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EFFECTS OF VAGINAL HYSTERECTOMY ON ANORECTAL SENSORIMOTOR FUNCTIONS – A PROSPECTIVE STUDY

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Abstract

Background—While bowel and bladder dysfunction are recognized consequences of a radical hysterectomy, the effects of a simple hysterectomy on anorectal sensorimotor functions, particularly rectal sensation, vary among studies and the effects on rectal compliance are unknown. Our aims were to prospectively evaluate anorectal sensorimotor functions before and after a hysterectomy.

Methods—Anal pressures, rectal compliance, capacity, sensation, and bowel symptoms were assessed before, at 2 months, and at 1 year after a simple vaginal hysterectomy for benign indications in 19 patients. Rectal staircase (0-44 mmHg, 4-mmHg steps), ramp (0-200mL at 50, 200 and 600 mL/min) and phasic distentions (8, 16, and 24mmHg above operating pressure) were performed.

Key Results—Anal resting (63 ± 4 before, 56 ± 4 mmHg after) and squeeze pressures (124 ± 12 before, 124 ± 12 mmHg after), rectal compliance and capacity (285 ± 12 before, 290 ± 11 ml 1 year after), and perception of phasic distentions were not different before versus after a hysterectomy. Sensory thresholds for first sensation and the desire to defecate were also not different, but pressure and volume thresholds for urgency were somewhat greater (Hazard Ratio=0.7, 95% CI [0.5, 1.0]) 1 year after (versus before) a hysterectomy. Rectal pressures were higher ($p < 0.0001$) during fast compared to slow ramp distention; this rate effect was greater at 1 year after a hysterectomy, particularly at 100 ml ($p=0.04$).

Conclusions and Inferences—A simple vaginal hysterectomy has relatively modest effects (i.e., somewhat reduced rectal urgency and increased stiffness during rapid distention) on rectal sensorimotor functions.

Keywords

anal pressures; anorectal functions; compliance; hysterectomy; rectal sensation; reproducibility

Hysterectomy is the second commonest surgical procedure among women in the USA with over > 600,000 procedures performed annually. (1) Hysterectomy is a risk factor for pelvic

organ prolapse (2) and urinary incontinence, (3) and, in some studies, is also thought to influence the prevalence of functional bowel disorders. In a health maintenance organization dataset of over 89,000 patients from the United States, women with a diagnosis of irritable bowel syndrome (IBS) were twice as likely as controls to have had a hysterectomy. (4) It is unknown if IBS symptoms occurred before or after surgery in that study. In a prospective study, 10% of a group of 205 women undergoing hysterectomy reported new symptoms of IBS, predominantly constipation, after the operation; bowel symptoms improved in 60% and worsened in 20% of a subset of 45 patients who had IBS symptoms before hysterectomy. (5) In addition, flatus incontinence, rectal urgency, and inability to distinguish between gas and feces have been reported after an abdominal but not vaginal hysterectomy. (6) However, in a recent prospective controlled study, abdominal pain but not disordered bowel habits were more common after compared to before a hysterectomy. (7)

Among women who develop bowel symptoms after a hysterectomy, the etiology is unclear. Peri-operative antibiotic use, the stress of surgery, and anorectal dysfunctions, perhaps secondary to nerve damage during dissection of the rectovaginal septum, have all been implicated. (8) Anorectal (9) and bladder dysfunction (10) are recognized to occur after a radical hysterectomy. However, there is conflicting evidence on the effects of simple hysterectomy on anorectal sensorimotor functions. Among women with non-diarrhea predominant irritable bowel syndrome, hysterectomy was associated with weaker squeeze pressures. (11) However, only 1 of 3 prospective studies that compared anorectal functions before and after a hysterectomy observed a statistically significant, albeit small, decline in anal pressures after a hysterectomy, primarily due to a large reduction in women with 5 or more vaginal deliveries. (12-14) The other 2 studies revealed no change in anal pressures and either no change or reduced rectal sensation in women who had a hysterectomy. (12, 13) In these 3 studies, the duration of follow up after hysterectomy was 4 months, 6 months, and 11-18 months. Moreover, rectal sensation was evaluated by manually distending a latex balloon, which is less precise than a barostat, and does not evaluate rectal compliance. (15) Hence, the mechanisms by which a hysterectomy may affect rectal sensation are unclear. This study prospectively evaluated the effects of a simple vaginal hysterectomy on bowel symptoms and anorectal sensorimotor functions.

