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Risk factors for sexual dysfunction after rectal cancer treatment

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ABSTRACT

This study aimed to identify risk factors for long-term sexual dysfunction (SD) after rectal cancer treatment.

Patients with resectable rectal cancer were randomised to total mesorectal excision with or without preoperative radiotherapy (PRT). Preoperatively and at 3, 6, 12, 18 and 24 months postoperatively, SD scores were filled out in questionnaires. Possible risk factors for postoperative deterioration of sexual functioning, including patients' demographics, tumour-specific factors and treatment-related variables, were investigated with univariate and multivariable regression analyses.

Increase in general SD, erectile dysfunction and ejaculatory problems were reported by 76.4, 79.8 and 72.2 percent of the male patients, respectively. Risk factors were nerve damage, blood loss, anastomotic leakage, PRT and the presence of a stoma. In female patients, increase in general SD, dyspareunia and vaginal dryness were reported by 61.5, 59.1 and 56.6 percent, respectively. This was associated with PRT and the presence of a stoma.

SD occurs frequently after rectal cancer treatment and is caused by surgical (nerve) damage with an additional effect of PRT. Patients should be informed preoperatively, and education of surgeons in neuroanatomy may provide the key to the improvement of functional outcome.

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1. Introduction

The past two decades have witnessed substantial improvement in survival from rectal cancer as a result of earlier diagnosis, improved efficiency and use of radiotherapy and advances in surgical techniques such as total mesorectal excision (TME).[1,2] Total mesorectal excision is defined as 'a sharp dissection under clear vision between the parietal and visceral planes of the pelvic fascia, removing the mesorectum contained within an intact endovisceral fascia'.[1–3] The prac-

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tice of TME in rectal cancer treatment improved autonomous nerve preservation substantially. Subsequently, the rates of sexual dysfunction (SD) were reduced.[4–6] However, SD after rectal cancer treatment is still a frequent and distressing complication.[7–9] There is a suggestion that sexual function is impaired by radiotherapy, but function can also be affected by surgery alone.[6,8,10,11] It is difficult to identify the contribution of each treatment component in the development of SD. There is a general lack of large, prospective studies concerning long-term SD after rectal cancer treatment, especially in female patients. In order to gain insight into the aetiology of SD after rectal cancer treatment, we prospectively investigated which treatment factors contributed to the development of long-term male and female SD in a large multicentre trial in which all patients had been treated by TME surgery and had been randomised for yes/no preoperative radiotherapy (PRT).

2. Patients and methods

2.1. Study population and treatment

From January 1996 to December 1999, 1861 patients with histologically proven adenocarcinoma of the rectum and without evidence of distant metastases were randomised to receive PRT followed by TME or TME alone in a large, international, multicentre trial. Details of the TME trial have been described elsewhere.[12] Patients assigned to PRT received a total dose of 25 Gy in five fractions over 5 to 7 days. Surgery had to take place within 10 days of the start of PRT. All patients underwent surgery according to the TME principles, as advocated by Heald.[13] Participating surgeons attended workshops and symposiums, saw instructional videotapes and were monitored by specially trained instructor surgeons. At each hospital, the first five total mesorectal excisions were supervised by an instructor surgeon.[14] Informed consent was obtained from all patients before randomisation and was separately obtained for the quality-of-life study. Health-related quality of life was evaluated in Dutch patients only ($n = 1530$). Patients with any recurrence during the period of evaluation were excluded to avoid confounding due to symptoms caused by disease recurrence.

2.2. Measures

For the quality-of-life study, patients were asked to fill out questionnaires before treatment and at 3, 6, 12, 18 and 24 months after surgery. Patients who failed to return two consecutive questionnaires were considered as withdrawn from the study and did not receive further questionnaires. For the different time-points, the following time windows were defined: 1.5 to 4.5 (3 months), 4.5 to 9 months (6 months), 9 to 15 (12 months), 15 to 21 (18 months) and 21 to 27 (24 months). Patients with a missing preoperative form were not analysed, however, patients with a missing form at a certain time-point after the treatment were still included in the other time-points.

In the quality-of-life questionnaire, sexual activity was also evaluated and several items concerning sexual functioning were included. Responses were given on four-point scales ranging from 'not at all' to 'very much'. Items within a scale were summed and linearly transformed to fit a range from 0 to 100, with lower scores representing better levels of functioning. The questionnaire consisted of one general SD scale (three items: interest, pleasure and satisfaction; Cronbach's α for females = 0.88 and for males = 0.85); for females a scale on dyspareunia (two items: $\alpha = 0.87$) and an item on vaginal dryness were also included, and for males a scale on erectile dysfunction (three items: $\alpha = 0.98$) and one on ejaculatory problems (two items: $\alpha = 0.86$) were included.

2.3. Objectives

This study aimed to evaluate the impact of rectal cancer treatment on male and female sexual functioning. The main objective of this study was to identify risk factors for male and female SD after rectal cancer treatment in order to gain insight into the aetiology.

2.4. Statistics

Male and female patients were analysed separately. Only patients who were sexually active before rectal cancer treatment were evaluated. Sexual activity after rectal cancer treatment was assessed, and the associated factors were identified with univariate and multivariable regression analyses.

Furthermore, postoperative deterioration of sexual functioning was evaluated. To do this, relative dysfunction scores were obtained by subtracting the baseline score (preoperative

Table 1 – Patient and treatment characteristics (continuous variables: median (minimum, maximum); categorical variables: number of patients (%)).

