How I Do It

Push-Back Technique Facilitates Ultra-Low Anterior Resection without Nerve Injury in Total Mesorectal Excision for Rectal Cancer

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Abstract

Background/Aims: To describe our anal approach with the concept of a mucosal stump in lower rectal cancer surgery. ***Methods:*** After rectal mobilization using an abdominal approach, mucosal cutting is performed circumferentially at the dentate line. The mucosal stump is closed, and the internal sphincteric muscle is resected partially or totally according to tumor location. Perianal dissection is performed along the medial plane of the external sphincteric muscles, and the hiatal ligament is dissected posteriorly. To resect the entire rectum, the closed rectal stump is pushed back to the abdominal cavity using composed gauze, without injury to autonomic nerve. ***Results:*** We performed colonic J-pouch anal anastomosis using our mucosal stump concept in 58 patients with lower rectal cancer located <4cm from the anal verge. According to Wexner score, 7% of patients were fully continent, 71% had acceptable function with minor continence problems, and 13% were incontinent. No patients required intermittent self-catheterization during follow-up. After a median follow-up of 49 months, there was only one case of local recurrence after surgery. ***Conclusion:*** Our anoabdominal approach under direct vision for internal sphincter resection with a mucosal stump concept is useful for satisfactory functional and oncological results in lower rectal cancer surgery.

The main goals of surgery for rectal cancer are to optimize oncological outcome and maintain anorectal and genitourinary function. The most important advance in operative technique has been the advent of total mesorectal excision (TME), which was proposed by Heald in 1982, as the oncological procedure to achieve good control and preserve autonomic nerve function [1]. We have previously reported our restorative procedures using colonic J-pouch anal anastomosis (CAA) for lower rectal cancer [2], and recently, we have simplified the original Heald TME procedure [3]. Our procedure has three principles: posterolateral dissection, which is helpful for performing complete TME with autonomic nerve preservation; detachment of the hiatal ligament, which enables mobilization of the whole mesorectum and transection of the distal rectum just above the anal canal; and CAA to support fecal continence. Generally, the most dangerous area for nerve injury is the anterolateral aspect of the rectum because this area is likely to be a blind spot for the surgeon. The relationship of Denonvilliers' fascia to the neurovascular bundles of Walsh and the back of the prostate can be appreciated, and dissection of Denonvilliers' fascia is a crucial aspect of complete TME. In surgery for very low rectal cancer, internal sphincter resection with coloanal anastomosis has also developed for decades to avoid permanent colostomy. Internal sphincter resection now usually performed in combination with TME, but the procedure may cause high incidence of the nerve injury because of the complex anatomy in pelvis. We therefore describe our anoabdominal procedure in patients with lower rectal cancer located <4cm from the anal verge, with special reference to our mucosal stump concept facilitating a variety of alternative internal sphincter resections to balance the functional

preservation against the oncological results.

Operative Procedure

Before our anal approach, we needed to perform careful rectal mobilization via an abdominal approach. Rectal mobilization is performed down to the S4 Ievel posterolaterally and anteriorly, and the hiatal ligament that is connected to the anococcygeal raphe and our landmark of TME is shown. The hiatal ligament was first described by Shafik A [4]. The levator plate is attached to the rectum by the hiatal ligament which consists of elastic and collagen fibers originating in the fascial covering on the levator plate pelvic surface. In our procedure for anoabdominal rectal resection, perianal rectal dissection began after recognition of the hiatal ligament, which fixes the rectum posteriorly to the levator hiatus. The patient is re-placed in an exaggerated Lloyd–Davies position. The anal surgeon explored the anus with 6–8 stitch retractions. Mucosal cutting is performed circumferentially at the dentate line (Fig.1a). Appropriate mucosectomy is performed and the mucosal stump is closed with sutures. The mucosal stump is tractioned by the operator for further dissection, and the internal sphincteric muscle is exposed. We have already developed four types of internal sphincter resection: (a) partial resection of the upper internal sphincteric muscle; (b) circumferential resection of the upper internal sphincteric muscle; (c) partial preservation of the lower internal sphincteric muscle; and (d) total resection of the internal sphincteric muscle, depending on the tumor location (Fig.2) [5]. Then, the exposed internal sphincteric muscle is resected partially, or totally, according to the distance from the dentate line to the distal tumor edge