MATERIALS & METHODS

Subjects

The protocol was approved by the Institutional Review Board at Mayo Clinic and all subjects provided written informed consent. Bowel symptoms and anorectal sensorimotor function were assessed before, 2 months, and 1 year after a vaginal hysterectomy for benign conditions (e.g. dysfunctional uterine bleeding unresponsive to hormonal management, uterine fibroids, benign adnexal mass, mild-moderate uterine prolapse (upto Stage II by Halfway scale) or pre-malignant conditions (e.g., cervical dysplasia, uterine hyperplasia) in 19 women. Patients had to be willing and able to return for follow-up assessment between 6 and 9 weeks and subsequently at one year after a hysterectomy.

Patients with known major risk factors for anal sphincter injury (i.e., any delivery with birth weight > 4000 gm, forceps-assisted deliveries, 6 vaginal deliveries, or a known 4th degree perineal tear) were excluded as were patients with inflammatory bowel disease, rectal cancer, or previous rectal surgery. A physical examination was performed to exclude significant cardiovascular, respiratory, neurologic, psychiatric or endocrine disease. Patients did not have prior abdominal surgeries except for appendectomy and/or cholecystectomy. They were not taking medications that potentially affect anorectal sensorimotor functions. Bowel symptoms were assessed by a validated bowel disease questionnaire. (16, 17)

Anxiety and depression were assessed by the Hospital Anxiety and Depression (HAD) Questionnaire. (18)

Assessment of Anorectal Sensorimotor Functions

After 2 sodium phosphate enemas (Fleets®, C.B. Fleet, Lynchburg, VA), anorectal testing (i.e., anal manometry, assessment of rectal compliance and sensation by a barostat) was conducted in the left lateral position. The water-perfused manometric catheter had 8 sensors, i.e., 4 circumferentially oriented sensors at each of 2 levels separated by 2 cm. Average anal resting and squeeze pressures were measured by the distal group of 4 sensors using the station pull-through technique. (16) Thereafter, rectal pressure-volume relationships (compliance) and sensation were recorded using previously validated techniques by an “infinitely” compliant 7-cm long balloon with a maximum volume of 500 ml (Hefty Baggies, Mobil Chemical Co., Pittsford, NY) linked to an electronic rigid piston barostat (Mayo Clinic, Rochester, MN). (19, 20) (Figure 1) An initial or conditioning distention, a rectal staircase distention (0-32 mm Hg in 4-mm Hg steps at 1 minute intervals), ramp distentions from 0-200 mL at 50, 200 or 600 mL/min in randomized order, and phasic distentions 8, 16, and 24 mmHg above operating pressure, also in randomized order, were performed. During the staircase distention, rectal pressure-volume relationships were analyzed by a power exponential function and summarized by the pressure corresponding to half maximum volume (Pr_{half}) and rectal capacity (i.e., maximum volume). (20, 21) Rectal sensory thresholds for first sensation, desire to defecate (DD), and urgency were recorded during staircase and ramp distentions; the threshold was the first sensation of each symptom. Subjects also rated the intensity of perception for the desire to defecate and pain on two separate 100 mm long visual analog scales (VAS) during phasic distentions; (22, 23) each distention was maintained for 1 minute, with an inter-stimulus interval of 1 minute, during which the balloon was deflated to operating pressure.