Age (years; $n = 990$)	64.0 (26, 92)
Gender ($n = 990$)	
Male	625 (63.1)
Female	365 (36.9)
Body mass index (kg/m^2; $n = 784$)	25.4 (16.9, 53.1)
Tumour location ($n = 157$)	
Anterior	79 (50.3)
Posterior	78 (49.7)
Tumour size (cm; $n = 979$)	4.0 (0, 13.0)
Tumour stage	
T0–T1	88 (8.9)
T2	388 (39.2)
T3	493 (49.8)
T4	21 (2.1)
Preoperative radiotherapy ($n = 990$)	497 (50.2)
Type of resection ($n = 990$)	
Low anterior resection	657 (66.4)
Abdominoperineal resection	293 (29.6)
Hartmann	40 (4.0)
Resection additional organ ($n = 990$)	185 (18.7)
Peroperative blood loss (ml; $n = 971$)	1000 (20, 15,000)
Anastomotic height of LAR (cm; $n = 607$)	5.5 (0, 14.0)
Anastomotic leakage after LAR ($n = 657$)	66 (10.0)
Temporary/definitive stoma ($n = 950$)	725 (73.2)

score) from the score at each subsequent time-point. For each patient, the mean postoperative relative scores with respect to general SD and to erectile dysfunction and ejaculatory problems or to dyspareunia and vaginal dryness were calculated. In this way, even patients who only filled in one postoperative questionnaire could be evaluated. Scores ranging from 0–10, 10–20 and >20 were considered as minor, moderate and severe deterioration, respectively.[15] The analysed risk factors were gender, age, body mass index (BMI), tumour stage, PRT, resection type (low anterior or abdominoperineal resection), level of anastomosis, resection of an additional organ, excessive peroperative blood loss (>1500 ml), surgical damage to the superior hypogastric plexus, hypogastric nerves and/or pelvic plexus (as mentioned in the surgery report), definitive or temporary stoma and anastomotic leakage. The influence of these variables was examined in univariate and multivariable regression analyses. $p \leqslant 0.05$ was considered statistically significant.

In addition, linear mixed models with random patient intercepts and time (categoric) and each significant risk factor as fixed factors were conducted to evaluate the possible time-effects and obtain estimates of each of the scheduled time-points to account for random drop-out. In a previous study, it was shown that it was not necessary to incorporate non-ignorable drop-out.[16] In these figures an asterisk is shown at each specific time-point at which there is a significant difference between the groups with $p < 0.001$ (to account for multiple analyses at five different time-points).

Data were analysed with the Statistical Package for the Social Sciences statistical software (version 12.0 for Windows; SPSS Inc, Chicago, IL).

3. Results

3.1. Study population

Of the 1530 Dutch patients, patients were excluded from the analysis for the following reasons: ineligible at randomisation ($n = 50$), no operation ($n = 37$), in-hospital deaths ($n = 52$), no informed consent for quality-of-life study ($n = 89$) and no quality-of-life forms returned ($n = 30$). In addition, 282 patients had a local or distant recurrence within the first two years, leaving 990 patients. Patient and treatment characteristics are listed in Table 1.

3.2. Sexual activity

Before treatment, 79.2 percent of male patients (388/490) and 51.7 percent of female patients (138/267) were sexually active. Univariate and multivariable regression analyses could not identify any clinical or pathological contributing factor correlating with the absence of sexual activity other than age >65 years, female gender and not having a partner ($p < 0.001$, RR = 0.16, $p < 0.001$, RR = 0.27 and $p < 0.001$, RR = 0.12, respectively).

Of the male patients sexually active before treatment, 31.5 percent indicated not to be sexually active at 3 months after surgery. This percentage remained more or less stable over time (28.5 percent at two years). However, only 59 male patients (15.2 percent) never indicated to be sexually active after treatment. Risk factors associated with never being sexually active were age >65 years ($p = 0.002$, RR = 0.40) and anastomotic leakage ($p = 0.008$, RR = 0.31). In contrast, of the female

