

PELVIC AUTONOMIC NERVE
PRESERVATION FOR PATIENTS WITH
CARCINOMA OF THE RECTUM

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ABSTRACT

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The median follow-up of 35 months in patients who were treated with pelvic autonomic nerve preservation (PAMP) developed in 17 of patients no local recurrence was observed. In Duke's A and B patients the 5-year survival rates of patients with Types A and B were 93% and 81% respectively. Of patients with Type C, 20.7% maintained the ability of anal sphincter control. In patients with Type I PAMP, 63% maintained male sexual function and 63% maintained female sexual function. In Type II PAMP, 96.7% were capable of erection and intercourse.

Early stage rectal carcinoma should be treated aiming to both local cure and complete preservation of urinary and sexual function. In high risk patients, an appropriate PAMP should be applied with consideration of the balance between achieving a cure and preserving autonomic function.

Introduction

Conventional surgical treatment of rectal carcinoma is difficult due

to the high local recurrence rate, gonorrhinary dysfunction and loss of anal sphincter function⁽¹⁾. Although the introduction of coloproctology

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ABSTRACT

Serious problems in the surgical treatment of patients with rectal carcinoma are local failure and urinary and sexual dysfunction. To resolve these problems, pelvic autonomic nerve preservation (PANP) combined with lateral lymph node dissection has been introduced.

This study included 104 patients with middle or low rectal carcinoma who underwent potentially curative surgery between 1988-1994. Ninety-four patients underwent PANP according to pre-and intraoperative staging. PANP was evaluated from the perspectives of oncologic outcome and urinary and male sexual function.

During the median follow-up of 55 months, local recurrence developed in 5.8% of patients; no local recurrence was observed in Dukes A nor Dukes B patients. The 5-year survival rates of Dukes A, B and C were 93%, 81% and 65% respectively. Of patients with type III PANP, 80.3% maintained the ability to void spontaneously. Of patients with type I PANP, 65% maintained male sexual function and of patients with type II PANP, 66.7% were capable of erection and intercourse without normal ejaculation.

Early stage rectal carcinoma should be treated aiming to both local cure and complete preservation of urinary and sexual function. In high risk patients, the appropriate PANP should be applied with consideration of the balance between achieving a cure and preserving autonomic function.

Introduction

Conventional surgical treatment of rectal carcinoma is difficult due

to the high local recurrence rate, genitourinary dysfunction and loss of anal sphincter function⁽⁵⁾. Although the introduction of coloanal

anastomosis and stapled anastomosis has increased the rate of sphincter saving procedures for patients with middle and low rectal carcinoma, local recurrence, urinary and sexual dysfunction are still serious problems⁽²²⁾. This continuing difficulty may be due to two anatomic conditions. First, there are two pathways for lymphatic drainage of the middle and low rectum, superior lymphatic drainage and lateral lymphatic drainage⁽¹²⁾. Second the genitourinary organs are located adjacent to the rectum and the autonomic nerves supplying these organs run along the rectum⁽¹³⁾. Extended lymph node dissection aimed at the radical removal of the two lymphatic pathways, have shown improved survival rates and a reduced local recurrence rate compared with the conventional surgery⁽¹⁷⁾. Despite these improvements, a high incidence of urinary and male sexual dysfunction continues to be a serious problem⁽⁹⁾.

The main causes of urinary and sexual dysfunction after rectal surgery may be the intentional sacrifice and/or accidental injury of the autonomic nerves supplying the genitourinary organs. Based on the accumulated experience with PANP and the introduction of endorectal ultrasonography (EUS) and pelvic computed tomography (CT), criteria for PANP were determined in 1987⁽⁸⁾. In this study PANP performed according to pre-and intraoperative

staging, was evaluated from the perspective of oncologic and functional outcome.

Material and Methods

Basic data for determining criteria for PANP :

Risk of lateral lymph node metastasis. Extended lymph node dissection of the pelvic cavity including lateral lymph node dissection for patients with middle and low rectal carcinomas results in sacrifice of the pelvic autonomic nerves⁽¹⁵⁾. To clarify the indication for lateral-lymph node dissection, risk factors for lateral lymph node metastasis were studied⁽¹⁰⁾. These factors include the site of the tumor whether above (Ra) or below (Rb) the peritoneal reflection, the depth of invasion whether confined to the wall (Ta) or passed through it (Tb) and the perirectal lymph node either negative (N1-) or positive (N1+). Lateral lymph node dissection was indicated when perirectal lymph node swelling or invasion into the perirectal fat through the rectal wall were suspected by EUS and/or CT.

Classification of PANP :

PANP was classified into four types⁽⁹⁾. In type I PANP all the components of the pelvic autonomic nerve system were preserved, the mesorectum was excised and lateral lymph node dissection was not performed. In type II PANP, lymph node dissection was performed

around the aortic bifercation and the common and internal iliac vessels. On the contralateral pelvic side wall of tumors in type III and on both pelvic side walls in type IV, lymph node dissection was performed around the common iliac and internal iliac vessels and within the obturator space⁽²¹⁾.

