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Nerve-sparing Surgery with Lateral Node Dissection for Advanced Lower Rectal Cancer

Y. Moriya, K. Sugihara, T. Akasu and S. Fujita

133 patients who underwent nerve-sparing surgery with lateral dissection for lower rectal cancer were analysed for survival and functional results, operative burdens, and modes of recurrence. In 84% of patients an acceptable urinary function was preserved. Operative time averaged 334 min, and blood loss averaged 935 ml. The 5-year survival rate was 67% in all patients, and 88% for Dukes' A, 74% for Dukes' B and 59% for Dukes' C. According to the number of positive nodes, the 5-year survival rate comprised 83% of patients with up to three nodes, and 34% of those with more than four nodes. Local recurrent rates were 2.7% in patients with Dukes' B and 13% with Dukes' C. At present, pelvic nerve-sparing procedures with lateral dissection is the most promising surgery, guaranteeing both adequate lymphadenectomy and preservation of urinary function.

Key words: nerve-sparing surgery for rectal cancer, lateral node dissection, urinary and sexual dysfunction, survival rate after nerve-sparing surgery

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INTRODUCTION

THE WIDESPREAD application of extended lymphadenectomy in Japan from the 1970s to early in the 1980s has achieved good survival rates in the treatment of advanced rectal cancer [1]. In contrast, extended resection resulted in many urinary and sexual dysfunctions. During this time, the development of a nerve-sparing operation gradually evolved because of the elucidation of the growth pattern of rectal cancer, especially in lateral spread, and the progress in both imaging diagnosis and surgical neuro-anatomy. Consequently, in Japan, our new nerve-sparing surgery has been developed and refined since the mid-1980s [2]. In this paper, patients who received nerve-sparing surgery have been analysed for operative burdens, survival and functional results and modes of recurrence.

PATIENTS AND METHODS

From 1975 to 1992, 542 patients with invasive rectal cancer below the peritoneal reflection received curative surgery. Of these, 139 patients underwent limited surgery. The remaining 403 comprised 270 patients who received extended surgery and 133 patients who received nerve-sparing surgery with lateral dissection (NSLD). In this paper, these 133 patients are analysed (Table 1). When comparison with other procedures was necessary, data from both the extended and limited group were collated. The overall incidence of postoperative death was zero. Disease-free survival rates were calculated by the Kaplan–Meier method, and survival difference assessed by the generalised Wilcoxon test. With respect to urinary disturbances, 105 male patients were contacted personally in clinics and questioned. Urinary disturbances were classified as four symptom types;

lowered sensation, prolongation of voiding time, residual urine after voiding in male, and intermittent self-catheterisation as the most serious urinary disturbance. Using the combination of these categories, the judgment of urinary function was made as follows: excellent, good, fair and poor. Ejaculation and erection in 61 male patients who had had normal sexual function before surgery were also investigated.

Techniques of nerve-sparing operation with lateral dissection

According to denervation of the autonomic nerve, nerve-sparing procedures were distinguished as three types: (a) total autonomic nerve preservation; (b) complete preservation; and (c) partial preservation of the pelvic nerve with lateral dissection (Figure 1) [2]. In our opinion, procedure (a) should be applied to patients with Dukes' A tumour, procedure (b) for patients with Dukes' B; and procedure (c) for patients with Dukes' C, on the basis of findings from endorectal ultrasonography.

NSLD

Cutting the lateral ligament of the rectum, which mainly consists of autonomic nerves, is the most intense phase during our nerve-sparing technique. The dissection should start along the internal iliac vessels, downward to the middle rectal artery, while removing the lymphatic tissue covering them. By meticulous sharp cuts of fascia on the piriformis muscle, we are able to expose the root of pelvic nerves. While preserving the pelvic nerve, lateral dissection is performed (Figure 2).

RESULTS

Chronological change of operative procedures

Extended lymphadenectomy was the most commonly used procedure before 1986. However, since then NSLD has become the main form of surgery, and from 1990 onwards limited surgery has been on the increase.

Correspondence to Y. Moriya.

All authors are at the Department of Surgery, National Cancer Center, 1-1 Tsukiji 5-chome, Chuo-ku, Tokyo, Japan.

Table 1. Patients' characteristics by type of operation

Lower rectal cancer	Age	M/F ratio	Miles/SSP	Mortality
Curative resection with lateral dissection				
Extended (n = 270)	55	1.47	1.9	1 (0.4%)
Nerve-sparing (n = 133)	57	1.70	1.1	0
Curative resection without lateral dissection				
Limited (n = 139)	61	1.72	0.47	1 (0.7%)

SSP, sphincter-saving procedure.