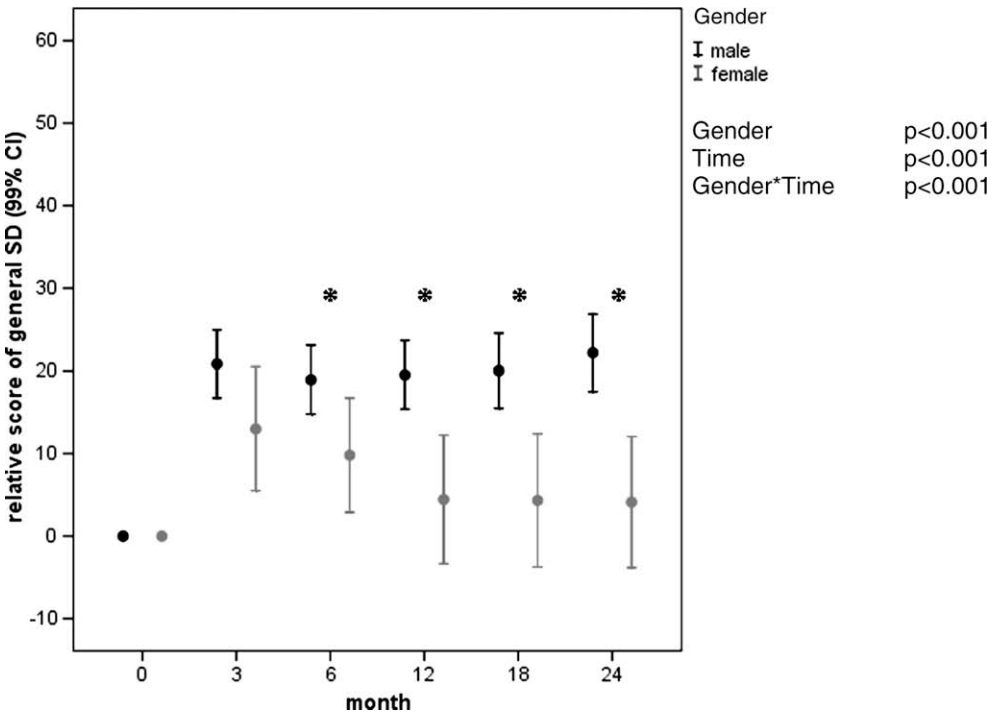

Fig. 1 – Linear mixed models analysis of relative general sexual dysfunction scores in male and female patients. Ninety-nine confidence intervals are displayed on the y-axis. An asterisk indicates a significant difference ($p < 0.001$) at a specific time-point (SD, sexual dysfunction; CI, confidence interval).

Table 2 – Results of univariate and multivariate regression analyses of the influence of patiënt-and treatment-related factors on the mean relative scores of general sexual dysfunction, erectile dysfunction and ejaculatory problems in male patients (SD, sexual dysfunction; N, number of patients; SE, standard error; LAR, low anterior resection; APR, abdominoperineal resection; uni, univariable analysis; and multi, multivariable analysis).

Risk factors	General SD					Erectile dysfunction					Ejaculatory problems				
	N	Relative score	SE	*p*-Value uni	*p*-Value multi	*N*	Relative score	SE	*p*-Value uni	*p*-Value multi	*N*	Relative score	SE	*p*-Value uni	*p*-Value multi
Age				0.343					0.089	0.298				0.559	
⩽65 years	243	21.16	1.76			225	33.39	2.25			220	31.14	2.37		
>65 years	117	18.23	2.55			97	26.51	3.24			86	28.57	3.53		
Body mass index				0.381					0.228					0.258	
⩽30 kg/m^2	266	20.58	1.70			245	30.29	2.13			232	30.49	2.31		
>30 kg/m^2	22	15.07	7.42			17	40.44	8.94			14	41.47	9.71		
Tumour stage				0.233					0.929					0.466	
I	41	24.00	3.47			39	31.29	5.20			36	34.96	5.59		
II	136	20.60	2.51			120	31.92	3.17			117	31.37	3.23		
III	179	19.60	2.02			159	31.14	2.58			149	28.86	2.84		
IV	4	−5.00	11.12			4	20.63	19.26			4	19.69	16.82		
Preoperative radiotherapy				0.003	0.003				0.108					0.024	0.026
No	185	16.06	2.06			170	28.50	2.59			162	26.22	2.68		
Yes	175	24.59	1.98			152	34.47	2.63			144	35.14	2.87		
Resection type				0.233					0.037	0.129				0.920	
LAR	233	18.96	1.69			210	28.04	2.21			204	30.52	2.47		
APR	116	22.72	2.91			102	36.41	3.52			93	30.08	3.47		
Level of anastomosis				0.398					0.230					0.244	
⩽4.0 cm	155	22.83	2.34			140	33.85	2.78			130	26.98	2.87		
4.0–7.0 cm	85	18.19	3.06			74	32.57	3.93			74	33.56	4.46		
>7.0 cm	71	19.27	2.59			67	25.49	4.09			63	34.78	4.38		
Resection additional organ				0.554					0.531					0.523	
No	321	19.91	1.55			288	30.92	1.95			273	30.86	2.10		
Yes	39	22.66	3.85			34	34.71	5.93			33	26.79	5.72		
Excessive blood loss				0.058	0.148				0.001	0.033				0.510	
No	256	18.46	1.69			233	27.82	2.17			222	29.68	2.32		
Yes	97	24.66	2.85			83	41.42	3.58			79	32.68	3.99		
Nerve damage				0.637					0.038	0.175				0.007	0.011
No	264	19.88	1.65			237	28.85	2.14			223	27.10	2.19		
Yes	93	21.45	3.07			82	37.67	3.72			80	39.17	4.23		
Temporary/definitive stoma				0.012	0.019				0.019	0.262				0.839	
No	78	13.24	2.13			74	22.83	3.65			69	29.64	4.19		
Yes	271	22.21	1.79			238	33.24	2.18			228	30.61	2.30		
Anastomotic leakage				0.031	0.076				0.043	0.034				0.022	0.043
No	332	19.30	1.46			299	30.28	1.89			284	29.17	2.02		
Yes	28	30.95	6.59			23	44.82	7.86			22	46.56	7.90		

patients sexually active before treatment, 32.5 percent indicated not to be sexually active at 3 months but this decreased to 18.4 at 2 years after rectal cancer treatment. Only 19 female patients (13.7 percent) never indicated to be sexually active after treatment. This was associated with increased age ($p = 0.041$, RR = 0.35).

3.3. *Male sexual functioning*

As stated in the methods section, only patients who indicated to be sexually active preoperatively were included in the analysis of sexual functioning (388 male patients and 138 female patients).

