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OBSTETRICS & GYNECOLOGY | RESEARCH ARTICLE

Surgical management is associated with sexual dysfunction in gynecologic cancer

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Abstract: *Introduction*: This study aims to assess the role of route of hysterectomy, operative times, and lymphadenectomy on sexual function using the female sexual function index (FSFI) questionnaire. *Methods/materials*: The FSFI, a survey of validated instruments, was used to assess sexual dysfunction in 171 women with gynecologic cancer in this cross-sectional study. A sub-analysis was performed for patients who underwent hysterectomy. A significant decline in sexual function was determined to be a decrease of 5.8 points from pre-diagnosis to post-treatment scores using a Reliable Change Index Statistic. Statistical analysis included chi-square, Student's *t*-tests, and logistic regression. The primary outcome was determination if surgical route is associated with sexual dysfunction. Secondary outcomes were effect of operative time, lymphadenectomy, and lymph nodes removed on postoperative sexual function. *Results*: Hysterectomy was performed in 123 patients; 67% (*n* = 82) had total abdominal hysterectomy (TAH) and 33% (*n* = 41) had minimally invasive surgery (MIS). Women with TAH reported greater sexual dysfunction (50% vs. 22%; OR: 3.6; 95% CI 1.5–8.4), were more likely to be age <50 (36.6% vs. 14.6%; OR: 3.4; 95% CI 1.3–8.9), have longer operating times (270 min ± 108 vs. 230 min ± 49; *p* = 0.02), and have more lymph nodes removed (15.9 ± 6.2 vs. 12.2 ± 9.8; *p* = 0.05). In logistic regression, TAH and age <50 were independent

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PUBLIC INTEREST STATEMENT

Gynecologic malignancies can effect outcomes in sexual function by causing anatomic disruptions, sexual arousal difficulty, decreased lubrication, and early menopause. In addition, many patients experience psychologic and emotional changes surrounding their sexuality after undergoing surgical treatment for gynecologic cancer. Surgery often plays an integral role in a new cancer diagnosis, and it is often performed early in the treatment course. However, there is limited data published on the effect of surgical route on female sexual function. The objective of this study is to determine the incidence and risk factors of self-reported sexual dysfunction in patients undergoing hysterectomy for management of gynecologic malignancy. We hypothesized that patients undergoing total abdominal hysterectomy (TAH) would have worse postoperative sexual function than those undergoing a minimally invasive surgery (MIS).

predictors of sexual dysfunction, while operative time and lymphadenectomy were not. *Conclusions*: TAH and age <50 are risk factors for sexual dysfunction following hysterectomy for gynecologic cancer.

Subjects: Obstetrics, Gynecology & Women's Health; Gynecologic Oncology; Gynecologic Surgery

Keywords: female sexual dysfunction; female sexual function index (FSFI); genital neoplasms; adult sexuality; cancer

1. Introduction

Gynecologic malignances account for 12.1% of female cancer diagnoses annually, with an estimated total of 98,280 new cases in the United States in 2015 according to the Surveillance, Epidemiology, and End Results (SEER) program (Howlader et al., 2016; Siegel, Miller, & Jemal, 2015). Disruptions to sexual function occur in many women after treatment for gynecologic cancer and have multi-factorial etiologies. Surgical management of cancer can alter sexual function by shortening the vagina, damaging pelvic nerves, orgasmic disruption, sexual arousal difficulty, decreased vaginal lubrication, and early menopause (Bergmark, Åvall-Lundqvist, Dickman, Henningsohn, & Steineck, 1999; Gilbert, Ussher, & Perz, 2011). Additionally, removal of the uterus and ovaries can affect feelings of femininity and contribute to loss of sexual identity (Cull et al., 1993).

Stead et al. conducted a study of semi-structured interviews to determine the effect of ovarian cancer on the psychosocial functioning of 15 women, and almost every participant indicated that she experienced some change in sexual function after her diagnosis. In addition, most of the women reported that changes in sexual functioning were handled alone with limited support from a healthcare professional (Stead, Fallowfield, Selby, & Brown, 2007). A retrospective chart review of 499 patients presenting for initial consultation with a gynecologic oncologist showed that only 15% of patients who indicated a sexual problem on an initial screening questionnaire had documentation of that problem in their note or referral for specialty care (Kennedy et al., 2015). Studies like these have shown that discussions regarding sexuality by providers is not part of the routine assessment of patients undergoing cancer care.

