

Genital and Subjective Sexual Response in Women After Restorative Proctocolectomy with Ileal Pouch Anal Anastomosis—A Prospective Clinical Trial

Malaika S. Vlug, MSc,* Ellen T. Laan, PhD,[†] Rik H.W. van Lunsen, MD, PhD,[†] Paul J. van Koperen, MD,* Sebastiaan W. Polle, MD, PhD,* and Willem A. Bemelman, MD, PhD*

*University of Amsterdam—Department of Surgery, Academic Medical Center, the Netherlands; [†]University of Amsterdam—Department of Sexology and Psychosomatic Gynecology, Academic Medical Center, the Netherlands

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ABSTRACT

Introduction. Sexual dysfunction after ileo pouch anal anastomosis (IPAA) is common. The most systematic physical reaction to sexual stimulation is an increase in vaginal vasocongestion. Genital response can be assessed by vaginal pulse amplitude (VPA) using vaginal photoplethysmography.

Aim. To assess whether restorative proctocolectomy with IPAA is associated with autonomic pelvic nerve damage and changes in subjective indices of sexual function in women.

Methods. Female patients undergoing IPAA between April 2004 and January 2006 were included. During sexual stimulation (visual and vibrotactile) changes in vaginal vasocongestion were measured by vaginal photoplethysmography. Concurrently, quality of life (SF-36) and sexual functioning (FSFI, FSDS) were assessed using validated questionnaires.

Main Outcome Measures. Primary endpoint was difference in VPA pre- and postoperatively. Secondary endpoints were differences in feelings of sexual arousal and estimated lubrication pre- and postoperatively and difference in psychological and sexual functioning pre- and postoperatively.

Results. Eleven patients were included. For eight patients (median age 37 [22–49 years]) pre- and postoperative data were collected. VPA analysis showed a significant reduction in vaginal vasocongestion during sexual stimulation postoperatively, $P = 0.012$. Subjective sexual arousal and estimated lubrication during the experiment, reported psychological and sexual functioning pre- and postoperative were not different.

Conclusions. Vaginal vasocongestion after IPAA was significantly reduced in this small study; indicating that IPAA in women might possibly be associated with autonomic pelvic nerve damage or partial devascularization of the vagina. Subjectively reported sexual arousal, estimated lubrication, psychological and sexual functioning were not diminished. Future research should focus on the possible advantage of a full close rectal dissection in these patients.

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Key Words. Vaginal Photoplethysmography; Ileal Pouch Anal Anastomosis; Sexual Dysfunction

Introduction

The standard treatment for patients with refractory ulcerative colitis (UC) and familial adenomatous polyposis (FAP) is restorative proctocolectomy with ileo pouch anal anastomosis (IPAA) via an open or laparoscopic approach [1,2]. At present, the laparoscopic approach is

the preferred procedure, because it proved to be safe and feasible with clear cosmetic advantages in this relatively young and sexually active patient group [3–6]. One of the complications seen after open and laparoscopic IPAA is sexual dysfunction [7–9]. This complication may have a large impact as most of the patients are sexually active.

In some studies up to 27% of the female patients have reported dyspareunia and vaginal dryness after IPAA [10–17]. Other studies reported an improved or preserved sexual function after IPAA [18,19].

The most systematic physical reaction to sexual stimulation in women is an increase in vaginal vasocongestion. A direct result of this increased vasocongestion is lubrication, as pressure in the small vessels of the vaginal wall increases and plasma transudate passively flows through the epithelium [20]. Damage to the autonomic nerves disrupt this process [17,21–24]. However, this is not the only cause of sexual dysfunction, anatomical changes, pouch related problems, psychological functioning, quality of life, and body image play a role as well [25–28].

The currently most sensitive, specific, and reliable instrument for measuring vaginal vasocongestion is vaginal photoplethysmography [24,29–32]. Vaginal pulse amplitude (VPA) fluctuations reflect phasic changes in the blood content of the illuminated capillary bed of the vaginal wall at each heart beat, with greater amplitudes indicating increased vasoengorgement. Subjective sexual arousal and sexual functioning can be assessed by validated questionnaires.

To this day, published studies only assessed pre- and postoperative sexual function using subjective, validated or even nonvalidated, questionnaires [10–19]. Mostly, sexual function is only evaluated after surgery. Only two studies assessed prospectively preoperative sexual function all well [11,18]. All other studies compared preoperative sexual function with postoperative sexual function retrospectively [10,12–17,19]. There are no studies that assessed genital response after IPAA, notwithstanding the fact that this measure has frequently been used in other studies, in which, for example, premenopausal women with and without sexual problems were compared [31].

Two studies have assessed vaginal blood flow after hysterectomy. Maas et al. found radical hysterectomy to be associated with a reduced VPA during sexual arousal compared with women who underwent simple hysterectomies and a control group [24]. In a preliminary report from the same study group, Pieterse et al. have shown that patients who underwent a radical hysterectomy with a nerve-sparing technique had higher VPA response during sexual stimulation than comparable patients who have had conventional surgery [32]. These studies suggest that radical pelvic surgery is associated with pelvic autonomic nerve

damage causing increased denervation of the vagina [24,32].