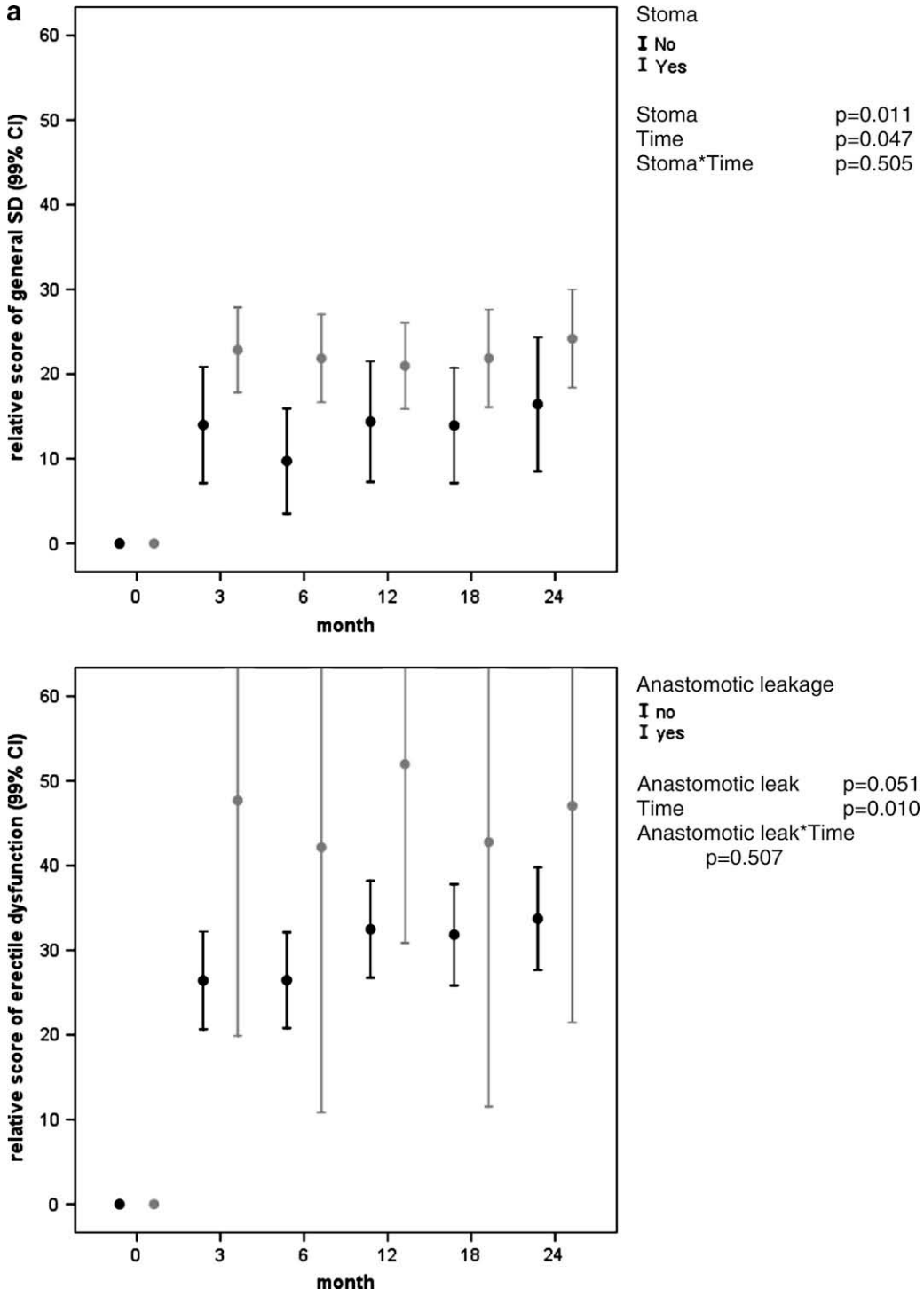

Fig. 2 – Linear mixed models analysis of (a) relative general sexual dysfunction scores in male patients with or without a temporary/definitive colostoma, (b) relative erectile dysfunction in male patients with or without excessive peroperative blood loss and with or without anastomotic leakage and (c) relative ejaculatory problems in male patients with or without nerve damage and with or without anastomotic leakage. Ninety-nine confidence intervals are displayed on the y-axis. An asterisk indicates a significant difference ($p < 0.001$) at a specific time-point (SD, sexual dysfunction; CI, confidence interval).

In both male and female patients general sexual functioning deteriorated postoperatively and remained worse over time for male patients, but improved for female patients (Fig. 1). Seventy-six percent (275/360) of male patients reported of either newly developed general SD or aggravation of pre-existent general SD after rectal cancer treatment, of whom 59.3 percent (163/275) had a mean relative score of more than 20 points, indicating severe deterioration. The mean postoperative increase in general SD score was 20.2 (standard error [SE] = 1.5) and was significantly associated with PRT, excessive peroperative blood loss, anastomotic leakage and temporary/definitive stoma in univariate regression analysis (Table 2). However, in multivariable analysis only PRT and temporary/definitive stoma remained significant risk factors ($p = 0.003$, mean difference = 8.53, SE = 2.9 and $p = 0.019$, mean difference = 8.97, SE = 3.5, respectively; Fig. 2a). Postoperative erectile dysfunction developed or worsened in 79.8 percent (257/322) of the patients compared to the