Surgery often plays an integral role in a new cancer diagnosis, and it is often performed early in the treatment course. However, there is limited data published on the effect of surgical route on female sexual function. Serati et al. (2009) concluded that there is no significant difference in laparoscopy versus laparotomy approaches to radical hysterectomy for patients with cervical cancer; of the 20 women in laparoscopy group, 15 (75%) reported decreased sexual function, compared to 10 women (55.5%) in the laparotomy group (p = 0.30). Previous studies suggest that lymphadenectomy may worsen postoperative quality of life and result in lower functional well-being, but there is no correlation to worsened sexual interest, activity, or enjoyment (Janda et al., 2010; van de Poll-Franse et al., 2012).

The female sexual function index (FSFI) was developed in order to diagnose female sexual dysfunction, including hypoactive sexual desire disorder, sexual arousal disorder, sexual pain disorders, and orgasmic disorder by using a self-reporting technique in order to measure response to different phases or domains of sexual function. The FSFI has been used in other studies to standardize diagnosis, guide treatment, and evaluate response to various therapies. This questionnaire has been validated in several settings, including HIV patients, spinal cord injuries, bladder reconstruction, vaginoplasty, and vulvodynia (Meyer-Bahlburg & Dolezal, 2007; Rosen, Brown, Heiman, & Leib, 2000). In addition, the FSFI demonstrated strong psychometric properties in a study of 181 female cancer survivors including gynecologic cancer, which supports its use for monitoring sexual function and cancer-related dysfunction (Baser, Li, & Carter, 2012).

The objective of this study is to determine the incidence and risk factors of self-reported sexual dysfunction in patients undergoing hysterectomy for management of gynecologic malignancy using the FSFI. We hypothesized that patients undergoing total abdominal hysterectomy (TAH) would have worse postoperative sexual function than those undergoing a minimally invasive surgery (MIS) due to a larger incision and physical scarring, longer recovery time after surgery, potential for damage to superficial pelvic nerves, and a more extensive surgical procedure related to burden of disease necessitating laparotomy.

2. Methods

Approval for this cross-sectional study was obtained from the Colorado Multiple Institutional Review Board (COMIRB). The study population consists of women seen in the gynecologic oncology clinic at University of Colorado and Denver Health Medical Center from September 1, 2009, through December 31, 2014, who consented to complete a survey to assess sexual dysfunction. Pre-operative assessments, physical exams, and inquiries regarding sexual function prior to surgery were performed according to the providers' standard protocols. Surgical management was primarily performed by the gynecologic oncology group at the University of Colorado health system, but several women had undergone surgery by physicians from outside institutions. Route of surgery was determined by the discretion of the primary surgeon.

Women were eligible to complete the survey if they were age 18–89 years with a diagnosis of gynecologic malignancy (including recurrence of gynecological cancer if treatment for initial diagnosis was completed within the last 5 years). Patients were approached to participate and complete the questionnaire during a gynecologic oncology office visit. The survey was available in both English and Spanish, and could be completed either on paper or electronically. Study data were collected and managed using the REDCap (Research Electronic Data Capture) tools hosted at University of Colorado (Harris et al., 2009).

The present analysis is a subset of a larger study which included the role of adjuvant chemotherapy and radiation treatment in sexual function. This analysis includes the 123 patients who were treated with hysterectomy. Participants were recruited after their treatment course by their provider and were administered a study survey either in person, by mail, or via encrypted email. Survey questions included demographic information, cancer diagnosis, relationship characteristics, and a validated questionnaire; the FSFI (Rosen et al., 2000). Although our study adapted the Rosen model by asking patients to recall their symptoms 4 weeks prior to administration of the study and 4 weeks prior to diagnosis of their malignancy, no other changes were made to the initial model. Sexual dysfunction was measured by asking patients to recall their symptoms in the 4 weeks prior to diagnosis compared to their symptoms in the 4 weeks prior to completion of the survey, and the questionnaire was completed at a single time-point. A significant decline in sexual function was determined to be a decrease of 5.8 points using a Reliable Change Index Statistic (RCIS) (Jacobson & Truax, 1991).