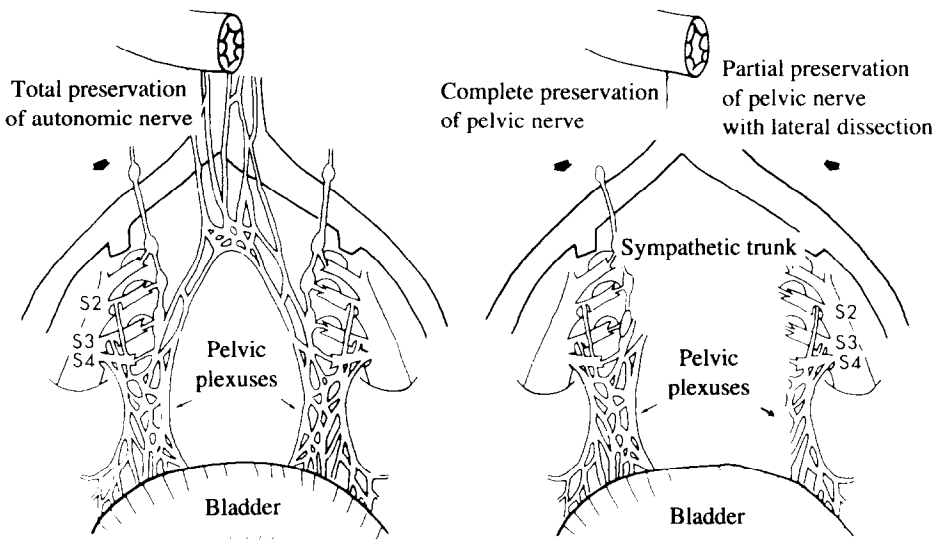


Figure 1. Types of nerve-sparing operation.



Figure 2. Completed NSLD.

Operative burdens (Table 2)

The operative time for patients who underwent NSLD averaged 334 min and the blood loss averaged 935 ml. Although blood loss was much less than that encountered with extended surgery, there were no significant differences in terms of operative time between the nerve-sparing and extended groups. Compared with limited surgery, operative time in patients who

Table 2. Operative time and blood loss

		Average	Mean
Operative time (min)			
Extended with LND	(n = 270)	359	330
Nerve-sparing with LND	(n = 133)	334**	325**
Limited without LND	(n = 139)	260**	256**
Blood loss (ml)			
Extended with LND	(n = 270)	1743*	1400*
Nerve-sparing with LND	(n = 133)	935*	741*
Limited without LND	(n = 139)	842	603

LND: lateral node dissection. * $P < 0.01$, ** $P < 0.05$.

underwent NSLD was much longer, but there was no significant difference in blood loss.

Functional results (Tables 3, 4)

Voiding function. Based on the four criteria for voiding function, 84% of male patients had an acceptable urinary function after surgery. However, in proportion to the decreasing degree of preserved pelvic nerve, the ratio of "fair" increased, amounting to 36% in patients who underwent the unilateral partial preservation of the pelvic nerve.

Table 3. Urinary disturbance after nerve-sparing operation

	Total (%) (n = 105)	Type of nerve-sparing		
		Hypogastric and pelvic N (%) (n = 49)	Bilateral pelvic N (%) (n = 28)	Unilateral pelvic N (%) (n = 28)
Excellent	29 (28)	20 (41)	8 (29)	1 (4)
Good	59 (56)	28 (57)	15 (54)	16 (57)
Fair	15 (14)	1 (2)	4 (14)	10 (36)
Poor	2 (2)		1 (4)	1 (4)

N, nerve.

Table 4. Sexual disturbance after nerve-sparing operation

	Preservation of total autonomic nerves (%) (n = 31)	Resection of hypogastric nerve and preservation of pelvic nerve	
		Bilateral (%) (n = 19)	Unilateral (%) (n = 11)
Ejaculation	21 (68)	2 (11)	—
No ejaculation	10 (32)	17 (89)	11 (100)
Erection	28 (90)	6 (32)	3 (27)
No erection	3 (10)	13 (68)	9 (82)

Sexual function. Of 31 patients in the group who had total preservation of the autonomic nerve, 10 were unable to ejaculate, and only 3 were incapable of erection. From the data, it can be seen that the total nerve-sparing operation can preserve both

ejaculation and erection in male patients. In contrast, almost all the patients who received only preservation of the pelvic nerve with resection of sympathetic nerves were subsequently incapable of ejaculation. Around 30% of patients had some erection function.