Sexual dysfunction after IPAA is common, but little is known about the contribution of damage to the pelvic autonomic nerves. Aim of this prospective study was to assess whether IPAA is associated with autonomic pelvic nerve damage and changes in subjective indices of sexual function in women.

Methods

Recruitment

All female patients undergoing an elective laparoscopic IPAA with or without defunctioning ileostomy for UC or FAP between April 2004 and January 2006 were eligible for this study. Exclusion criteria were being under 18 years of age, no informed consent, prior operation on genitals, diabetes mellitus, a history of sexual abuse or pre-existent sexual dysfunction, use of medication with a possible effect on sexual response (antihypertensives, psychopharmaceutical drugs) and presence of a depressive disorder. This comparative prospective study was approved by the Medical Ethics Committee.

After a brief telephone interview in which details of the study were provided, patients were mailed a detailed information sheet. Subsequently, the patient visited the department of Sexology for a detailed sexual history and to sign the informed consent. The second visit was a familiarization visit in which neutral and sexual videos were shown and VPA was recorded to get acquainted with the experimental procedures. In addition, validated questionnaires had to be filled out. During the third visit the preoperative test session was done. After at least 1 year of surgery and, in case of a defunctioning ileostomy, at least 3 months after bowel continuity was restored, patients were approached for the postoperative experiment. All patients received travelling expenses and a fee of €50 to compensate them for invested time.

Endpoints

Primary endpoint was difference in VPA pre- and postoperatively. Secondary endpoints were differences in feelings of sexual arousal and estimated lubrication pre- and postoperatively and difference in psychological and sexual functioning pre- and postoperatively.

Surgical Technique

The colon was resected applying a total laparoscopic approach. The rectum was laparoscopically dissected down to the pelvic floor and transected at midrectum. The colon and half of the rectum were removed through a Pfannenstiel incision. In all the cases hypogastric nerves were identified and spared. Further dissection of the rectum, pouch construction (J-pouch and double-stapled) and making of the ileo-anal anastomosis were done via the Pfannenstiel open. Posteriorly, the rectum was dissected applying the total mesorectal excision technique, anteriorly a close rectal dissection was done. All operations were performed or supervised by a senior surgeon.

Measures and Materials

Vaginal Pulse Amplitude (VPA)

VPA was continuously measured using vaginal photoplethysmography developed by the department of Technical Support (Department of Psychology) based on instruments initially developed by Sintchak and Geer (Figure 1) [33]. This device, sized and shaped as a menstrual tampon, can easily be inserted by the patient herself and contains a light source (3-mm light-emitting diode; Agilent Technologies HLMP-NH04, Santa Clara, CA, USA, $\lambda = 620$ nm) and an optical sensor (Texas Instruments TSL250; Dallas, TX, USA). The devices were produced in batches of 100 pieces, resulting in a set with nearly identical electronic characteristics. A signal-conditioning amplifier (Technical Support) separated the VPA from the direct current component using a 12-dB/octave, 0.7-Hz filter. Additional filtering for VPA was a 24-dB/octave, 0.4-Hz high-pass filter. The signal was digitalized at 100 Hz with a Keithley

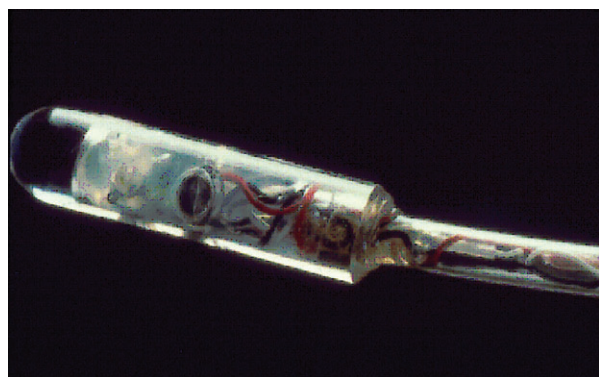


Figure 1 Probe used for vaginal photoplethysmography.

KPCI3107 A/D converter (Keithley Instruments, Cleveland, OH, USA) running on a Window 2000 system. Depth of the probe and orientation of the light source were controlled by a device (a 9×2 -cm United States Food and Drug Administration -approved perspex plate; ODV Rubber en kunststoffen, Zaandam, the Netherlands) attached to the cable within 5 cm of the optical sensor. Patients were instructed to insert the probe such that the plate touched their labia. The probe and plate were sterilized in a solution of Cidex-activated glutaraldehyde (Cidex OPA; Johnson and Johnson, Amersfoort, the Netherlands).