Descriptive statistics and tests of normality were computed. Groups were compared using chi-square or fisher's exact test for comparisons with cells <5 were used to compare dichotomous or categorical variables. Student's t-tests were used to compare continuous variables. Variables significant in bivariate analyses were entered into logistic regression models to assess independent predictors of sexual dysfunction. All P-values were two-sided, and a $p < 0.05$ was considered statistically significant. Statistical analysis was performed using IBM SPSS version 23.

A cross-sectional study design was employed with a primary outcome of determining whether route of hysterectomy is associated with sexual dysfunction. Secondary outcomes were identification of risk factors during surgical management of gynecologic malignancies that may affect postoperative sexual function, such as operative time, performance of lymphadenectomy, and number of lymph nodes removed.

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3. Results

There were a total of 1,000 women who were approached for recruitment during the course of their routine clinic follow up, of which 320 elected to enroll in the study. The FSFI was completed by 208 women who self-identified as being in sexual relationships. Of these, 171 of them were treated at the University of Colorado Hospital and Denver Health Medical Center and 123 women underwent hysterectomy for treatment of their cancer diagnosis. Average age was 54.4 ± 11.5 years (range 30–84). Of these women, 67% (n = 82) had TAH and 33% (n = 41) had MIS via robotic-assisted laparoscopic hysterectomy or total laparoscopic hysterectomy. Concomitant bilateral oophorectomy was performed in 85.3% with TAH (n = 70) and in 95.1% with MIS (n = 39). At the time of survey, recurrent disease was present in 25.6% of women who had TAH (n = 21) and 9.7% of women who had MIS (n = 4). Descriptive characteristics of the sample and both groups are presented in Table 1.

Women undergoing TAH were younger than those having MIS (52.6 ± 11.5 versus 58.1 ± 10.9 years; p = 0.01). Cancer type was statistically different between the two groups; more patients undergoing TAH had a diagnosis of ovarian cancer (57.3% vs. 9.7%, respectively; OR: 7.6; 95% CI 5.6–55.3), while more patients undergoing MIS had uterine cancer (87.8% vs. 29.3%, respectively). In addition, TAH patients had similar rates of low-risk (stage I or II) and high-risk (stage III or IV) disease, while MIS patients predominantly had low-risk disease (75.6% low-risk vs. 17.1% high-risk; OR 2.1; 95% CI 0.9–4.4).

Relationship characteristics between the two groups were similar, with low rates of post-diagnosis infidelity, marital therapy, separation, and divorce (Table 2). Patients undergoing TAH had a statistically significant decrease in frequency of sexual intercourse in the 4 weeks prior to diagnosis to post-treatment (8.12 ± 10.1 vs. 3.64 ± 7.1 episodes per month, p < 0.001). Similarly, patients undergoing MIS reported decreased frequency of intercourse after treatment (4.89 ± 5.1 vs. 2.4 ± 3.4 episodes per month, p = 0.009). However, there was no significant difference in change of frequency of episodes of post-treatment intercourse between the TAH and MIS groups (4.5 ± 6.3 vs. 2.5 ± 5.8 episodes per month, p = 0.58). In the total sample, women < 50 years old had significantly higher frequency of intercourse per month both before and after their diagnosis than those ≥50 (before diagnosis 12.6 ± 13.3 vs. 4.7 ± 4.3, respectively, p < 0.001; after diagnosis 6.0 ± 9.7 vs. 2.0 ± 2.7, respectively, p < 0.001).

The pre-diagnosis and post-treatment FSFI responses are shown in Table 3. These are stratified by domain type according to the FSFI scoring appendix: desire, arousal, lubrication, orgasm, satisfaction, and pain. Each domain corresponds to two to four questions from the FSFI, and the total FSFI is calculated using an algorithm described originally by Rosen et al. Prior to diagnosis, patients undergoing TAH showed significantly lower scores for arousal, orgasm, satisfaction, and pain, as well as a lower overall score than patients undergoing MIS. After treatment, TAH scores were lower than MIS scores in all categories except for pain.

There were 41 (50.0%) women who reported sexual dysfunction after TAH, versus 9 (22.0%) women after MIS (OR: 3.6; 95% CI 1.5–8.4). Additionally, women with TAH were more likely to be <50 years old (36.6% vs. 14.6%; OR: 3.4; 95% CI 1.3–8.9), have longer operating times (270 min ± 108 vs. 230 min ± 49; p = 0.02), and have more lymph nodes removed (15.9 ± 6.2 vs. 12.2 ± 9.8; p = 0.05).

