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Pelvic floor disorders in women with gynecologic malignancies: a systematic review

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Abstract

Introduction and hypothesis—Pelvic floor disorders (PFDs) negatively affect quality of life in the general population, and their prevalence in gynecologic cancer survivors has not been systematically described. This study aimed to determine the prevalence of PFDs in cancer survivors. We hypothesized that the prevalence of PFDs in the gynecologic cancer population would be higher than in the general female population.

Methods—We searched PubMed (1809 to present), EMBASE (1974 to present), and the Cochrane Central Register of Controlled Trials (CENTRAL) through May 2017. The search combined subject headings, title, and abstract words for gynecologic cancer, PFDs, and prevalence. Any studies evaluating the prevalence of PFDs in gynecologic malignancies were included.

Results—A total of 550 articles met the designated search criteria and 31 articles were included in this review. In cervical cancer survivors, before treatment the prevalences of stress urinary incontinence (SUI), urgency urinary incontinence (UUI) and fecal incontinence (FI) were 24–29%, 8–18% and 6%, respectively, and after treatment the prevalences of SUI, UUI, urinary retention, FI, fecal urge, dyspareunia and vaginal dryness were 4–76%, 4–59%, 0.4–39%, 2–34%, 3–49%, 12–58% and 15–47%, respectively. In uterine cancer survivors, before treatment the prevalences of SUI, UUI and FI were 29–36%, 15–25% and 3%, respectively, and after treatment the prevalences of urinary incontinence (UI) and dyspareunia were 2–44% and 7–39%, respectively. In vulvar cancer survivors, after treatment the prevalences of UI, SUI and FI were 4–32%, 6–20% and 1–20%, respectively. In ovarian cancer survivors, the prevalences of SUI, UUI, prolapse and sexual dysfunction were 32–42%, 15–39%, 17% and 62–75%, respectively.

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Conclusions—PFDs are prevalent in gynecologic cancer survivors and this is an important area of clinical concern and future research.

Keywords

Prevalence; Pelvic floor disorders; Gynecologic cancer; Survivor

Introduction

Approximately 14.5 million cancer survivors in the USA were reported in 2014, and this number is expected to increase to 19 million by 2024 [1]. As the number of cancer survivors continues to increase, the quality of life (QOL) of these survivors is an important consideration for healthcare providers. In 2016, an estimated 105,890 women in the USA were diagnosed with a gynecologic malignancy, including endometrial, cervical, ovarian/fallopian tube/primary peritoneal, vaginal, and vulvar cancer [2]. Major advances in current radiotherapy, chemotherapy and surgical treatments offer the chance of enhanced long-term survival in these women [3, 4]. With such improvements in survival, the morbidity of therapy and its impact on QOL must increasingly be considered when evaluating treatment options. Gynecologic cancer therapy often includes multiple treatment modalities, which alone and in combination have the potential to affect the pelvic organs and lead to pelvic floor disorders (PFDs). Yet, the actual prevalence of PFDs in women with specific gynecologic malignancies has not been well described.

The overall prevalence of PFDs in healthy, nonpregnant women is reported to be up to 25% [5]. Specifically the prevalences of urinary incontinence (UI), fecal incontinence (FI), and symptoms of pelvic organ prolapse are 15.7%, 9%, and 2.9%, respectively [6]. The prevalence of PFDs is known to increase with age: 31.6% of women aged 50–59 years were noted to have at least one or more PFDs [5]. Despite PFDs being prevalent, especially in older women, with significant negative effects on QOL, the impact of gynecologic oncologic treatment on the prevalence of PFDs is not well understood and is likely infrequently discussed with oncologic patients [7].

There has not yet been a comprehensive systematic literature review investigating the rates of PFDs in women who have undergone different types of treatment for gynecologic malignancies. Our aims in this systematic review were: (1) to investigate the prevalence of PFDs in cancer survivors after surgical and nonsurgical treatments for cervical, uterine, ovarian, and vulvar cancer; and (2) to compare rates of PFDs among gynecologic cancer survivors and the general population. We hypothesized that the prevalence of PFDs in the gynecologic cancer population would exceed that in the general female population.