(Fig. 1b). The use of a harmonic scalpel enables this procedure to be carried out more easily compared with monopolar electrocautery. The use of a 5 mm Blade Dissecting Hook (DH105;Hthicon Endo-Surgery,Cincinnati,OH,USA) of the harmonic scalpel is more advisable for use in graduated mucosectomy. The hook blade is available for sharp dissection. The concave hook edge engages tissue to provide tension and to facilitate the coupling of the blade surface to the tissue. The outer convex surface and the large flat side of the blade can be used to apply significant pressure for coaptive coagulation. According to previous studies [6–9], nerves that should be preserved, such as the hypogastric nerve, pelvic plexus, and urogenital neurovascular bundle, including the cavernous nerve, are originated from posterior and located anterolaterally to the mesorectum, where Denonvilliers' fascia has no definable lateral edge. In our anal approach, we always keep in mind preservation of the neurovascular bundle that is located at the lateral edge of Denonvilliers' fascia, by a U-shaped cut, so named by Heald [10]. After closure of the oral rectal stump including resected internal sphincteric muscle, perianal dissection is performed along the medial plane of the external sphincteric muscles. Just above the puborectal muscle, the hiatal ligament is dissected posteriorly (Fig. 1c). The closed rectal stump is pushed back to the abdominal cavity using five pieces of composed gauze in our anoabdominal rectal resection procedure, and the muscular layer of the rectum is divided anteriorly and the composed gauze is removed (Fig. 1d).

Our anal approach under direct vision for internal sphincter resection and push back technique facilitate dissection behind Denonvilliers' fascia, without injury to the rectourethralis muscle when the tumor is non anterior. Consequently, a

reasonable preservation of neurovascular bundles is completed (Fig. 3). In cases of lower rectal cancer with anterior wall involvement, Denonvilliers' fascia needs to be resected in most cases to obtain good oncological outcomes rather than functional ones. The concept of a mucosal stump also makes it easy to shift the anterior resection line from standardized to additional partial resection of the prostate, for example in male, when direct invasion to the prostate is confirmed under direct vision, and the tumor resection would be completed by following push back technique.

Results

Between January 2000 and January 2010, we performed CAA using our anal approach based on the concept of a mucosal stump in 58 patients with rectal cancer located <4 cm from the anal verge. Patients characteristics are shown in Table 1. The mean age was 63 years old (range: 35–84 years).Thirty-eight patients (66%) were male, and 20 (34%) were female. The distribution of pathological stage according to TNM classification was 21 stage I (36%), 11 stage II (19%), 25 stage III (43%), and 1 stage IV (2%). In regard to tumor location, 20 of 58 patients (35%) had rectal cancer with mainly anterior wall involvement. Preoperative chemoradiotherapy (CRT) was given to 45/58 (78%) of the patients. Twenty-nine patients (50%) underwent CAA with anal sphincter preservation, and the other 29 (50%) underwent modified CAA with partial internal sphincter resection. All patients were underwent diverting ileostomy. The median operative time was 257 min (range: 159–459 min), and the median operative blood loss was 474 g (range: 174–891 g).

Functional results were assessed in 45 patients at 6 -12months after ileostomy closure. The other 13 of 58 patients (22%) were not underwent ileostomy closure, because of 2 anastomotic strictures, 4 pelvic fistula, 5 disease progression and 2 non-cancerous deaths. Incontinence was assessed by the continence score of Wexner [11]. According to the Wexner score, three patients (7%) were fully continent (Wexner score = 0), 32 (71%) had an acceptable function with minor continence problems (mean Wexner score = 4.5), and seven (13%) were incontinent, with a mean Wexner score of 13. There was no significant difference in the continence score between CAA patients with anal sphincter preservation (n=25, Wexner score = 5.5) and modified CAA with partial internal sphincter resection (n=20, Wexner score = 6.8). Preoperative CRT did not deteriorate the anal function of the patients significantly (34 CRT group; Wexner score = 6.3, 11 non-CRT group; Wexner score = 5.4). Urinary function was also assessed in all 58 patients. Transitory postoperative urinary dysfunction that required medical treatment (α1 adrenergic receptor antagonist and temporary catheterization) developed in two patients (3%); however, all were discharged without a urinary catheter. None of these participants required intermittent self-catheterization during the follow-up period. In addition, male sexual function outcome was assessed by questions relating to pre- and post-operative erections and ejaculations. Only 20 patients replied to the questionnaire on their sexual function, and 5 of 20 patients (25%) had either impotent or unable to ejaculate. After a median follow-up of 49 months, a total of 11 patients in our study population developed recurrence: 1 was local (2%) and 10 were distant recurrences (17%).

Discussion

We first recognized the existence of the hiatal ligament when performing endoanal mucosal proctectomy for patients with ulcerative colitis or familial adenomatous polyposis in the late 1980s. The hiatal ligament spans the edges of the levator hiatus and the intrahiatal viscera, and fixes the rectum posteriorly to the top of the anal canal. We observed that the anterior distal rectum moves upward after perianal detachment of the hiatal ligament. We also transect the distal rectum or internal sphincter perianally in anoabdominal rectal resection for extremely low-lying rectal cancer, to keep a precise safety margin from the distal tumor edge. In the 1990s, we devised an original push back method using composed gauze for graduated mucosectomy for ulcerative colitis or familial adenomatous polyposis [12]. These experiences have been developed into our modified TME procedure with a variety of alternative internal sphincter resection for extremely low-lying rectal cancer.