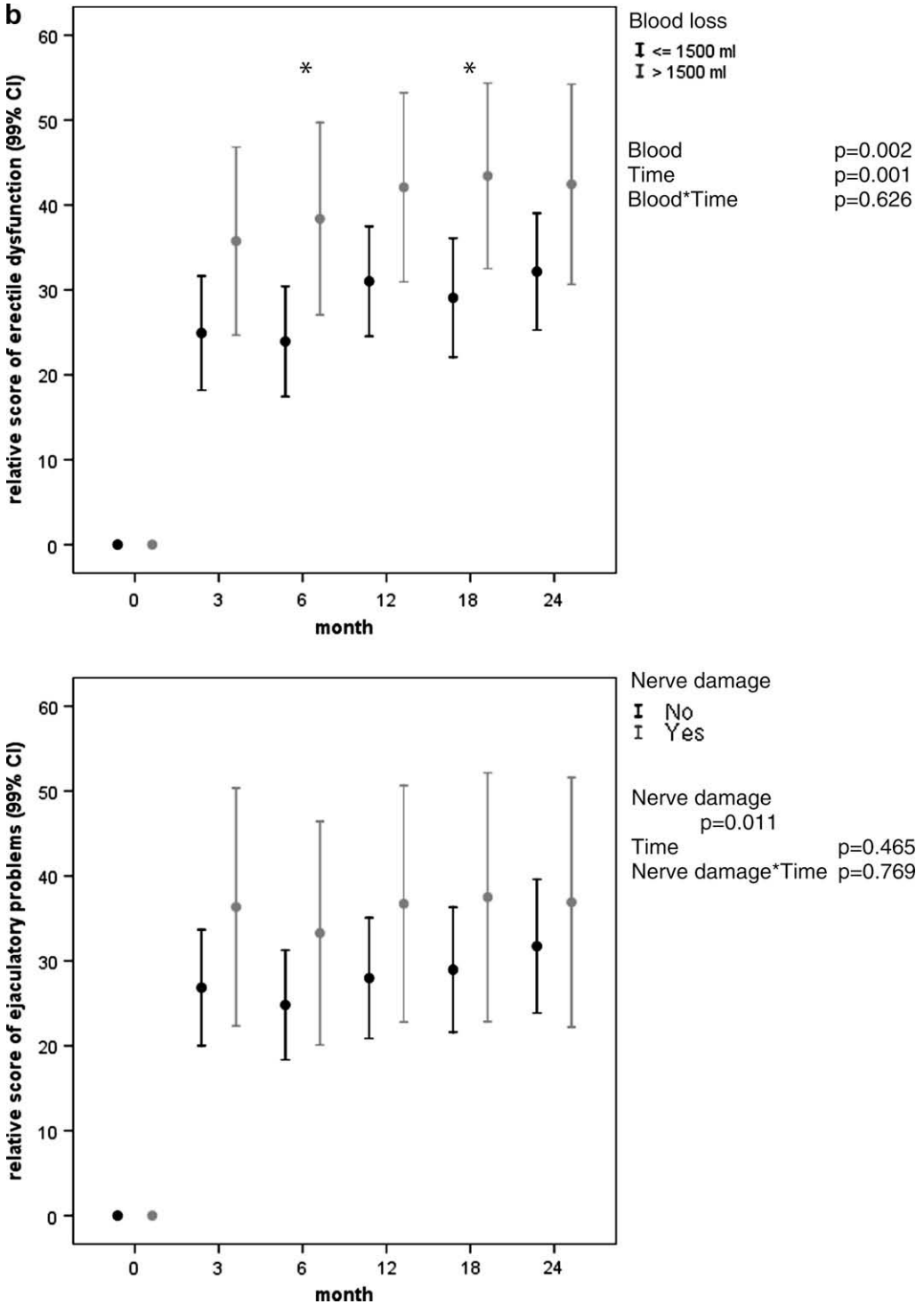

Fig. 2. *(continued)*

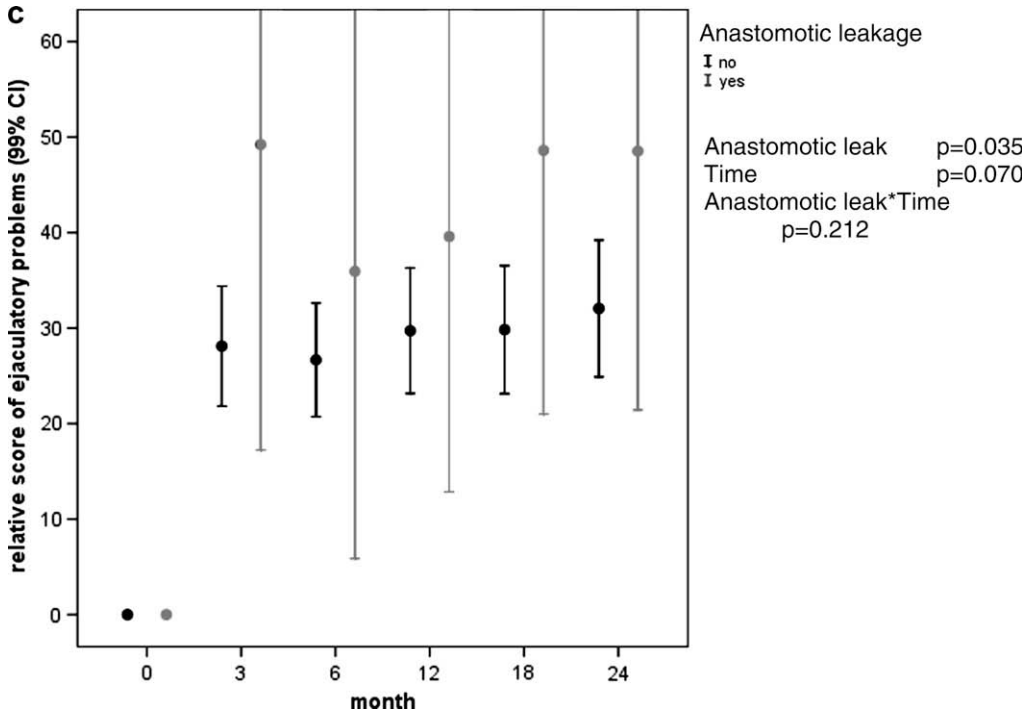

Fig. 2. *(continued)*

pre-treatment situation. Of these patients, 71.2 percent (183/257) had a mean relative score of more than 20 points. The mean postoperative increase in erectile dysfunction score was 31.3 (SE = 1.9) and was significantly associated with age > 65 years, nerve damage, resection type, excessive peroperative blood loss, temporary/definitive stoma and anastomotic leakage in univariate regression analysis. However, in multivariable analysis only excessive peroperative blood loss and anastomotic leakage remained significant risk factors ($p = 0.033$, mean difference = 13.6, SE = 4.2 and $p = 0.034$, mean difference = 14.5, SE = 7.2, respectively; Table 2; Fig. 2b). Ejaculatory problems developed or worsened postoperatively in 72.2 percent (221/306) of the patients, of whom 67.4 percent (149/221) had a mean relative score of more than 20 points. The mean postoperative increase in ejaculatory problem score was 30.4 (SE = 2.0) and was significantly associated with PRT ($p = 0.026$, mean difference = 8.92, SE = 3.9), autonomic nerve damage ($p = 0.011$, mean difference = 12.07, SE = 4.4) and anastomotic leakage ($p = 0.043$, mean difference = 17.39, SE = 7.6; Table 2; Fig. 2c).

3.4. *Female sexual functioning*

Sixty-two percent (72/117) of the female patients reported of either newly developed general SD or aggravation of pre-existent SD after rectal cancer treatment, of whom 45.8 percent (33/72) had a mean relative score of more than 20 points. The mean postoperative increase in general SD score was 8.2 (SE = 2.5). Preoperative radiotherapy was the only significant risk factor ($p = 0.033$, mean difference = 10.5, SE = 4.9; Table 3). Postoperative dyspareunia developed or worsened compared to the pre-treatment situation in 59.1 percent (65/110) of the patients, of whom 44.6 percent (29/65) had a mean relative score of more than 20 points. The mean postoperative increase in dyspareunia score was 12.3 (SE = 2.5) and was only associated