Sexual Arousal and Lubrication Estimate

To assess sexual feelings and sexual affect during sexual stimulation patients were asked to fill out a 37-item questionnaire (Subjective Self-Assessment Questionnaire [SSAQ]), prior to and immediately after the erotic films. This questionnaire consisted of five scales: sexual arousal (sexually aroused, mentally sexually aroused, physically sexually aroused; Cronbach's $\alpha = 0.87$); genital sensations (any physical reaction, any genital feelings, feelings of warmth, genital pulsing or throbbing, warmth of genitals, genital wetness or lubrication; Cronbach's $\alpha = 0.96$); sensuality (sensuous, a desire to be close to someone, loving, uninhibited, relaxed; Cronbach's $\alpha = 0.73$); positive affect (pleasant, interested, attracted, aroused, sexually attractive; Cronbach's $\alpha = 0.93$); and negative affect (anxious, worried, angry, disgusted, embarrassed, guilty; Cronbach's $\alpha = 0.65$) [34]. Each question was preceded by "During the video, I felt: . . ." after which a positive, negative, physical, or sexual experience was described—for instance, pleasant, worried, genital pulsing or throbbing, and sexual aroused. All items were measured on a 1 (not at all) to 7 (intensely scale).

At the end of the procedure patients were asked to estimate their vaginal lubrication on a 10-point scale from 1 (no lubrication) to 10 (fully lubricated).

Psychological, Relational and Sexual Functioning

Pre- and postoperative psychological, relational and sexual functioning was assessed by validated questionnaires. To assess psychological and relational functioning patients were asked to fill out the Short Form-36 (SF-36), Beck Depression Inventory (BDI), and Maudsley Marital Questionnaire (MMQ).

The SF-36 consists of 36 items within eight dimensions: Psychological Functioning; Role

Limitations due to physical problems; Pain; General Health Perceptions; Energy/Vitality; Social Functioning; Role Limitations due to emotional problems and Mental Health. Scores range from 0 to 100, with a higher score representing a better quality of life [35]. BDI was used to determine if a depressive disorder was present. For each answer a value of 0–3 was assigned, the total score was compared with a key, in which 0–9 indicates no depression, 10–18 indicates mild–moderate depression, 19–29 indicates moderate–severe depression, and 30–63 indicates severe depression [36]. MMQ is an instrument used for assessment of relationship quality comprised of three scales: marital, sexual and general life, with higher scores representing greater dissatisfaction [37].

To assess sexual functioning two questionnaires were used: the Female Sexual Function Index (FSFI) and the Female Sexual Distress Scale (FSDS). FSFI assesses sexual functioning on the six domains of desire, arousal, lubrication, orgasm, satisfaction and pain. By adding individual domain scores, a total score was calculated. Higher scores indicate better sexual functioning (maximum score: 36) [38]. A total score of <26.55 is considered indicative of sexual dysfunction [39]. Sexuality related personal distress was measured by FSDS, in which a higher score (range 0–48) indicates more sexual distress [40].

Stimuli

In each test session two different erotic stimuli were provided. The first stimulus was a 5-minute clip of an erotic film depicting manual caressing of genitals and cunnilingus. The second stimulus was an erotic film consisting of 5 minutes of intercourse, during this film clitoral vibration was given. Women-made, female-initiated and female-centered erotic film clips were used [41]. Even though the postoperative test session was done at least one year after the preoperative test session, two different but comparable sets of erotic visual stimuli were used to avoid habituation resulting from repeated exposure to the same sexual stimulus [42].

The clitoral vibrator consisted of a rubber stopper of two centimeters in diameter. The vibrator was mounted on a flexible metal strap lined with washable lycra cloth. The patient was instructed to place the rubber stopper against the clitoris. The design of the vibrator did not compromise the VPA measurements. In two earlier studies, vibrotactile stimulation combined with

visual stimulation generated significantly greater genital responses than visual stimulation alone [43].

Procedure

The experiment was carried out by a female experimenter. During the whole experiment the patient was alone in the laboratory with the experimenter in an adjacent room. Patients were instructed to insert the probe and take a seat in front of the monitor. When they felt comfortable, they were asked to let the experimenter know, through an intercom-system, that the session could start. From then on all instructions were provided by monitor, only by written text, and VPA was continuously registered.

First, baseline value was determined by showing a nonerotic documentary for 5 minutes, of wherein the last 2 minutes was used to determine baseline 1 (B1). After that the first erotic film was shown. After filling out the SSAQ, the nonerotic documentary was continued to allow genital response to return to baseline. If after 3 minutes, genital response had not returned to B1 level, patients were asked to count backwards until B1 was reached. Subsequently, a new baseline measurement was done for 2 minutes (B2) and the 2nd erotic film was shown with concurrent clitoral vibration. Finally, patients were asked to fill out the SSAQ and to estimate their vaginal lubrication. The entire experimental setup is shown in Figure 2. Patients were asked not to masturbate during the experiment.