Care must be taken in the perineal approach in abdominoperineal resection to avoid injury of the neurovascular bundle on the posterior surface of the prostate to maintain male sexual function⁽¹³⁾

Indications of PANP :

Type I PANP was applied when the tumor was confined to the bowel wall and there is no perirectal lymph node. Type II PANP was indicated for Ra tumors that penetrated the rectal wall or with suspected lymph node metastasis. Type III was performed for Rb tumors that penetrated the rectal wall or with suspected lymph node metastasis, but that did not involve both sides of the rectal wall. The pelvic nerve plexus on the uninvolved side was preserved. In annular Rb tumors that penetrated the rectal wall or with lymph node metastasis, bilateral lymph node dissection was performed (type IV PANP).

Patients :

Between March 1988 and June 1994, 104 consecutive patients un-

derwent potentially curative surgery for middle or low rectal carcinoma at the Surgical Oncology Unit, Mansoura University Hospital. The functional studies comprised 94 patients with exclusion of ten patients: 5 who underwent other types of PANP than types I, II, III and IV PANP, and five who underwent additional pelvic surgery, due to prolonged septic complications. Assessment before operations included digital examination, barium enema, colonoscopy and biopsy, for histopathological examination, EUS and/or CT. Also, carcinoembryonic antigen (CEA) assay and the routine laboratory investigations, were done. Non of the patients who were included in this study received adjuvant radiotherapy or chemotherapy.

Oncologic outcome :

For detection of metastasis or local recurrence, patients were followed-up by physical examination, CEA assay, ultrasonography, chest x-ray, CT and/or magnetic resonance. Also colonoscopy or barium enema were performed.

Functional outcome:

The patients records were reviewed for urinary function at discharge, at 6 months and at 12 months after surgery. Urinary function was classified into two categories : a spontaneous voiding group and a self catheterization one. Male sexual function was evaluated in pa-

tients who were younger than 66 years of age at surgery and were confirmed to be disease free. The patient was asked about preoperative and postoperative (more than one year after surgery) sexual activity, which was evaluated in terms of libido, erectile potency, sexual intercourse and ejaculation.

The survival rate was estimated by the Kaplan-Meier method and the statistical significance of the differences in the survival curves was determined using the long rank test. Independent individual variables were evaluated by the Chi-square test or Fisher's exact test.

RESULTS

Patients Data :

This study comprised 68 males and 36 females with an average age of 54.6 years (range 19 to 72 years). Anterior resection (AR) with sphincter saving procedure was performed in 62 patients (59.6%; 32 of 34 Ra tumors [94.1%] and 30 of 70 Rb tumors [42.9%]). Abdominoperineal resection (APR) was performed in 39 patients (37.5%), and Hartmann's procedure was done in 3 patients (2.9%). The surgical procedure and type of PANP are shown in (table 1). Types I, II, III and IV PANP were performed in 37 (35.6%), 24 (23%), 24 (23%) and 14 (13.4%) patients respectively. Of the 27 patients with Dukes stage A, 74% underwent type I PANP, and

of the 34 patients with Ra tumors 28 (82.3%) underwent type I or II PANP (Table 1).

Oncologic Data (Tables 2, 3) :

During the median follow-up period of 55 months, recurrent diseases were found in 27 patients (26%). The recurrence rate increased with the Dukes stage ($P < 0.001$): 3.7% in Dukes A, 20.6% in Dukes B and 44.2% in Dukes C (Table 2). Recurrent tumors of the pelvic cavity (local recurrence) developed in 6 patients (5.8%), all of whom were Dukes C (14% of the patients with Dukes C). No differences were observed among the types of PANP in either the rate or the site of recurrence (Table 3). In the patients with local recurrence there were no tumors near the preserved nerves.

The 5-year survival rates of patients with Dukes A, B and C were 93%, 81%, and 65.1% respectively (Fig. 1). There are statistically significant differences between the survival rates of patients with Dukes A and Dukes C ($P = 0.0005$) and between those of patients with Dukes B and Dukes C ($P = 0.0264$).

FUNCTIONAL OUTCOME

Urinary function :

Recovery of the ability to void spontaneously depended both on the type of PANP and the number of months after surgery (Table 4).

Within 12 months after surgery, all 36 patients with type I, (100%), 21 of 22, patients with type II (91.3%) and 19 of 22 patients with type III (86.3%) regained spontaneous voiding. Conversely, 38.5% of the type IV patients required self catheterization.