with the presence of a temporary or definitive colostoma ($p = 0.051$, mean difference = 11.3, SE = 5.7; Table 3; Fig. 3a). Vaginal dryness developed or worsened postoperatively in 56.6 percent (60/106) of patients. Sixty-two percent (37/60) of these patients had a mean relative score of more than 20 points. The mean postoperative increase in vaginal dryness score was 13.4 (SE = 2.5) and was only associated with the presence of a stoma ($p = 0.063$, mean difference = 10.8, SE = 5.7; Table 3; Fig. 3b).

4. Discussion

In the light of improved prognosis of rectal cancer, quality of life has become an increasingly important criterion. Policy makers have insisted on including assessment of quality of life in clinical trials. However, quality of life is influenced by the ability to adapt to unfortunate conditions, and it has been shown that it does not reflect poor functional outcome.[11,17] The present study evaluated the development of long-term sexual morbidity in a large randomised multicentre trial. To our knowledge there are no other studies available in which sexual morbidity has been evaluated prospectively on such a large scale in both male and female patients.

Prospective questionnaires were used in order to prevent under-reporting. However, SD might still have been underreported, for example, out of shame. Furthermore, assessment of female SD remains a difficulty as simple end-points equivalent to potency and ejaculation are not available and sexual intercourse often remains technically possible, even if SD is present. In addition, the questionnaires were not validated. At the time the Dutch TME trial was conducted, validated

Table 3 – Results of univariate and multivariate regression analyses of the influence of patiënt-and treatment-related factors on the mean relative scores of general sexual dysfunction, dyspareunia and vaginal dryness in female patients (SD, sexual dysfunction; N, number of patients; SE, standard error; LAR, low anterior resection; APR, abdominoperineal resection; uni, univariable analysis; and multi, multivariable analysis).