Data Reduction and Statistical Analysis

VPA was registered during the entire experiment. Data were entered into a computer program developed at the department of Psychology [30]. After artefact deletion peak-to-through amplitude was calculated for each remaining pulse, averaged over 30-second epochs and multiplied by 0.000477 to convert to mV. For all VPA analyses differences relative to preceding mean baseline were used. A mean VPA score (VPA_{mean}) for erotic film and erotic film and clitoral vibration (each lasting 5 minutes) minus each participant's mean baseline was calculated, as well as a maximum VPA consisting of the highest 30-second epoch minus baseline (VPA_{max}). All dependent variables were submitted to a 2 (pre- or postoperative) × 2 (erotic film or erotic film and clitoral vibration) analysis of

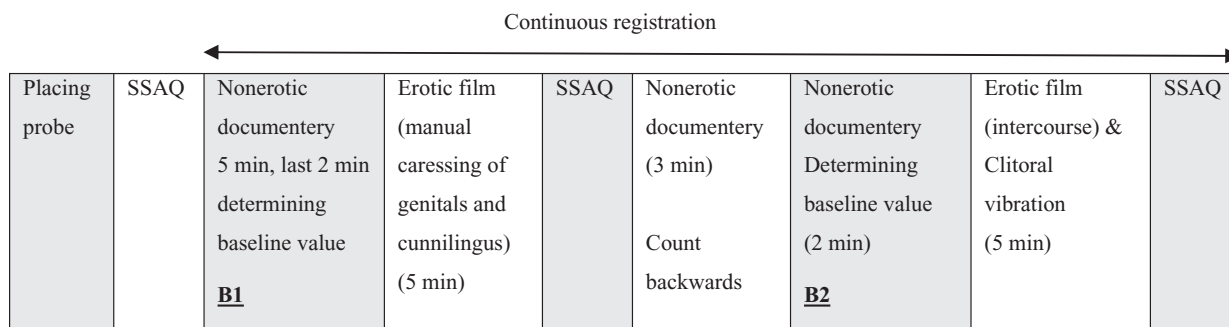


Figure 2 Experiment set-up. SSAQ = Subjective Self-Assessment Questionnaire.

variance. To inspect possible differences in change in VPA response over time, the 30-second VPA epochs minus each participant's mean baseline value were submitted to a 2 (pre- or postoperative) \times 2 (erotic film or erotic film and clitoral vibration) \times 10 (change in response over time) repeated measures analysis. Data were presented as mean (standard error of the mean [SEM]) or median (range) were appropriate. Questionnaire endpoints were analyzed by Mann–Whitney *U*-test. Statistical analysis was performed using SPSS for Windows version 15.0.1 (SPSS Inc., Chicago, IL, USA). Significance was set at $P < 0.05$.

Results

Participants

Thirty-three women underwent an elective laparoscopic IPAA with or without primary protecting loop ileostomy for UC or FAP between April 2004 and January 2006, of those patients 30 were eligible. Eleven (37%) patients gave informed consent and were included in this study (Table 1) of whom three refused to undergo the postoperative session. Two patients refused because they felt undergoing another test session was too bothersome (one of them did fill out the questionnaires) and one patient refused because her husband had

Table 1 Characteristics and postoperative results of eligible patients

	Patients with informed consent	Patients without informed consent
N	11	19
Age	37 (22–49)	33 (18–57)
ASA I : II	4:7	9:10
Operating time	300 (235–341)	277 (200–360)
Diagnosis		
Ulcerative colitis	10 (91%)	16 (84%)
Familial adenomatous polyposis	1 (9%)	3 (16%)
Type of surgery		
IPAA	9 (82%)	11 (58%)
IPAA + defunctioning ileostomy	2 (18%)	8 (42%)
Number of patients with morbidity within 30 days, N (%)	5 (45%)	7 (37%)
Major complications within 30 days, N (%)		
Anastomotic leakage	1 (9%)	2 (11%)
Reoperation because of suspicion anastomotic leakage	2 (18%)	0
Other complication requiring reoperation	0	3 (16%)
Minor complications within 30 days, N (%):		
Pulmonary embolism	1 (9%)	0
Urinary tract infection	1 (9%)	0
Other infection	0	2 (11%)
Reoperation within 30 days, N (%)	3 (27%)	5 (26%)
Readmission within 30 days, N (%)	2 (18%)	1 (5%)
Primary hospital stay (days)	10 (7–16)	8 (5–41)
Total hospital stay (days)	10 (7–17)	8 (5–71)

Values are median (range).

ASA = American Society of Anaesthesiologists; IPAA = proctocolectomy with ileal pouch anal anastomosis.