In logistic regression, age (aOR: 0.94; 95% CI 0.89–0.99) and surgical approach (aOR: 6.8; 95% CI 1.2–38) were the only independent predictors of postoperative sexual dysfunction. Operative time, performance of lymphadenectomy, or number of lymph nodes removed did not remain in the final model.

Table 1. Participant characteristics by surgical intervention				
Variables	**Total**	**TAH**	**MIS**	**p-value or odds ratio (95% CI)**
	(N = 123) **Mean ± SD or n (%)**	**(n = 82)** **Mean ± SD or n (%)**	**(n = 41)** **Mean ± SD or n (%)**	
Demographic				
Age (years)	54.4 ± 11.5	52.6 ± 11.5	58.1 ± 10.9	0.013*
Self-reported race				
Caucasian	98 (79.7)	61 (74.4)	37 (90.2)	Ref
Hispanic	16 (13.0)	14 (17.1)	2 (4.9)	4.2 (0.9–19.7)
Other minority	9 (7.3)	7 (8.5)	2 (4.9)	2.1 (0.4–10.8)
Education				
8th grade to high school	18 (14.6)	17 (20.8)	1 (2.4)	9.6 (1.2–77.4)
College	64 (52.0)	39 (47.6)	25 (60.9)	Ref
Professional	40 (32.5)	25 (30.5)	15 (36.6)	1.1 (0.5–2.4)
Insurance				
Private	83 (67.5)	53 (64.6)	30 (73.2)	Ref
Government	26 (21.1)	18 (21.95)	8 (19.5)	1.3 (0.5–3.3)
Military	11 (8.9)	8 (9.7)	3 (7.3)	1.5 (0.4–6.1)
None	3 (2.4)	3 (3.7)	0	–
Cancer diagnosis				
Uterine	60 (48.8)	24 (29.3)	36 (87.8)	Ref
Ovarian	51 (41.5)	47 (57.3)	4 (9.7)	17.6 (5.6–55.3)*
Cervical	11 (8.9)	10 (12.2)	1 (2.4)	15 (1.8–124.9)*
Disease severity				
Stage I or II	65 (52.8)	34 (41.5)	31 (75.6)	Ref
Stage III or IV	46 (37.4)	39 (47.5)	7 (17.1)	2.1 (0.9–4.4)
BMI (kg/m^2)				
15–22	26 (21.1)	21 (25.6)	5 (12.2)	Ref
23–29	48 (39.0)	28 (34.1)	20 (47.9)	0.3 (0.1–1)
30–39	36 (29.3)	24 (29.3)	12 (29.3)	0.5 (0.1–1.6)
>40	9 (7.3)	6 (7.3)	3 (7.3)	0.5 (0.1–2.6)
Recurrent disease	25 (20.3)	21 (25.6)	4 (9.7)	0.04*
Surgery				
Operative time (minutes)	255.6 ± 92.8	270.3 ± 107.9	229.7 ± 49.3	0.02*
Lymphadenectomy	81 (65.8)	53 (64.6)	28 (68.3)	0.8 (0.4–1.9)
Number lymph nodes	14.5 ± 9.1	15.9 ± 9.8	12.2 ± 9.8	0.05*
Concomitant bilateral oophorectomy	109 (88.6)	70 (85.3)	39 (95.1)	0.11
ASA classification				
I	10 (8.1)	6 (7.3)	4 (9.7)	Ref
II	47 (38.2)	28 (34.1)	19 (46.3)	1 (0.2–3.9)
III	34 (27.6)	26 (31.7)	8 (19.5)	2.2 (0.5–9.6)
Sexual dysfunction	50 (40.6)	41 (50)	9 (22)	3.6 (1.5–8.4)

*Denotes statistically significant value.