Risk factors	General SD					Dyspareunia					Vaginal dryness				
	N	Relative score	SE	*p*-Value uni	*p*-Value multi	N	Relative score	SE	*p*-Value uni	*p*-Value multi	N	Relative score	SE	*p*-Value uni	*p*-Value multi
Age				0.673					0.140					0.694	
⩽65 years	92	7.69	2.91			88	14.19	2.85			84	13.95	2.81		
>65 years	25	10.25	4.45			22	4.85	5.23			22	4.83	5.97		
Body mass index				0.363					0.676					0.972	
⩽30 kg/m^2	81	8.03	3.06			75	13.97	3.00			71	13.91	3.17		
>30 kg/m^2	13	15.67	8.52			12	17.34	7.07			12	13.61	9.72		
Tumour stage				0.622					0.788					0.624	
I	9	12.66	7.86			8	9.72	5.98			7	0.95	15.27		
II	51	4.80	4.10			45	9.75	3.71			45	14.12	3.18		
III	52	11.17	3.57			53	15.03	4.07			50	14.20	4.03		
IV	5	4.86	4.29			4	10.42	7.89			4	17.92	8.75		
Preoperative radiotherapy				0.033	0.033				0.845					0.384	
No	62	3.30	3.33			59	11.86	3.58			55	11.29	3.24		
Yes	55	13.80	3.57			51	12.85	3.57			51	15.74	3.97		
Resection type				0.584					0.293					0.431	
LAR	89	8.64	2.86			82	10.76	2.92			79	12.22	2.97		
APR	26	5.38	4.96			26	17.12	5,44			25	17.00	5.21		
Level of anastomosis				0.438					0.557					0.325	
⩽4.0 cm	62	11.13	2.80			58	10.81	3.91			55	9.10	3.96		
4.0–7.0 cm	27	5.20	4.37			26	9.86	4.38			25	17.93	4.13		
>7.0 cm	16	3.69	9.94			14	19.07	7.02			14	15.24	3.43		
Resection additional organ				0.184					0.558					0.591	
No	86	6.26	2.98			81	11.43	3.06			77	12.59	3.07		
Yes	31	13.73	4.23			29	14.81	4.38			29	15.67	4.51		
Excessive blood loss				0.488					0.404					0.475	
No	96	7.27	2.81			90	13.01	2.86			87	14.14	3.00		
Yes	20	11.87	5.18			19	7.41	5.31			18	9.26	3.64		
Nerve damage				0.222					0.788					0.527	
No	89	6.60	3.05			82	12.04	2.81			80	14.15	2.88		
Yes	27	13.82	3.62			27	13.63	5.82			25	10.33	5.56		
Temporary/definitive stoma				0.930					0.051	0.051				0.063	0.063
No	32	7.55	4.01			29	4.01	3.96			28	5.48	4.38		
Yes	83	8.04	3.07			79	15.33	3.15			76	16.28	3.09		
Anastomotic leakage				0.123					0.662					0.434	
No	111	9.13	2.32			104	12.59	2.59			100	13.92	2.55		
Yes	6	–8.19	22.53			6	7.69	12.46			6	5.28	15.41		

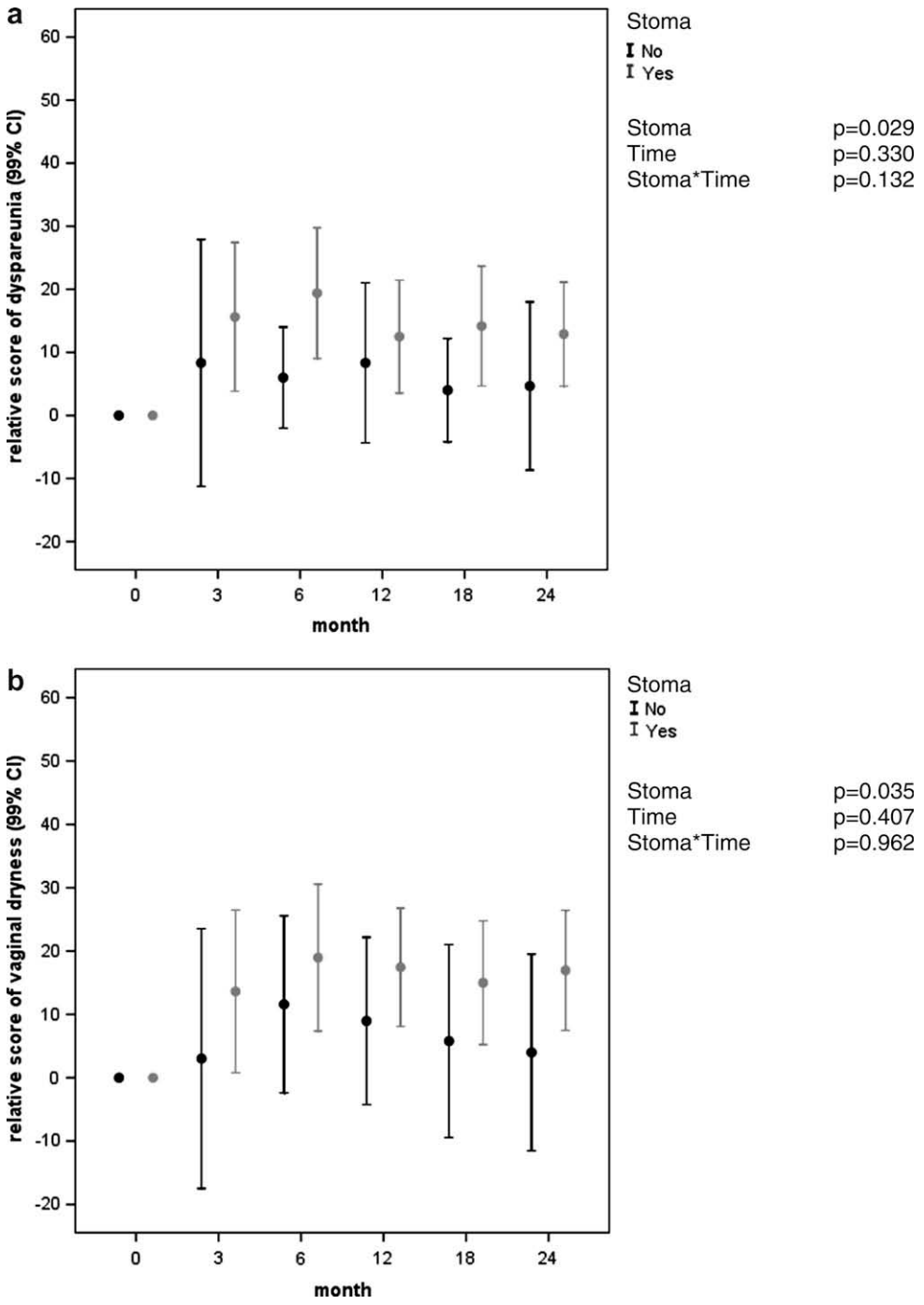

Fig. 3 – Linear mixed models analysis of (a) relative dyspareunia scores and (b) relative vaginal dryness scores in female patients with or without a temporary/definitive colostoma. Ninety-nine confidence intervals are displayed on the y-axis (CI, confidence interval).

questionnaires concerning specific sexual problems were not available, such as the recently developed module CR29 of QLQ-C30. It should also be noted that the used mean relative scores do not account for a possible time-effect. However, this is justified since the linear mixed models showed no time-effect of surgical factors.