Statistical Analysis

The statistical analysis compared anorectal functions before and after a hysterectomy. Parametric (e.g., paired t test) or corresponding nonparametric tests (Wilcoxon signed rank) compared anal pressures and balloon expulsion after (i.e., 2 months and 1 year) versus before a hysterectomy. The effects of a hysterectomy on rectal compliance (i.e., Pr_{half} and rectal capacity) and VAS scores during phasic distentions were assessed by a repeated measures analysis of variance. Sensory thresholds for first sensation, desire to defecate, and urgency before and after hysterectomy were assessed using proportional hazard regression models that estimated the “risk” (probability) for reporting a specific sensation threshold over increasing pressure steps analogous to a survival analysis over time. When a sensation was not recorded, the pressure values were “censored” at the next more intense threshold or last pressure step during the staircase distention. Using the observed variation of within subject differences (e.g. baseline vs. 1-year post hysterectomy) in endpoints (i.e., anal pressures, balloon expulsion, compliance (Pr_{50}), and phasic distention scores), we estimated the magnitude of the differences (baseline vs. 1-year) that could be detected with approximately 80% power (2-sided alpha level of 0.05) assuming a sample size of 20 subjects.

RESULTS

Clinical Features and Surgical Characteristics

Nineteen women aged 25 to 66 years (46 ± 3 years, Mean $\pm$ SEM) with a BMI of 31.4 ± 1.4 kg/m², who had a hysterectomy for benign indications (i.e., uterine fibroids [4 patients], uterine prolapse [6 patients], menstrual disorders [6 patients], endometriosis [1 patient], pelvic pain [1 patient], or an abnormal PAP smear (1 patient) elected to participate in the

study. Another 8 women (49 ± 4 years) with a BMI of 29.4 ± 1.8 kg/m² who were scheduled to have a hysterectomy were screened but declined to participate in the study.

Among the participants, 6 women also had a procedure to repair anterior and posterior pelvic organ prolapse and 1 patient had an anterior pelvic floor repair procedure. Twelve patients had a salpingo-oophorectomy. Seventeen patients had an uncomplicated procedure; one patient each had a urinary tract infection and a transient ischemic attack after the hysterectomy. There were no significant local complications after a hysterectomy. All patients completed all assessments. Two patients had symptoms of functional constipation before and 2 different patients had symptoms of functional constipation after a hysterectomy. However, these symptoms were neither clinically significant nor required therapy. The HAD score revealed mild anxiety at baseline in 1 patient.

Effect on Anal Pressures and Rectal Pressure-Volume Relationships

Average anal resting and squeeze pressures were not significantly different at 2 months or 1 year after a hysterectomy (Table 1). There were no significant differences in rectal compliance parameters measured during staircase distentions (i.e., rectal capacity, Pr₁₀, or Pr_{half}) after (i.e., 2 months or 1 year) compared a hysterectomy either (Table 1).

During rectal ramp distentions, rectal balloon pressures were influenced ($p < 0.0001$) by the rate of distention, being higher during fast compared to slow distention at low (i.e., 50 ml), intermediate (i.e., 100 ml), and high (i.e., 200 ml) volumes (Figure 2). This rate effect was more pronounced, suggesting the rectum was stiffer, at 1 year after a hysterectomy, particularly at 100 ml ($p = 0.04$) and to a lesser extent at 50 ml ($p = 0.08$).

Effect on Rectal Sensation

During staircase distentions, 18 subjects perceived the first threshold and desire to defecate and 16 subjects perceived rectal urgency on all 3 occasions (i.e., at baseline, 2 months, and 1 year after hysterectomy). One subject each did not perceive the first threshold (at 1 year) and desire to defecate (at baseline). One subject did not perceive urgency at baseline and 3 did not perceive urgency at 2 months and at 1 year after a hysterectomy. Compared to baseline, pressure and volume thresholds for first sensation and the desire to defecate were not significantly different at 2 months and separately at 1 year after a hysterectomy (Table 2). However, compared to baseline, the hazard ratios (HR) for pressure and volume thresholds were 0.7 (95% CI, 0.5, 1.0) at 1 year. A hazard ratio of 0.7 implies the pressure threshold was 30% lower in the first study relative to the second, i.e., the rectum was more sensitive at baseline (or less sensitive at 1 year). For example, the volume needed to evoke urgency in ~60% of subjects was 236ml after versus 204ml before. For pressure thresholds, the H.R. was also 0.7 but the shift was subtle, as evidenced by comparable median values (i.e., 24 mmHg) before and after hysterectomy (Table 2).