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Table 2. Relationship characteristics by surgical intervention

Variables	Total (*N* = 123) Mean ± SD or n (%)	TAH (*n* = 82) Mean ± SD or *n* (%)	MIS (*n* = 41) Mean ± SD or *n* (%)	*p*-value or odds ratio (95% CI)
Committed relationship at time of diagnosis	111 (90.2)	75 (91.4)	36 (87.8)	0.7 (0.2–2.3)
Relationship length (years)	21.1 ± 15.0	19 ± 13.9	25.5 ± 16.4	0.033*
Infidelity since cancer diagnosis	3 (2.4)	1 (1.2)	2 (4.9)	0.2 (0.02–2.7)
Required marital counseling since cancer diagnosis	8 (6.5)	6 (7.3)	2 (4.9)	1.5 (0.3–8)
Separation since cancer diagnosis	9 (7.3)	6 (7.3)	3 (7.3)	1 (0.2–4.2)
Divorce since cancer diagnosis	5 (4.1)	3 (3.6)	2 (4.9)	0.7 (0.1–4.6)
Post-treatment sexual dysfunction	50 (40.7)	41 (50)	9 (22)	3.6 (1.5–8.4)
Change in frequency of intercourse from before to after diagnosis (episodes per month)	3.8 ± 6.2	4.5 ± 6.3	2.49 ± 5.8	0.058

*Denotes statistically significant value.

Table 3. FSFI responses by domain

Variables	Total (*N* = 123) Mean ± SD	TAH (*n* = 82) Mean ± SD	MIS (*n* = 41) Mean ± SD	*p*-value
Prior to diagnosis				
Desire	3.4 ± 1.6	3.3 ± 1.6	3.7 ± 1.4	0.09
Arousal	5.1 ± 3.3	3.5 ± 2.1	8.2 ± 3.0	<0.001*
Lubrication	3.7 ± 2.2	3.7 ± 2.2	3.9 ± 2.2	0.34
Orgasm	3.7 ± 2.2	3.5 ± 2.2	4.3 ± 2.1	0.03*
Satisfaction	4.5 ± 1.6	4.3 ± 1.7	5.0 ± 1.3	0.01*
Pain	3.3 ± 2.2	3.0 ± 2.2	3.7 ± 2.3	0.04*
Total FSFI Score	23.7 ± 10.8	21.1 ± 10.4	28.7 ± 9.9	<0.001*
After diagnosis				
Desire	2.8 ± 1.5	2.6 ± 1.6	3.2 ± 1.4	0.02*
Arousal	2.6 ± 2.1	2.2 ± 2.0	3.4 ± 2.1	<0.001*
Lubrication	2.3 ± 2.2	2.0 ± 2.1	3.0 ± 2.2	0.005*
Orgasm	2.7 ± 2.3	2.2 ± 2.1	3.5 ± 2.4	0.002*
Satisfaction	3.4 ± 1.8	3.0 ± 1.6	4.2 ± 1.7	<0.001*
Pain	2.1 ± 1.9	2.0 ± 1.8	2.5 ± 1.9	0.07
Total FSFI score	15.9 ± 10.5	13.9 ± 10.1	19.7 ± 10.3	0.002*

Notes: Domain maximum scores (desire, arousal, lubrication, orgasm, satisfaction, and pain) = 6.0. Total FSFI maximum score = 36.0.

*Denotes statistically significant value.

4. Conclusions

The role of treatment of gynecologic cancers on female sexual function is a topic of ongoing research. An analysis of data from the National Health and Social Life survey in 1999 showed that sexual dysfunction is an important public health concern in the United States; it is more prevalent for women (43%) than men (31%) and is associated with age, educational status, physical health, and emotional well-being (Laumann, Paik, & Rosen, 1999). Sexuality-related problems in the gynecologic oncology population are underestimated, and multi-modality management by gynecologists, radiotherapists, nurse specialists, and psychologists is needed to manage these considerable concerns (Iavazzo et al., 2015). In addition, this is a topic that providers do not spend sufficient time counseling patients on during treatment of gynecologic malignancies (Kennedy et al., 2015; Zeng, Liu, & Loke, 2012).

There are many benefits to MIS approaches to hysterectomy in cancer care, including improved quality of life (QOL). In a study comparing total laparoscopic hysterectomy (TLH) versus TAH in 332 patients with endometrial cancer, Janda et al. found a statistically significant lower incidence of severe postoperative adverse events, significantly better physical, functional, and body image QOL scores, and earlier return to normal activities in the TLH group (Janda et al., 2010; Joly et al., 2014). The Gynecologic Oncology Group (GOG) conducted a randomized, prospective clinical trial (GOG-2222) to compare comprehensive surgical staging by laparotomy versus laparoscopy for the treatment of women with uterine cancer. The results of this trial showed that patients undergoing laparoscopy had a superior overall QOL during the six-week postoperative period, with fewer physical symptoms, less pain-related interference with functioning, better physical functioning and emotional state, earlier resumption of normal activities, and better body image as compared with those undergoing laparotomy (Kornblith et al., 2009). Neither of these studies specifically addressed postoperative sexual dysfunction, but it is likely an important component of emotional and psychological wellness.