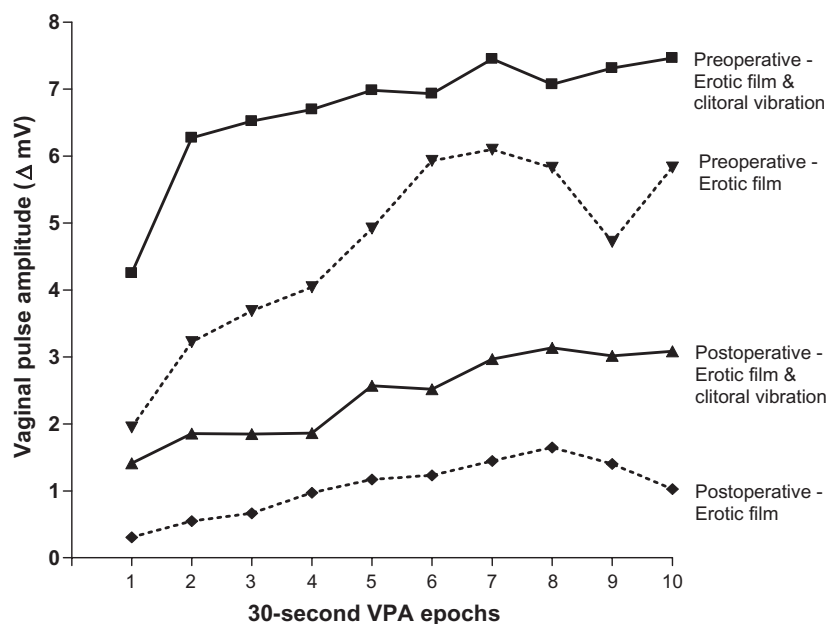


Figure 3 Results of vaginal pulse amplitude (VPA) response during sexual stimulation. Values are mean. Significant effect of operation and stimulus, $P = 0.012$ and $P = 0.022$.

just had a cerebrovascular accident. For the final analysis, eight patients were available.

Median (range) age at the time of the preoperative test session was 36 (21–41) years and during the postoperative test session 38 (23–42) years. None of the patients was postmenopausal. Preoperatively, five out of the eight patients were taking corticosteroids whether or not combined with mesalazine and/or azathioprine, four out of the eight patients were taking mesalazine combined with corticosteroids and/or azathioprine, and four out of eight were taking azathioprine whether or not combined with corticosteroids and/or azathioprine. One patient was not taking any medication. None of the patients had an alcohol intake of more than two glasses per week. The postoperative test session was done after a median of 1.9 (range 1.0–3.7) years and in case of a defunctioning ileostomy 1.4 (range 1.4–2.0) years after bowel continuity was restored.

Sexual History

Preoperatively all patients had a monogamous heterosexual relationship. At the time of the postoperative test session one patient was divorced and she did not have a sexual relationship. Patients had a median number of 3 (range 1–15) prior sex partners and 2 (range 1–3) long-term relationships. Two patients had never seen erotic materials prior to the study.

VPA

Mean (\pm SEM) VPA baseline values (B1 and B2) were significantly lower postoperatively (2.14 mV

± 0.68 and $2.10 \text{ mV} \pm 0.55$) than preoperatively ($6.05 \text{ mV} \pm 0.85$ and $7.16 \text{ mV} \pm 1.39$), $P < 0.001$. Pre- as well as postoperatively, B2 value returned to B1 value, $P = 0.51$ and $P = 0.96$, respectively.

There were no significant differences in mean (\pm SEM) preoperative VPA baseline values (B1 and B2) between patients taking corticosteroids or no corticosteroids, patients taking mesalazine or no mesalazine, or patients taking azathioprine or no azathioprine.

There was a significant negative effect of the operation ($P = 0.012$) and a significant effect of stimulus ($P = 0.022$), indicating that visual stimulation combined with clitoral vibration yields higher levels of VPA than visual stimulation alone. Also, the change in response over time was significant ($P = 0.049$), signifying an expected increase in VPA over time (Figure 3). The operation \times change in response over time interaction was marginally significant ($P = 0.074$). Postoperatively, VPA responses increased at a slower rate than preoperative VPA responses. In Figure 4, the significant effect of operation and significant effect of stimulus on VPAm_{mean} and VPAm_{max} are represented.

Three patients were suspected for an anastomotic leakage (Table 1) of whom 1 refused to undergo the postoperative test session. These three patients were reoperated. Because a second procedure may have had a greater impact on VPA, a subanalysis of the VPA data was done without the reoperated patients. In this subanalysis, the negative effect of the operation remained ($P = 0.033$ for