During phasic distentions, sensation scores for the desire to defecate and pain were higher ($p < 0.0001$) with increasing intensity of distention, indicating a “dose” effect (Table 1). For the desire to defecate, this dose effect was modified by a hysterectomy (i.e., the interaction term was significant), as evidenced by different temporal profiles in VAS scores at 8, 16, and 24 mmHg pressure levels at 2 months and 1 year after a hysterectomy. Between baseline and 2 months after a hysterectomy, VAS scores increased for 8 mmHg and decreased for 24 mmHg distention, remaining unchanged for the 16 mmHg distention. However, at 1 year after a hysterectomy, VAS scores were very similar to baseline.

Effects of Pelvic Floor Repair

The effects of a hysterectomy on anorectal functions were not significantly different among women who did ($n = 6$) and women who did not have a posterior pelvic floor repair procedure ($n = 13$) (Table 3).

Post-Hoc Sample Size Assessment

Assuming a sample size of 20 subjects and a two-sided alpha level of 0.05, the estimated differences that could have been detected with approximately 80% power are provided in Table 4. This assessment suggests that the sample size was sufficient to detect clinically significant effects on anorectal sensorimotor functions.

DISCUSSION

In this prospective study, anal pressures, rectal compliance, and capacity were not significantly different at 2 months and 1 year after versus before a simple vaginal hysterectomy. However, at 1 year after a hysterectomy, rectal pressures during rapid rectal distention were higher, suggestive of a more pronounced rectal contractile response. Also, pressure and volume thresholds for rectal urgency were somewhat higher at 1 year after surgery suggestive of reduced rectal perception.

The effects of a simple hysterectomy on rectal sensation have varied among studies. Cross-sectional studies reported that rectal sensation was lower in women who had compared to women who did not have a hysterectomy. (24, 25) In contrast, prospective studies reported no change or increased rectal sensation after a hysterectomy. (12-14) However, these studies evaluated rectal sensation by manually distending a latex balloon, which only measures rectal sensation but not compliance. We evaluated rectal perception with a variety of barostat-driven distention paradigms. The only difference after a hysterectomy was reduced rectal perception of urgency, which was mild, of borderline statistical significance, and of uncertain clinical significance. Both pressure and volume thresholds for urgency were reduced, which suggests that these changes are not secondary to altered rectal compliance but perhaps reflect a primary effect on rectal sensation. Reduced sensation has been attributed to colorectal denervation during a hysterectomy. (26)

Rectal compliance and capacity measured by staircase distention were not significantly different after a hysterectomy. Confirming previous studies in asymptomatic women and in women with fecal incontinence, the rectum was stiffer during fast than slow ramp distention, probably because rapid distention evokes a more pronounced contractile response than slow distentions. (27, 28) At 1 year after a hysterectomy, this rate effect was more pronounced, particularly at an intermediate volume (100 mL) and to a lesser extent at 50 mL, but was not evident at the highest volume (200 mL). Since “active” properties (e.g., the contractile response to distention) explain a larger component of rectal distensibility at lower than higher distending volumes, (23) these observations are consistent with the explanation that rapid distention induces a more pronounced contractile response after a hysterectomy. Conceivably, disruption of inhibitory sympathetic fibers emanating from the inferior hypogastric plexus or in the uterine supporting ligaments, which can occur even during a simple hysterectomy, may predispose to an exaggerated contractile response during rapid rectal distention. (8, 29) Significantly more autonomic nerves are transected during dissection of the uterine supporting ligaments in a radical hysterectomy, (8, 30, 31) which likely explains why this procedure has more pronounced effects on anal resting and squeeze pressures and rectal sensation than a simple hysterectomy. (9, 32) In addition, adjuvant pelvic radiotherapy in patients with malignancy undergoing a radical hysterectomy may also affect rectal function. However, even among women undergoing a simple hysterectomy, the

incidence of bowel symptoms may be influenced by the type of hysterectomy. In one cross sectional study, vaginal or laparoscopic but not abdominal hysterectomy was associated with a two-fold increased risk of defecatory symptoms. (33) In contrast, anal incontinence of flatus (6) or feces (6) was more common after abdominal than vaginal hysterectomy. Also, among women with descending perineum syndrome, fecal incontinence was more common among women with than without an abdominal hysterectomy. (34) Hence, the effects of an abdominal hysterectomy on anorectal functions should be studied.