Our results show a decrease of two more episodes of intercourse per month after TAH than after MIS. Although not statistically significant, these findings could be of clinical relevance. In addition, all of the scores for the domains of sexual function except for pain were lower in the TAH group after surgery than the MIS group. However, as the MIS group had higher scores at prior to diagnosis, this could be an underlying bias that women undergoing minimally invasive surgery have better baseline sexual function. Nevertheless, our study suggests that MIS may be less disruptive of sexual function, providing additional support for its use in cancer therapy.

Our findings demonstrate that performance of lymphadenectomy and number of lymph nodes removed were not associated with worse postoperative sexual dysfunction. Patients who underwent TAH were more likely to have more lymph nodes removed, but this may be related to operative technique and more difficult dissection using the laparoscopic approach. We therefore agree with the current literature that neither lymphadenectomy nor amount of lymph nodes removed appear to affect postoperative sexual function. These procedures should continue to be performed as clinically indicated.

Operative times were significantly longer in the TAH group. While time itself was not associated with sexual dysfunction, longer operative times expose patients to additional surgical risks. Catanzarite et al. showed that operative time ≥240 min was associated with increased overall complications, surgical complications, medical complications (pneumonia, unplanned intubation, ventilator dependence over 48 h, acute renal failure, urinary tract infection, peripheral neurologic deficiency, cardiac arrest, blood transfusion, deep venous thrombosis, pulmonary embolism, sepsis/septic shock, death, and return to the operating room (Catanzarite, Saha, Pilecki, Kim, & Milad, 2015). Our study did not include data collection on specific postoperative complications, but these may be confounding variables that increased surgical morbidity and contributed to sexual dysfunction in the TAH group.

Our data showed an association between age <50 years and sexual dysfunction. Our younger participants had higher baseline frequency of intercourse and sexual function as mentioned above. Additionally, our FSFI responses indicated that women <50 years old reported sexual intercourse to be a more important factor in their relationship. In a survey of 703 healthy women, Ponholzer et al. showed that women age 61–70 years had a 2.8 higher risk for desire disorders, a 5.1 higher risk for arousal disorders, and a 3.7 higher risk for orgasmic disorders compared with the age group of younger women. In addition, there was a statistically significant decline in frequency of intercourse in patients age greater than 60 years (Ponholzer, Roehlich, Racz, Temml, & Madersbacher, 2005). In addition, a national sample of 1,550 women in the United States showed that the prevalence of sexual activity declines with age: 73% among respondents ages 57–64, 53% among respondents ages 65–74, and 26% among respondents ages 75–85 (Lindau et al., 2007). Although older patients are at higher risk for sexual dysfunction at baseline, fewer of them indicated that their cancer treatment altered their perceptions of sexuality. It is also important to consider the lack of endogenous estrogen as a contributor to age-related differences in sexual function, as both the TAH and MIS groups commonly underwent bilateral oophorectomy with their cancer surgery. It is possible that an abrupt entry into surgical menopause in the younger subjects may be associated with their perceived sexual dysfunction.

One of the strengths of this study is its design to capture pre- and post-treatment sexual function scores by asking patients to recall their sexual behavior in the 4 weeks prior to their cancer diagnosis. These scores were then compared to behaviors after cancer treatment was initiated, with the goal of assessing the patient's perception of her own sexuality. Therefore, our survey captured subjects' recollections of their sexual function prior to treatment in comparison to their current status, which highlights how they feel that diagnosis and treatment have changed their sexuality. Additional strengths include the use of a validated instrument with a defined RCIS to assess for sexual dysfunction and inclusion of patients from two large metropolitan hospitals.

Weaknesses of this study are small sample size, incomplete medical records, and incomplete survey responses. There was no control group of women who underwent hysterectomy for benign indications. Data regarding postoperative complications (including infection, venous thromboembolism, readmission, and bleeding) was not collected, but these complications may have a role in postoperative sexual dysfunction. The larger analysis reviews the role of adjuvant chemotherapy and radiation in sexual dysfunction, and this information was intentionally omitted from the current study. Although the collection of data at a single time-point can be a strength as mentioned above, it also inherently introduces recall bias. Women were asked to reflect on their sexual habits in a retrospective manner, and the duration of time from surgery to the time of responding to the survey could impact responses.