Male sexual function :

Libido was lost in 6 patients and decreased in ten after surgery (Table 5). Sexual function in the 46 patients, excluding the 6 who felt no libido and were not sexually active, is shown in (table 6). Overall, 13 patients (28.3%) maintained complete sexual function and 18 (39.1%) were not able to perform sexual inter-

course. The degree of sexual dysfunction depended on the type of PANP (Table 6). In type I, 65% of patients retained complete sexual function, and 20% were able to penetrate and sustain an erection during sexual intercourse without normal ejaculatory function. Among the seven patients with impaired sexual function in type I, four had undergone PANP combined with extended lateral lymph node dissection including the obturator cavity. Non of the patients with type II, III and IV PANP retained normal ejaculatory function. Six of the 9 patients with type II PANP and 4 of the nine patients with type III maintained the ability to achieve an erection and perform sexual intercourse.

Table (1) : Type of PANP, clinical and pathological characteristics (n = 104)

	No. of patients	No. of patients				
		Type I	Type II	Type III	Type IV	Others
AR	(62)	29	18	9	4	2
Hartmann	(3)	1	1	1	0	0
APR	(39)	7	5	14	10	3
Ra	(34)	12	16	3	2	1
Rb	(70)	25	8	21	12	4
Dukes A	(27)	20	3	3	1	0
Dukes B	(34)	8	9	12	3	2
Dukes C	(43)	9	12	9	10	3

Table (2) : Site of recurrence and Dukes stage (n = 104)

Stage	No. of patients	Site						
		Liver (H)	Lung (L)	H & L	Pelvic cavity (PC)	PCα hematogenous (Hem)	Retroperitoneal lymph node (Ret)	Other organs
Dukes A	(27)	0	0	0	0	0	1	0
Dukes B	(34)	2	2	1	0	0	1	1
Dukes C	(43)	6	4	1	4	2	1	1

Table (3) : Site of recurrence and type of PANP (n = 104)

PANP No. of patients	Site							Other organs
	H	L	H & L	PC	PC α	Hem.	Ret. L.N.	
Type I (37)	1	2	0	1	0		1	0
Type II (24)	3	1	0	1	0		1	1
Type III (24)	2	2	1	1	1		0	1
Type IV (14)	1	1	1	0	1		1	0
Others (5)	1	0	0	1	0		0	0

Table (4) : Urinary function and type of PANP (n = 94)

PANP No. of patients	Rate of spontaneous voiding (%)					
	At discharge		6 months		12 months	
	No	%	No	%	No	%
Type I (36)	32	88.9	34	94.4	36	100
Type II (23)	14	60.9	20	87	21	91.3
Type III (22)	5	22.7	17	77.2	19	86.3
Type IV (13)	3	23	6	46.1	8	61.5

Table (5) : Male libido and type of PANP (n = 52)

PANP No. of patients	Libido	
	Lost	Decreased
Type I (20)	0	3
Type II (12)	3	3
Type III (10)	1	2
Type IV (10)	2	2

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Table (6) : Male sexual function and type of PANP (n =46)

PANP No. of patients		Sexual Function			
		Erection	Sexual intercourse	Ejaculation	
Type I (20)	+	+	+	-	1
Type II (9)	0	6	3	0	0
Type III (9)	0	4	4	1	1
Type IV (8)	0	1	3	4	4

3"+ signs (vertically) : male sexual function is maintained completely; 2"+ signs and 1"- sign (vertically) "potency to penetrate and to sustain, an erection is maintained but normal ejaculation is lost; 1"+ sign and 2"- signs vertically: an erection is possible but difficult to sustain; 3"- signs (vertically): male sexual function is lost completely.