While this study was uncontrolled, anorectal sensorimotor functions were assessed by rigorous and reproducible techniques. (19) Without a control group (e.g., of patients undergoing endometrial ablation), it is unclear whether the observed changes after the operation are due to a hysterectomy per se. The population was predominantly comprised of Caucasian subjects and a majority were obese. BMI is an independent risk factor for fecal incontinence (36) and is also positively associated with a lower pelvic floor, suggesting pelvic weakness at rest (unpublished data). To speculate, if a higher BMI predisposes to anorectal dysfunctions after a hysterectomy, it is conceivable, based on these data, that a hysterectomy will have less pronounced effects on anorectal functions in non-obese women. The indications for hysterectomy were heterogeneous and some patients had adjunct procedures (e.g., salpingo-oophorectomy). Though small, the sample size was probably sufficient to identify clinically significant effects of a hysterectomy on anorectal parameters. For example, the minimum detectable difference in anal pressures in this study was lower than observed differences between women with fecal incontinence and controls. (20) Similarly, the minimum detectable effect on rectal compliance was smaller than the observed effects of neostigmine. (35) While the sample size was probably insufficient to identify the effects of adjunct procedures (e.g., salpingo-oophorectomy), which may potentially affect anorectal functions through hormonal effects, menopausal status was not an independent risk factor for FI in a recent case-control study. (36) Since associations between defecatory disorders, voiding dysfunction, and pelvic organ prolapse have been described, further studies evaluating the effects of a hysterectomy on rectal evacuation are necessary. (37-40) Since the onset of fecal incontinence after a vaginal hysterectomy may be delayed, long term studies are necessary to evaluate the effects of a hysterectomy on anorectal functions. (41)

From a clinical perspective, these findings are reassuring and suggest that the risk of developing bowel symptoms should not influence the decision to opt for a hysterectomy or a less invasive option (e.g., endometrial ablation) in women who do not have bowel symptoms before the procedure. (42) Perhaps, a subtotal hysterectomy, which does not require dissection of the uterosacral ligaments, should be considered in women who have significant anorectal symptoms, prior to hysterectomy. (43)

In conclusion, the results of this prospective, uncontrolled study suggest that anal pressures, rectal compliance, and capacity during staircase distention and perception of first sensation and desire to defecate during rectal distentions were not significantly different before and after a hysterectomy. However, relatively subtle effects on anorectal sensorimotor functions (i.e., increased rectal stiffness during rapid distention and borderline reduced perception of urgency during phasic distention), which are of uncertain clinical significance, were observed at 1 year after a simple vaginal hysterectomy. Taken together with a recent prospective assessment of bowel symptoms (7), these findings suggest that overall, a simple vaginal hysterectomy has relatively modest effects on anorectal functions.

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Figure 1. Study Design

After anorectal manometry (not shown), rectal sensorimotor functions were assessed by a conditioning distention (labeled 1), a staircase distention (2, 0-32 mmHg, 4 mmHg steps), ramp distentions (3) from 0 to 200 ml (at 50, 200, and 600 ml/min in randomized order), and phasic distentions (4) 8, 16 and 24 mmHg above operating pressure, also in randomized order. Sensory thresholds were assessed during staircase distentions while VAS scores for desire to defecate and pain were recorded during phasic distentions.

Figure 2. Effect of Hysterectomy on Rectal Balloon Pressure During Ramp Distentions at Varying Rates

Rectal pressures were higher ($p < 0.0001$) during rapid than slow distention and, at a volume of 100 ml ($p = 0.04$), more so at 1 year after hysterectomy. For clarity, data at 2 months after hysterectomy are not shown here.