The TAH and MIS groups significantly differed in cancer diagnosis, with more ovarian cancer in the TAH group and more uterine cancer in the MIS group. The extent of tumor burden, natural disease progression, and overall pathophysiology of these two gynecologic malignancies are quite different, and may play a role in postoperative recovery and sexual function. Additionally, TAH patients were more likely to have recurrent disease, which supports the fact that their disease process is more aggressive at baseline. Recurrent disease can play a large psychological role in the recovery process and limit patients' desires for intimacy, which can serve as a confounding variable in interpretation of these results. These differences limit the comparability of the two groups. In order to eliminate biases, a prospective cohort analysis separating women by cancer type would be valuable.

In summary, this study shows that TAH and age <50 years are associated with significantly worse postoperative sexual function outcomes. Our findings support the minimally invasive approach to hysterectomy in cancer treatment. Route of hysterectomy is dependent on a variety of factors, and expectations regarding sexual dysfunction should be included in this discussion during the preoperative planning process. Providers should initiate conversations regarding sexual health early in the course of a patient's cancer treatment and referral of patients with psychological and emotional

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needs to the appropriate providers. It is especially important to have these conversations with women <50 years old or who are being scheduled for TAH. MIS should be offered to patients who are especially concerned about sexual changes after therapy whenever feasible. Referral to sex therapy, marriage counseling, and pelvic floor physical therapy should be offered early for at-risk patients in which MIS is not an option.

Declaration
The contents of this article are the authors' sole responsibility and do not necessarily represent official NIH views.

Competing Interests
The authors declare no competing interests.

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References
Baser, R. E., Li, Y., & Carter, J. (2012). Psychometric validation of the female sexual function index (FSFI) in cancer survivors. *Cancer, 118*, 4606–4618. http://dx.doi.org/10.1002/cncr.26739

Bergmark, K., Åvall-Lundqvist, E., Dickman, P. W., Henningsohn, L., & Steineck, G. (1999). Vaginal changes and sexuality in women with a history of cervical cancer. *New England Journal of Medicine, 340*, 1383–1389. http://dx.doi.org/10.1056/NEJM199905063401802

Catanzarite, T., Saha, S., Pilecki, M. A., Kim, J. Y., & Milad, M. P. (2015). Longer operative time during benign laparoscopic and robotic hysterectomy is associated with increased 30-day perioperative complications. *Journal of Minimally Invasive Gynecology, 22*, 1049–1058. http://dx.doi.org/10.1016/j.jmig.2015.05.022

Cull, A., Cowie, V. J., Farquharson, D. I., Livingstone, J. R., Smart, G. E., & Elton, R. A. (1993). Early stage cervical cancer: Psychosocial and sexual outcomes of treatment. *British Journal of Cancer, 68*, 1216–1220. http://dx.doi.org/10.1038/bjc.1993.507

Gilbert, E., Ussher, J. M., & Perz, J. (2011). Sexuality after gynaecological cancer: A review of the material, intrapsychic, and discursive aspects of treatment on women's sexual-wellbeing. *Maturitas, 70*, 42–57. http://dx.doi.org/10.1016/j.maturitas.2011.06.013

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics, 42*, 377–381. http://dx.doi.org/10.1016/j.jbi.2008.08.010

Howlader, N. N. A., Krapcho, M., Garshell, J., Miller, D., Altekruse, S. F., Kosary, C. L., ... Cronin, K. A. (Eds.). (2016). *SEER cancer statistics review, 1975–2012*. Bethesda, MD: National Cancer Institute.

Iavazzo, C., Johnson, K., Savage, H., Gallagher, S., Datta, M., & Winter-Roach, B. A. (2015). Sexuality issues in gynaecological oncology patients: Post treatment symptoms and therapeutic options. *Archives of Gynecology and Obstetrics, 291*, 653–656. http://dx.doi.org/10.1007/s00404-014-3491-2

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology, 59*, 12–19. http://dx.doi.org/10.1037/0022-006X.59.1.12

Janda, M., Gebski, V., Brand, A., Hogg, R., Jobling, T. W., Land, R., ... Obermair, A. (2010). Quality of life after total laparoscopic hysterectomy versus total abdominal hysterectomy for stage I endometrial cancer (LACE): A randomised trial. *The Lancet Oncology, 11*, 772–780. http://dx.doi.org/10.1016/S1470-2045(10)70145-5