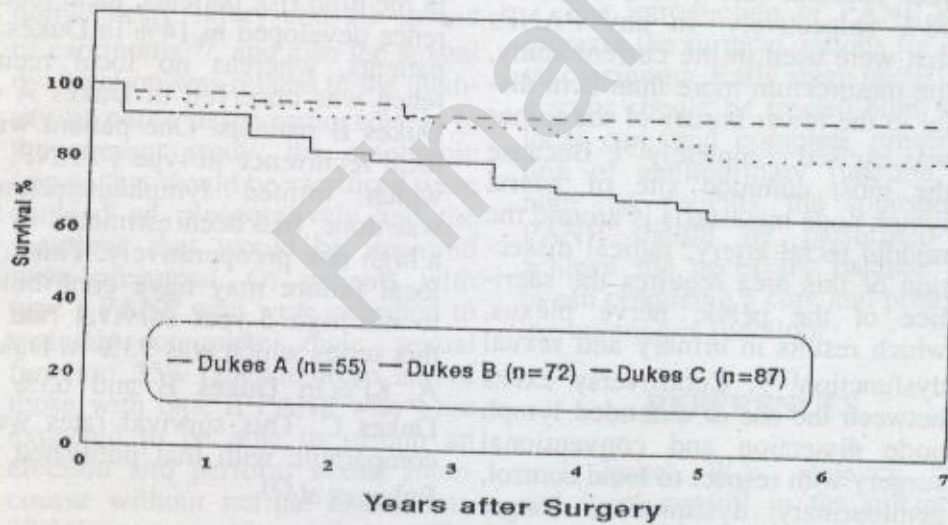


Figure (1) : Comparison of Survival Among Duke's Stages

DISCUSSION

A high local recurrence rate (from 10-30%) after conventional lymphadenectomy for rectal carcinoma is a clinical problem⁽¹⁷⁾. Although adjuvant radiotherapy and chemotherapy have been used to reduce the incidence of recurrence, there is still high local recurrence rate more than 10%⁽²¹⁾. The other method to achieve good local control is total mesorectal excision (TME) Havenga et al.⁽⁷⁾. MacFarlane et al.⁽¹⁴⁾ reported a low recurrence rate of 4% in patients with Dukes B and Dukes C tumors who underwent anterior resection with TME. In the work of Enker et al.⁽²⁾ using TME, the local recurrence rate of Dukes B and Dukes C was 4% and 8.1% respectively, and their 5-year survival rate was 86.7% and 68% respectively. In any PANPs that were used in the current study, the mesorectum more than 2cm distal to the lower border of the tumor was excised completely⁽³⁾. Because the most common site of lateral lymph node metastasis is around the middle rectal artery, radical dissection of this area requires the sacrifice of the pelvic nerve plexus, which results in urinary and sexual dysfunction⁽¹⁸⁾. Controversy exists between the use of extended lymph node dissection and conventional surgery with respect to local control, genitourinary dysfunction, longer operating time, and the small number of patients with positive lateral

lymph nodes⁽²⁰⁾. PANP according to carcinoma spread, evaluated by preoperative and intraoperative examination has been introduced to address the balance between the need to achieve a cure and the desire to maintain urinary and sexual function⁽¹⁶⁾. Local recurrence may develop from metastasized lymph node that are left in the area of lateral pelvic wall⁽⁶⁾.

Based on the study of the risk factors for lateral lymph node metastases, lateral lymph node dissection was indicated in high risk patients who were found to have swollen perirectal lymph nodes or Rb tumors invading the perirectal fat by EUS and/or CT⁽¹⁹⁾.

In the current study in which lateral lymph node dissection was used in the high risk patients, local recurrence developed in 14% in Dukes C patients, whereas no local recurrence was observed in Dukes A or Dukes B patients. One patient with local recurrence in type I PANP, in which limited lymphadenectomy was done, had been estimated to be a high risk preoperatively. This low local failure may have contributed to the high 5-year survival rate in this series which was 93% in Dukes A, 81% in Dukes B and 65% in Dukes C. This survival rates were comparable with that published by Enker et al.⁽³⁾.

The current study disclosed that

preservation of the unilateral pelvic nerve plexus allowed the maintenance of spontaneous voiding, and patients with preservation of only the distal part of the pelvic nerve plexus may be able to void spontaneously. Even among patients with complete removal of the pelvic autonomic nerve system, two-thirds were able to empty their bladder spontaneously. These results were comparable with other published works⁽¹¹⁾. The backward displacement of the bladder after abdominoperineal resection was partly responsible for urinary dysfunction⁽¹⁵⁾.

Impairment of male sexual function after rectal surgery occurs in conventional lymphadenectomy and even in benign diseases⁽¹⁾. There was a relationship between autonomic nerve injury and the spread of carcinoma⁽⁴⁾, and also the sexual dysfunction was related to the quantity of nerve tissue removed⁽²²⁾. In the present study, the autonomic nerves that would be sacrificed were decided on preoperatively and the functions that would be impaired were presumed. Of patients with type I PANP who were expected to maintain complete male sexual function, 35% failed to do so, and of those with type II PANP who were expected to be able to sustain an erection and perform sexual intercourse without normal ejaculation, 33.3% were unable to do so. The main cause of failure may be dissec-

tion around the preserved autonomic nerves, which may result in devascularization of the nerves⁽²²⁾. Conversely, 44.4% of patients with type III PANP unexpectedly maintained the ability to achieve an erection and perform sexual intercourse. Enker et al.⁽²⁾ reported good local control and maintenance of male sexual potency in the patients who underwent a sphincter-saving procedure and trunkal autonomic nerve preservation (ANP) which was similar to type I PANP in the current study. His observation that 86.7% of patients retained erectile potency and 76.3% maintained complete sexual function was similar to the current study results with type I PANP.

Conclusion :

The introduction of PANP may increase the surgical options for rectal carcinoma. Early stage rectal carcinoma should be treated both with local cure and complete preservation of genitourinary function. In high risk patients, the appropriate PANP should be performed to achieve the necessary balance between producing a cure and preserving autonomic function.

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