Table 1

Effects of Hysterectomy on Anal Pressures, Rectal Compliance, and Rectal Perception of Phasic Distention

Parameter	Before	After (2 months)	After (1 year)
Anal resting pressure (mmHg)	63 ± 4	63 ± 4	56 ± 4
Anal squeeze pressure (mmHg)	124 ± 12	127 ± 11	124 ± 12
Rectal compliance (Pr _{half} , mmHg)	16.3 ± 0.9	17.2 ± 0.6	16.4±0.8
Rectal capacity (ml)	285±12	288±10	290±11
VAS scores during rectal distension Sensation (distension intensity)*			
Desire to defecate (8)	30. ± 5	40 ± 6	30 ± 5
Desire to defecate (16)	45 ± 6	49 ± 4	49 ± 5
Desire to defecate (24)	64 ± 5	54 ± 4	64 ± 5
Pain (8)	26 ± 6	37 ± 6	26 ± 5
Pain (16)	44 ± 7	49 ± 4	39 ± 6
Pain (24)	55 ± 7	52 ± 5	54 ± 7

* Distentions are in mmHg above balloon operating pressure

Table 2
Effects of Hysterectomy on Rectal Sensory Thresholds During Staircase Distentions

	Before	After (2 months)		After (1 year)	
	Median (Range)	Median (Range)	HR (95% CI) versus before	Median (Range)	HR (95% CI) versus before
First sensation Pressure Volume	15 (0 – 27) 109 (6 – 274)	12 (3 – 24) 58 (11 – 209)	1.4 (0.8, 2.7) 1.3 (0.7, 2.5)	12 (0 – 19) 85 (3 – 170)	1.6 (0.9, 2.9) 1.4 (0.8, 2.3)
Desire to defecate Pressure Volume	18 (7 – 44) 149 (50 – 288)	16 (3 – 44) 137 (15 – 325)	0.1 (0.7, 1.5) 1.0 (0.6, 1.65)	16 (11 – 28) 148 (62 – 238)	1.2 (0.8, 1.9) 1.3 (0.8, 1.9)
Urgency Pressure Volume	24 (11 – 44) 190 (99 – 312)	24 (7 – 44) 201 (30 – 336)	0.7 (0.5, 1.1) 0.8 (0.5, 1.2)	24 (15 – 44) 215 (76 – 351)	0.7 (0.5, 1.0) 0.7 (0.5, 1.0)

HR = Hazards ratio

Pressure and volume thresholds are in mmHg and ml respectively

Table 3

Comparison of Anorectal Functions before and after Hysterectomy with and without Pelvic floor Repair

	Hysterectomy without repair (n=6)		Hysterectomy with repair (n=13)	
	Before	After	Before	After
Anal resting pressure (mmHg)	61 ± 7	59 ± 6	64 ± 6	54 ± 5
Anal squeeze pressure (mmHg)	122 ± 12	114 ± 16	126 ± 17	128 ± 16
Rectal capacity (ml)	296 ± 11	296 ± 21	280 ± 17	287 ± 14
Rectal compliance (Pr _{half} , mmHg)	17.7 ± 2.2	16.6 ± 1.3	15.6 ± 1.0	16.3 ± 1.0
VAS Score – Desire to defecate (mm)	41 ± 13	50 ± 8	48 ± 7	49 ± 7
VAS Score – Pain (mm)	42 ± 13	38 ± 25	46 ± 8	39 ± 8

Table 4

Estimated Differences That Could Have Been Detected for the Effects of Hysterectomy on Anorectal Sensorimotor Functions

	SD of differences (Before – 1 year)	Difference that could be detected with ~80% power[†]
Anal resting pressure (mmHg)	16.8	11 mmHg
Anal squeeze pressure (mmHg)	30.8	21 mmHg
Rectal compliance (mmHg) Pr ₅₀	3.1	2.1 mmHg
VAS Score – Desire to defecate (mm)	30	20 units
VAS Score – Pain (mm)	30	20 units