Dissection of Denonvilliers' fascia is a crucial aspect of complete TME. Until recently, however, there has been some controversy as to whether Denonvilliers' fascia lies anteriorly or posteriorly to the fascia propria during anterior rectal dissection in TME. Heald has advocated that optimal TME for rectal cancer is by dissection in front of Denonvilliers' fascia [9], whereas Lindsey and Mortensen have recommended dissection behind, rather than in front of Denonvilliers' fascia to preserve all autonomic nerves [13]. There is also some argument about anterior dissection for rectal cancer in Japan. Kinugasa et al. have suggested that optimal TME requires dissection behind Denonvilliers'

fascia, based on their histological study of cadaveric specimens [14]. Kusunoki et al. also have recommended operating behind Denonvilliers' fascia to preserve the neurovascular bundles in their modification of TME, except in cases of lower rectal cancer with anterior wall involvement [3].

To resolve the issue, recent attention has focused on the rectourethralis muscle, which is a mass of smooth muscle that occupies the levator hiatus. The rectourethralis muscle arises deep within the substance of the smooth muscle of the rectal wall as two lateral arms which fuse in the midle and insert into the perineal body [15]. Tanaka et al. have described that, in men, the cavernous nerve perforates the rectourethralis muscle to enter the penile hilum, and takes various courses such as frontal, sagittal or horizontal. Moreover, the nerve sometimes takes a long tortuous course across the rectourethralis muscle [16]. Uchimoto et al., in a histological study using cadaveric specimens, also have demonstrated that the rectal muscularis propria communicates with the rectourethralis muscle, and Denonvilliers' fascia extending along the long course immediately behind the prostatic capsule in addition to the seminal vesicle ends at the rectourethralis muscle. They have recommended TME behind Denonvilliers' fascia to avoid excess invasion into the rectourethralis muscle, when the tumor is non anterior [17]. In our anal procedure, except in cases of lower rectal cancer with anterior wall involvement, the anterior membrane of Denonvilliers' fascia is preserved, in order to preserve the neurovascular bundles and give better postoperative function. When the tumor is anterior of the rectum, our anal procedure would be also useful for a precise safety margin from the tumor under direct vision, although Denovillier's fascia would be resected. In

other words, our procedure is characteristics in that the concept of mucosal stump has advantages of both nerve and sphincter preservation with a precise safety margin from the tumor in extremely low-lying rectal cancer.

In conclusion, the rectal mobilization method in our procedure enables us to perform perfect TME that is both easy and fast. Furthermore, the concept of a mucosal stump facilitate a variety of alternative internal sphincter resections with good functional and oncological outcomes in lower rectal cancer surgery.

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Figure Legends

Fig.1. Photographs showing the anal approach. a. After saline containing adrenalin was injected under the mucosa, mucosal cutting is performed circumferentially at the dentate line by using the Dissecting Hook of the harmonic scalpel. b.The arrow shows exposure of the internal sphincteric muscle. The internal sphincteric muscle is resected partially or totally by using the harmonic scalpel. c. Hiatal ligament before being divided, as shown by the dotted lines. d. The closed rectal stump is pushed back to the abdominal cavity using five pieces of gauze. Then the muscular layer of the rectum is divided anteriorly, and the composed gauze can be identified easily.

Fig.2.Scheme shows our four types of internal sphincter resection: (a) partial

resection of the upper internal sphincteric muscle; (b) circumferential resection of the upper internal sphincteric muscle; (c) partial preservation of the lower internal sphincteric muscle; and (d) total resection of the internal sphincteric muscle.

Fig. 3. Scheme showing our push back technique in CAA for lower rectal cancer. The dotted line shows our resection line. The closed rectal stump is pushed back to the abdominal cavity using composed gauze. Our push back technique facilitates dissection behind Denonvilliers' fascia without injury to the rectourethralis muscle.

Table 1. Clinical characteristics of patients

Age	
Mean age	63
Range	35–84
Gender	Number of patients (%)
Male	38(66)
Femal	20(34)
Pathological TNM stage	
I	21(36)
II	11(19)
III	25(43)
IV	1(2)
Tumor location	
(Anterior wall involvement)	
Yes	20(35)
No	38(65)
Preoperative chemoradiotherapy	
Yes	45(78)
No	13(22)
Postoperative chemotherapy	
Yes	47(81)
No	11(19)
Internal sphincter resection	
Yes	29(50)
No	29(50)
Diverting ileostomy	
Yes	58(100)