The clinical importance of SD after rectal cancer treatment is demonstrated by this study as the majority of the patients were sexually active (526 of 757 patients). The majority of patients reported of the deterioration of sexual functioning after rectal cancer treatment. Sexual dysfunction after rectal cancer treatment is a multidimensional problem. Reduced self-esteem, body-image, fatigue, loss of independence, depression, and changes in interpersonal relationships have been shown to harm sexual function.[17] In this study, the presence of a temporary or definitive colostoma was associated with SD, probably indicating its psychological role in the development of SD, which is supported by a previous study.[17] De-

creased arousal due to the presence of a colostoma may result in reduced lubrification and dyspareunia in female patients, which were also related to each other (data not shown).[18] In addition to psychological factors, physical factors can play a role. Pelvic organ dysfunction after rectal cancer treatment occurs frequently and surgical damage to the pelvic autonomic nerves is believed to be an important cause.[5,19–21] Damage to the superior hypogastric plexus and hypogastric nerves could lead to disturbed ejaculation.[22] Disruption of the pelvic splanchnic nerves or the pelvic plexus could lead to erectile dysfunction. In the present study, the main predictive factor of increased ejaculatory problems was preoperative autonomic nerve damage. However, erectile dysfunction was only associated with peroperative blood loss and anastomotic leakage and not with nerve damage. With respect to autonomic nerve damage, surgeons most commonly indicated 'total preservation' or 'unclear' in the surgery report. Therefore, nerve damage was probably underreported and excessive peroperative blood loss may be a surrogate parameter for surgical nerve damage. Use of diathermic coagulation to secure haemostasis may cause nerve damage, especially if it is used improperly and in proximity to the pelvic plexus. Moreover, excessive blood loss hinders vision deep in the pelvis, making nerve sparing virtually impossible.[6] Anastomotic leakage as an important risk factor may be explained by its association with extensive inflammation, which may cause damage to the nerves and seminal vesicles. Theoretically, damage to the superior hypogastric plexus in women could lead to impaired lubrication and disruption of the pelvic splanchnic nerves or the pelvic plexus could cause diminished labia-swelling response. However, this was not supported by the present study. In female patients, nerve preservation is less difficult than in the narrow conically shaped male pelvis, which could explain why SD was more common in male patients than in female patients. Moreover, in women sexual function may be primarily mediated by the sexual centres in the cerebrum and by impulses carried by the pudendal nerves.

A well-known surgical risk factor for SD is abdominoperineal resection, especially with respect to erectile dysfunction in male patients.[7,19,23,24] Avulsion of the pelvic splanchnic nerves from their sacral roots might occur following a tear of the presacral parietal fascia during the perineal phase of this procedure.[23] In the present study, abdominoperineal resection resulted in increased erectile dysfunction. However, this effect did not remain significant after correcting for preoperative blood loss, which was increased during abdominoperineal resection compared to that during low anterior resection (data not shown).

In addition to surgical damage, it is known that PRT is associated with long-term functional morbidity.[7,8,10,11,25] The cause of radiotherapy-related SD is multifactorial, involving fibrosis, vascular toxicity, neurotoxicity and psychological factors.[26] Radiation damage to the cavernous arteries may result in impotence and the seminal vesicles may stop functioning after irradiation, resulting in ejaculatory problems.[26,27] However, in the present study PRT was not an independent risk factor for erectile dysfunction or ejaculatory problems. Furthermore, the effect of PRT on the dysfunction scales running to 100 was less than ten points, while postoperative scores were approximately 20 points higher than preoperative scores. Therefore, despite the additional effect of PRT, SD seems to be mainly caused by surgery. It is difficult to influence surgical factors, except for nerve damage. Expert studies have shown that autonomic nerve preservation is achievable, but their results have not been reproduced in larger studies.[6,20] Because exact identification of the autonomic nerves can be difficult, the use of a nerve-stimulating device could possibly facilitate preservation of the pelvic autonomic nerves during TME.[28] Also high volume hospitals and surgeons may have better results.

In conclusion, we believe that education and training of surgeons in pelvic neuroanatomy and crucial anatomical dissection planes is the key to the improvement of functional outcome.

In addition, any doctor treating rectal cancer patients should be aware that many are sexually active and should inform their patients about the possible negative sexual consequences of treatment. A preoperative discussion about sexual function has been shown to be desired by most patients; however, it occurs in less than ten percent of consults prior to rectal cancer treatment.[7,17] Furthermore, a recent study by da Silva and colleagues has demonstrated the need for better emotional support during follow-up, as mental health recovery is of major importance for body image, self-esteem and sexual function.[17] During follow-up doctors should be aware that patients might experience substantial distress from SD. Further studies concerning the effect of postoperative sexual counselling and therapies, such as sildenafil (Viagra) for erectile dysfunction, are necessary.[29]

Conflicts of interest statement

None declared.

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