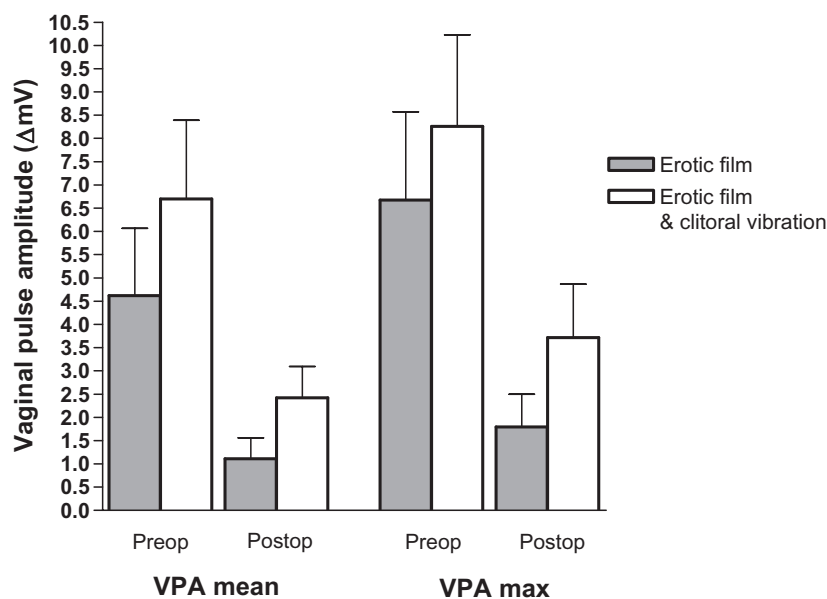


Figure 4 Results of vaginal pulse amplitude (VPA) response during sexual stimulation. Values are mean (VPAmean) and maximum (VPAmax) increase in VPA (\pm standard error of the mean) relative to baseline/VPAmean: Significant effect of operation and stimulus, $P=0.012$ and $P=0.020$.

VPAmax: significant effect of operation and stimulus, $P=0.009$ and $P=0.023$.

VPAmean and $P=0.030$ for VPAmax). All other effects remained significant as well.

Sexual Arousal and Lubrication Estimate

There was no effect of the operation on sexual feelings and affect on any of the five scales as measured by SSAQ (Table 2). Both pre- and postoperatively there was an effect of stimulus however, patients reported significantly stronger feelings of sexual arousal, genital sensations and positive affect during the erotic film and clitoral vibration than during the erotic film alone ($P=0.016$, $P=0.006$, $P=0.042$, respectively). Preoperative estimated vaginal lubrication was not significantly different from postoperative estimation (5.6 ± 1.27 versus 5.9 ± 0.73 , respectively).

Psychological, Relational and Sexual Functioning

There were no significant differences between pre- and postoperative reported psychological and relational functioning. Orgasmic functioning as measured with FSFI was significantly better postoperatively. The other postoperative scores on the different sexual functioning scales were not significantly different (Table 2).

Preoperatively patients scored significantly worse on 3 domains of the SF-36 (Role limitations due to physical problems, General health perceptions and Energy/vitality) when compared with a norm group of 135 healthy Dutch women aged 36–45 years [35]. Postoperative scores did not increase significantly compared with preoperative values, but postoperative scores no longer differed from the same norm group (Table 2).

Preoperative MMQ and BDI scores did not differ significantly from postoperative MMQ and BDI scores. One patient had a score of 28 on the domain of marital satisfaction measured by MMQ preoperatively; she was divorced at the time of the postoperative test session and did not fill in the MMQ postoperatively as she was not in a relationship. Her preoperative Δ VPA mean values for S1 and S2 were 0.87 and 1.78 mV, respectively; postoperative values were 0.37 and 0.65 mV. The other patients had MMQ scores that were not indicative of marital discord. No patient scored higher than 20 on the BDI, indicating that none of them was suffering from a depression.

Three patients had a preoperative FSFI score below 26.55, a score that is indicative of sexual dysfunction in one or more of the domains. All of these women reported distress about their sexual function (FSDS scores >15), as did one other woman with a FSFI score of 28.30. Postoperatively, one of these three women still scored below 26.55 on the FSFI, she complained of vaginal dryness and dyspareunia and reported distress (FSDS score of 19.1) about her sexual functioning. None of the women scoring within the functional range preoperatively had FSFI and FSDS scores within the dysfunctional range postoperatively.

Discussion

The present study is the first prospective clinical trial comparing preoperative genital response with postoperative genital response during sexual stimulation measured objectively by VPA in