Table 5. Disease-free 5-year survival rate according to Dukes' classification and number of nodes metastasis

	Percentage	
	Extended	Nerve-sparing
Dukes' A	100 (n = 35)	88 (n = 21)
B	83 (n = 103)	74 (n = 37)
C	46 (n = 132)	59 (n = 75)
Positive node		
≤ Three	63 (n = 70)	83 (n = 51)
≥ Four	28 (n = 62)*	34 (n = 25)**

* $P < 0.05$, ** $P < 0.01$.

Disease-free survival (Table 5)

The disease-free 5-year survival rate was 67% in all patients who underwent NSLD. According to Dukes' classification, the disease-free 5-year survival rates were 88% for Dukes' A, 74% for Dukes' B, and 59% for Dukes' C. These survival results are similar to those of the extended group. Subsequently, survival rates were analysed on the basis of number of positive lymph nodes. Disease-free 5-year survival rates were 83% in patients with up to three positive nodes, and 34% in those with more than four nodes ($P < 0.01$) who received NSLD.

Mode of recurrence (Table 6)

Sites of recurrence in patients with Dukes' B and C tumours were investigated. Overall, the recurrence rate in patients who

Table 6. Mode of recurrence

		Local (%)	Distant (%)	Total (%)
Extended	(n = 270)	38 (14)	47 (17)	85 (32)
Dukes' B	(n = 103)	3 (2.9)	13 (13)	16 (16)
Dukes' C	(n = 132)	34 (26)	34 (26)	68 (52)
Nerve-sparing	(n = 133)	11 (8.2)	23 (17)	34 (26)
Dukes' B	(n = 37)	1 (2.7)	6 (16)	7 (19)
Dukes' C	(n = 75)	10 (13)	15 (20)	25 (33)

received NSLD was 26%; local recurrence was 2.7% for Dukes' B and 13% for Dukes' C. Recurrence rates in the extended group were higher both locally and distant compared to those in the nerve-sparing group due to selection bias.

DISCUSSION

Over the last three decades, the overall survival rate of patients with rectal cancer has remained unchanged in Western countries, except for a slight improvement in some adjuvant trials. However, since the early 1980s, data from Japan on extended lymphadenectomy in the treatment of advanced rectal cancer have shown survival improvement [1]. However, urinary and sexual dysfunction were recognised as serious drawbacks that accompanied lymphadenectomy. As such, Japanese surgeons have endeavoured to produce better techniques to prevent these functional disturbances, and the result has been nerve-sparing procedures for rectal cancer.

Although, in the early 1950s, Sauer and Bacon [3] and Stearns and Deddish [4], reported the importance of lymphadenectomy for rectal cancer, the end results of their trials showed few survival benefits. Thereafter, the concept of wide lymphadenectomy for the treatment of rectal cancer was somewhat discounted.

Although there is immense variation in the literature of the incidence of urinary dysfunction, there has been no report concerning this following nerve-sparing surgery for rectal cancer. In our study, patients who received total nerve preservation and/or complete preservation of the pelvic nerve had very few urinary disturbances. Although urinary dysfunction could develop after NSLD, voiding functions were much better than those obtained following extended lymphadenectomy. The neuro-anatomical investigation by Smith and Ballantyne [5] demonstrated that the main trunks of the nerves to the bladder lie in the outer layer of the pelvic nerve plexuses. Consequently, nerves directly related to urinary function can be clearly seen and safely preserved if an adequate cutting plane is maintained. The possibility of injuring the autonomic nervous system accidentally during rectal excision is drastically reduced with the newly developed nerve-sparing procedures.

Male sexual dysfunction seems to be dependent on damage to the autonomic nervous system [6]. Therefore, the dissection

plane should be kept beneath the mesorectum under direct vision of the hypogastric nerve to preserve ejaculation capability. Only a few male patients had preserved erection ability as a result of NSLD, which was insufficient for intercourse.

Hence, in our opinion, NSLD is a most promising compromise between adequate lymphadenectomy and preservation of urinary function. The total preservation of the autonomic nervous system, however, is certainly essential to maintain pre-operative sexual function. However, interrelationships between neural injury and sexual disturbance in female patients still remains an unsolved question. The solution to this problem must be examined in the future.

Heald and Ryall [7] have stressed the importance of total mesorectal excision, and this type of resection has also been successfully performed, even with our total preservation of autonomic nerves. With NSLD, we are in the position to obtain excellent survival results and relatively well-preserved urinary function. Survival results in patients with more than four positive nodes, however, were poor. Consequently, adjuvant chemo-radiotherapy should be offered to such patients.

Our current policy tends towards aggressive application of various nerve-sparing operations to patients with lower advanced cancer, in accordance with the type of cancer spread on the basis of pre-operative imaging diagnosis.

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