Joly, F., McAlpine, J., Nout, R., Åvall-Lundqvist, E., Shash, E., & Friedlander, M. (2014). Quality of life and patient-reported outcomes in endometrial cancer clinical trials. *International Journal of Gynecological Cancer, 24*, 1693–1699. http://dx.doi.org/10.1097/IGC.0000000000000299

Kennedy, V., Abramsohn, E., Makelarski, J., Barber, R., Wroblewski, K., Tenney, M., ... Lindau, J. (2015). Can you ask? We just did! Assessing sexual function and concerns in patients presenting for initial gynecologic oncology consultation. *Gynecologic Oncology, 137*, 119–124. http://dx.doi.org/10.1016/j.ygyno.2015.01.451

Kornblith, A. B., Huang, H. Q., Walker, J. L., Spirtos, N. M., Rotmensch, J., & Cella, D. (2009). Quality of life of patients with endometrial cancer undergoing laparoscopic international federation of gynecology and obstetrics staging compared with laparotomy: A gynecologic oncology group study. *Journal of Clinical Oncology, 27*, 5337–5342. http://dx.doi.org/10.1200/JCO.2009.22.3529

Laumann, E. O., Paik, A., & Rosen, R. C. (1999). Sexual dysfunction in the United States. *JAMA, 281*, 537–544. http://dx.doi.org/10.1001/jama.281.6.537

Lindau, S. T., Schumm, L. P., Laumann, E. O., Levinson, W., O'Muircheartaigh, C. A., & Waite, L. J. (2007). A study of sexuality and health among older adults in the United States. *New England Journal of Medicine, 357*, 762–774. http://dx.doi.org/10.1056/NEJMoa067423

Meyer-Bahlburg, H. F., & Dolezal, C. (2007). The female sexual function index: A methodological critique and suggestions for improvement. *Journal of Sex & Marital Therapy, 33*, 217–224. http://dx.doi.org/10.1080/00926230701267852

Ponholzer, A., Roehlich, M., Racz, U., Temml, C., & Madersbacher, S. (2005). Female sexual dysfunction in a healthy austrian cohort: Prevalence and risk factors. *European Urology, 47*, 366–375. http://dx.doi.org/10.1016/j.eururo.2004.10.005

Rosen, R., Brown, C., Heiman, J., & Leib, S. (2000). The female sexual function index (FSFI): A multidimensional self-report instrument for the assessment of female sexual function. *Journal of Sex & Marital Therapy, 26*, 191–208. http://dx.doi.org/10.1080/009262300278597

Serati, M., Salvatore, S., Uccella, S., Laterza, R. M., Cromi, A., Ghezzi, F., & Bolis, P. (2009). Sexual function after radical hysterectomy for early-stage cervical cancer: Is there a difference between laparoscopy and laparotomy? *The Journal of Sexual Medicine, 6*, 2516–2522. http://dx.doi.org/10.1111/j.1743-6109.2009.01363.x

Siegel, R. L., Miller, K. D., & Jemal, A. (2015). Cancer statistics, 2015. *CA: A Cancer Journal for Clinicians, 65*, 5–29.

Stead, M. L., Fallowfield, L., Selby, P., & Brown, J. M. (2007). Psychosexual function and impact of gynaecological cancer. *Best Practice & Research Clinical Obstetrics & Gynaecology, 21*, 309–320. http://dx.doi.org/10.1016/j.bpobgyn.2006.11.008

van de Poll-Franse, L. V., Pijnenborg, J. M. A., Boll, D., Vos, C. M., van den Berg, H., Lybeert, M. L. M., … Kruitwagen, R. F. P. M. (2012). Health related quality of life and symptoms after pelvic lymphadenectomy or radiotherapy vs. no adjuvant regional treatment in early-stage endometrial carcinoma: A large population-based study. *Gynecologic Oncology, 127*, 153–160. http://dx.doi.org/10.1016/j.ygyno.2012.06.007

Zeng, Y. C., Liu, X., & Loke, A. Y. (2012). Addressing sexuality issues of women with gynaecological cancer: Chinese nurses' attitudes and practice. *Journal of Advanced Nursing, 68*, 280–292. http://dx.doi.org/10.1111/jan.2011.68.issue-2