Table 2 Outcome of questionnaires

	Preoperative	Postoperative	P
SSAQ (all scales 1–7); erotic film [†]			
Sexual arousal	3.2 ± 1.1	2.6 ± 0.9	0.28
Genital sensations	3.2 ± 1.2	2.9 ± 1.1	0.57
Sensuality	3.1 ± 1.3	3.1 ± 0.7	1.00
Positive affect	2.6 ± 1.3	2.3 ± 0.5	0.50
Negative affect	1.1 ± 0.1	1.1 ± 0.2	1.00
SSAQ (all scales 1–7); erotic film and clitoral vibration [†]			
Sexual arousal	4.1 ± 1.3	3.9 ± 1.1	0.73
Genital sensations	4.4 ± 1.3	4.1 ± 0.9	0.60
Sensuality	3.7 ± 1.0	3.4 ± 0.6	0.48
Positive affect	3.4 ± 1.4	3.1 ± 1.1	0.67
Negative affect	1.1 ± 0.2	1.2 ± 0.2	0.66
SF-36 (all scales 0–100) [‡]			
Physical functioning	80 (45–95)	90 (35–100)	0.47
Role physical	25 (0–100)	25 (25–100)	0.34
Bodily pain	73 (41–100)	74 (64–100)	0.51
General health perception	35 (25–97)	87 (25–100)	0.13
Vitality	45 (20–70)	60 (40–85)	0.08
Social functioning	63 (50–100)	100 (50–100)	0.29
Role emotional	100 (67–100)	100 (0–100)	0.62
Mental health	72 (60–88)	92 (40–96)	0.17
BDI [‡]			
Total score (0–63)	9.5 (7–17)	8 (3–17)	0.27
MMQ [‡]			
Marital satisfaction (0–80)	1.5 (0–28)	6.5 (1–14)	0.21
Sexual satisfaction (0–40)	5 (1–16)	6.5 (2–19)	0.72
General life (0–40)	11 (2–16)	9.5 (6–14)	0.83
FSFI [‡]			
Desire (1.2–6)	3 (2.4–3.6)	3.6 (2.4–4.2)	0.46
Arousal (0–6)	4.5 (0–6)	5.1 (1.2–6)	0.52
Lubrication (0–6)	5.7 (0–6)	5.9 (3.6–6)	0.59
Orgasm (0–6)	4.4 (0–6)	5.6 (2.8–6)	0.05
Satisfaction (0.8–6)	4.8 (1.6–6)	4.8 (3.6–5.6)	0.55
Pain (0–6)	6 (0–6)	6 (4–6)	0.29
Total score (2–36)	28.2 (5–34)	31.8 (19–33)	0.09
FSDS [‡]			
Total score (0–48)	14.2 (0–25)	7.6 (0–26)	0.45

Values are mean ± standard deviation or median (range).

[†]Student's *t*-test.

[‡]Mann-Whitney *U*-test.

SSAQ = Subjective Self-Assessment Questionnaire; score ranging from 1 (not at all) to 7 (intensely). SF-36 = Short-Form 36; higher score is better quality of life. BDI = Beck Depression Inventory; higher score is more depression. MMQ = Maudsley Marital Questionnaire; higher score is more dissatisfied. FSFI = Female Sexual Function Index; higher score is better sexual function. FSDS = Female Sexual Distress Scale; higher score is more sexual distress.

women who underwent a restorative proctocolectomy with IPAA.

Pelvic autonomic nerves regulate the blood flow in the vessels of the vaginal wall [20]. This study demonstrated that vaginal blood flow after IPAA was significantly reduced, indicating some sort of damage to the pelvic autonomic nerves. As the lubrication response is also neurogenically controlled, reduced lubrication will result in vaginal dryness, which can lead to dyspareunia [20]. Nevertheless, self-estimated vaginal lubrication, psychological and sexual functioning before and after surgery were comparable. Sexual feelings and sexual affect after an erotic stimulation were also assessed, these were equally strong pre- and postoperatively.

It was surprising that VPA was significantly lower after IPAA as the hypogastric nerve was carefully identified and spared in all patients. As the hypogastric nerve trunk was preserved, and anteriorly a close rectal dissection was performed it is difficult to explain the cause of decreased VPA after surgery. Extirpation of nerve fibres in the mesorectum might play a role. Another explanation might be the disconnection between the posterior vaginal wall and the anterior part of the rectum, possibly affecting vaginal blood flow, but this is not likely as the vaginal blood flow originates from the side. The role of inflammation and its concomitant effect on vascularized tissues should be considered as a possible explanation as well. Seven out of the eight analyzed patients were

operated because of refractory ulcerative colitis. Ulcerative colitis is an inflammatory bowel disease. Inflammation can be classified into acute or chronic inflammation. Acute inflammation is characterized by a classic vascular response (dilatation of the small vessels resulting in tissue hyperaemia), whereas chronic inflammation is associated with a diminished vascular perfusion [44]. All operations were performed in an elective setting. This suggests that most patients were suffering from chronic inflammation and not from acute inflammation, which implies that the significantly higher preoperative VPA values have not been caused by higher vascularization in the genital system because of ulcerative colitis. Nevertheless, this assumption cannot be assured, as the colon of a refractory colitis patient, in an elective setting, can definitely be engorged and inflamed. So, it might be possible that the inflammatory response has been responsible for the elevated preoperative baseline VPA values in this study.

As a reduced genital response was recorded after IPAA, it could be expected that postoperative sexual arousal, estimated vaginal lubrication and sexual functioning was diminished. This would have been in accordance with 8 out of the 10 studies published about sexual function after IPAA [10–17]. However, sexual feelings, perception of lubrication and sexual functioning were similar pre- and postoperatively in our study group. This observation can be explained by the fact that correlations between genital arousal and subjective sexual arousal are generally low in women [45]. In addition, the best predictors of good sexual functioning in women are emotional well-being and the emotional relationship with the partner, whereas physical aspects (including arousal, lubrication) are poor predictors [26]. Another explanation might be that all patients in this study were operated for a benign disease and studies have shown that ulcerative colitis patients have a better quality of life after IPAA [46,47] as removal of the diseased colon has reduced the need for hospital visits and the usage of medication. Lastly, sexual function is not only determined by the autonomic nerves. Anatomical changes, pouch related problems and psychological factors play a role as well [26–28].

