addition to sphincter invasion , clear contraindications to a coloanal anastomosis include a bulky tumor that cannot be lifted off the pelvic floor [61] . Preoperative RT / chemotherapy tumor bulk reduction may , in these otherwise unresectable bulky cases , facilitate resection and sphincter preservation. Another current contraindication is a lesion located near the uppermost part of the anorectal ring. In carefully selected cases (well differentiated , small , mostly superficial lesions) Kusunoki and colleagues [57] resected portions of the internal sphincter in a modified anoabdominal resection and J - pouch hand - sewn coloanal anastomosis. At a mean follow - up of 27 months , there were no local recurrences , and none of the patients was incontinent. Although this series was limited to seven patients , the results suggest that although portions of the upper internal sphincter can be removed there is a functional advantage to preserving the distal components of the anal sphincter in a circumferential manner.

Resume

De meilleures connaissances sur l ' anatomie pelvienne d ' une part , et sur la physiologie , d ' autre part , combinees a une meilleure comprehension des mecanismes de la diffusion du cancer rectal , ont permis

de grands progres dans le traitement du cancer du rectum distal et moyen , notamment pour realiser de plus en plus souvent des resections anterieures avec reconstruction. Alors que les resultats carcinologiques apres resection anterieure du rectum etait le soucis principal il y a vingt ans , aujourd ' hui , l ' amelioration des resultats fonctionnels est egalement prise en consideration. Cependant , l ' espoir d ' ameliorer la fonction doit etre tempere par l ' idee directrice qu ' il ne faut pas diminuer les resultats carcinologiques pour ameliorer le taux de conservation sphincterienne a tout prix. Les questions principales abordees ici sont : quels parametres faut - il prendre en compte pour optimiser et les resultats fonctionnels et les resultats carcinologiques de la resection anterieure basse suivie d ' une reconstruction coloanale? Quel type de reconstruction coloanale doit - on preferer (anastomose coloanale avec ou sans reservoir , anastomose mecanique versus manuelle , anastomose avec ou sans colostomie de protection?) pour un patient donne? Qui est le candidat a la reconstruction coloanale?

Resumen

Gracias a un mejor conocimiento de la anatomia y la fisiologia pelvicas junto con una mejor comprension de los patrones de extension del cancer rectal , se han logrado grandes avances en cuanto a la capacidad de realizar resecciones restaurativas para un constante incremento de canceres del recto medio y distal. En tanto que los resultados oncologicos luego de una reseccion anterior baja constituyeron la preocupacion principal hace veinte an~os , ahora el esfuerzo se concentra en el mejoramiento de los resultados funcionales. Sin embargo , las aspiraciones para lograr una mejor funcion se mitigan con la comprension de que las tasas de mejor funcion esfinteriana deben ser consecuencia de mejores resultados oncologicos y que , en ningun caso , deben interferir con estos. Los principales interrogantes planteados en el presente articulo son : ? Cuales son las variables involucradas en la optimizacion tanto de los resultados oncologicos como funcionales de una reseccion anterior baja y de una reconstruccion coloanal? , ? Cuales son los elementos involucrados en la seleccion de una reconstruccion coloanal determinada (directa versus bolsa , sutura automatica versus manual , con o sin derivacion fecal) para un paciente en particular? , ? Quien no es un buen candidato para reconstruccion coloanal? .

Conclusions

Proper patient selection for a coloanal reconstruction is essential. Clearly , limited preoperative sphincter function will lead to limited postoperative bowel function following a coloanal anastomosis. Similarly , although a colonic pouch is easy to perform , it should be used selectively. Patients with a capacious descending colon and a narrow pelvis may not benefit much from a colonic pouch. However , a colonic pouch clearly would be indicated in a patient with a wide pelvis and a narrow caliber colon.

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