At the end of the procedure patients were asked to estimate their vaginal lubrication, which is obviously a subjective account. Another way to estimate vaginal lubrication is by measuring vaginal transudate using a weighed absorbent material (tampons, filter paper, gel) inserted into the

vaginal lumen and left for a fixed time. On its removal it is weighed, heated to dryness and then reweighed. From these weighings the amount of fluid and solid absorbed onto the absorbent can be calculated [48]. The method cannot follow rapid changes in lubrication and it is difficult to do serial measures as the tampons dry out the epithelium [49]. Also, reliability of the method is questionable given that the squamous surface of the vaginal epithelium may not allow accurate assessment of transudate volume [50]. It is therefore unknown whether measurement of vaginal transudate is more accurate than subjective patient accounts of vaginal lubrication. Very few studies matched subjective lubrication estimates with physiological data. One small pilot study [51] reported on the relationship between subjective lubrication and vaginal vasocongestion using magnetic resonance imaging and vaginal photoplethysmography. The physiological measures did not correlate with subjective assessments of lubrication. Another study found reasonable agreement between VPA and subjective lubrication scores [52].

After a radical prostatectomy, erectile dysfunction is one of the major complications and considered a consequence of neuropraxia (cavernosal dysfunction). Literature has shown though, that recovery of erectile function occurs. Up to 3 years of recovery time has been reported [53–55]. In this study, the postoperative test session was done within two years after the operation. When considering the time needed for recovery in erectile function, a recovery in vaginal vasocongestion due to a recovery of the hypogastric nerve is not unimaginable. So, we might have performed the postoperative VPA measurement too early. It will be interesting to measure the same patients again.

The applied surgical technique has been a nerve saving total mesorectal excision approach towards the posterolateral rectum. Anteriorly, the dissection was done close rectal in order to avoid nerve damage anteriorly. It is unknown whether the nerve fibers within the mesorectum running to the pelvic floor play a role. A close rectal approach posteriorly might preserve these fibres. Whether this is clinically relevant must be determined by future research.

It proved to be very difficult to recruit patients for this study as it is an intimate experiment and may be experienced as invading on one's privacy; the power of this study is therefore low. Only 11 of the 30 eligible patients wanted to participate in this study, but as patient characteristics of the nonparticipants and participants were comparable, these

results are representative for the entire patient group. Nevertheless, the nature of this study has introduced a volunteer bias as it is known that patients willing to participate in a sexuality study have a more positive attitude towards sexuality and are more sexually active. This is true for all women participating in this type of research, regardless of their health-status [56]. The small sample size should be taken into account when interpreting the results of the questionnaires. Although there were no significant differences found, all scores on the domains of the SF-36 and FSFI were similar or higher postoperatively, and higher scores are related to a better quality of life and better sexual function. Unfortunately, the small sample size precluded an originally planned multiple regression analysis investigating whether potential changes in vaginal vasocongestion postoperatively can be explained by psychological and relationship functioning. The descriptive information provided on these variables suggests that it is unlikely that the reduction in postoperative vaginal vasocongestion can be explained by changes in these variables.

Up to date, the role between anxiety and VPA is still unclear; some studies have shown an increase of VPA and some a decrease of VPA. In this study the VPA procedure did not result in negative affect and therefore it is unlikely that negative affect has been of influence on genital response.

Patients that were reoperated because of a suspected anastomotic leakage were excluded in a subanalysis as this could possibly be of bigger influence on the postoperative VPA data than the noncomplicated patients. Nevertheless, vaginal vasocongestion was still significantly reduced after the operation in the remaining six noncomplicated patients.

In conclusion, vaginal vasocongestion after IPAA was significantly reduced in this small study; indicating that IPAA in women might possibly be associated with autonomic pelvic nerve damage or partial devascularization of the vagina. Subjective reported sexual arousal, estimated lubrication, psychological, and sexual functioning were not diminished. Future research should include more patients and focus on the possible advantage of a full close rectal dissection.

Corresponding Author: Willem Bemelman, MD, PhD, Department of Surgery, Academic Medical Center, PO Box 22660, 1100 DD, Amsterdam, The Netherlands. Tel: 0031205666818; Fax: 0031206915462; E-mail: w.a.bemelman@amc.uva.nl

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Statement of Authorship

Category 1

(a) Conception and Design

Ellen T. Laan; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman; Malaika S. Vlug

(b) Acquisition of Data

Malaika S. Vlug; Ellen T. Laan; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman

(c) Analysis and Interpretation of Data

Malaika S. Vlug; Ellen T. Laan; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman

Category 2

(a) Drafting the Article

Ellen T. Laan; Malaika S. Vlug; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman

(b) Revising It for Intellectual Content

Malaika S. Vlug; Ellen T. Laan; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman

Category 3

(a) Final Approval of the Completed Article

Malaika S. Vlug; Rik H.W. van Lunsen; Paul J. van Koperen; Sebastiaan W. Polle; Willem A. Bemelman

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