Materials and methods

The University of Maryland Institutional Review Board provided exemption for this research. An expert in systematic reviews conducted structured searches of the following databases: PubMed (1809 to present), the Cochrane Central Register of Controlled Trials (Wiley), and Embase (Embase.com, 1974 to present). All searches were updated in May 2017. The combined searches yielded 550 unique citations.

The Population, Intervention, Comparison, Outcomes and Study Design (PICOS) approach was used to set parameters for this systematic review. The population inclusion criteria were as follows: women with any gynecologic cancer (uterine, ovarian, fallopian tube, primary peritoneal, cervical, vulvar, and/or vaginal) before or after any oncologic treatment with data on prevalence of PFDs. Women without a gynecologic malignancy and those without any clinical data on specific gynecologic cancer were excluded. While our search included all gynecologic malignancies, this systematic review only includes data on cervical, uterine, ovarian and vulvar as the search did not yield any studies that met the inclusion criteria for fallopian tube, vaginal or peritoneal cancer. Our primary outcome of interest was to evaluate the prevalence of PFDs in those who received any intervention for any type of gynecologic malignancy. Based on the definitions established by the Standardization and Terminology Committees of the International Urogynecological Association (IUGA) and the International Continence Society (ICS) [8], a comprehensive list of approximately 100 PFD terms was compiled as search terms (Appendix A). Studies of any design were included. References retrieved had at least one term from each of three concepts: (1) PFD terms, (2) gynecologic cancer terms, and/or (3) prevalence terms. Search terms were adjusted slightly for each database, and search strategies incorporated both subject headings and text words. No date restriction was applied.

As shown in Fig. 1, 550 studies met the criteria for retrieval. Abstracts were doubly screened by two reviewers, with each team consisting of two independent reviewers; discrepancies were adjudicated by the principal investigator. An additional 20 studies were included based on review of references and expert opinion. After screening of abstracts, two reviewers evaluated the full text of 74 articles, and a total of 31 articles were included in the review. The methodologic quality of each study was assessed using predefined criteria from a three-category system modified from the Agency for Healthcare Research and Quality. Studies were graded as of good (A), fair (B), or poor (C) quality based on the likelihood of biases and the completeness of reporting [9]. This systematic review was registered with the PROSPERO international database of prospectively registered systematic reviews prior to data extraction. The MOOSE checklist and guidelines for reporting were used for this systematic review of observational studies [10].

Results

Of the 550 studies retrieved, 31 met the criteria for systematic review including 17 on cervical cancer, 10 on endometrial cancer, 4 on ovarian cancer, and 8 on vulvar cancer. The study selection flow chart is shown in Fig. 1. Most studies were cross-sectional in design, and the overall quality of the studies was poor, with the majority grade C. Treatment of gynecologic malignancies may include various combinations of surgery, external beam radiotherapy (EBRT), chemotherapy, and brachytherapy based on the extent of disease and other patient characteristics. The prevalence of major PFDs before and after treatment in survivors of major gynecologic malignancies is summarized in Table 1. The prevalence of PFDs according to cancer type is discussed in the following sections.

Cervical cancer

The prevalence of PFDs in 2,875 survivors of cervical cancer was evaluated in 17 studies [11-27], as shown in Table 2.

Urinary dysfunction

Urinary incontinence: UI, including general UI, stress UI (SUI) and urgency UI (UUI), was reported in 12 studies. In seven studies in patients with cervical cancer, general UI rates ranged from 4% to 55% [23, 27]. Of the seven studies investigating UI, three used validated questionnaires. Vistad et al. [19] and Georg et al. [18] used the Late Effects in Normal Tissues – Subjective, Objective, Management and Analytic (LENT-SOMA) scale [28], while Hazewinkel et al. [24] used the Urinary Distress Inventory (UDI) questionnaire [29]. Among patients with early stage cervical cancer who underwent primary surgical management, as evaluated in four studies, the UI rates ranged from 9% [22] to 48% [24]. Ceccaroni et al. [23] and Naik et al. [14] found higher rates of 55% and 48%, respectively, in patients evaluated less than 6 weeks after surgery. As anticipated, the higher rate of UI (55% [23]) was found in patients who underwent radical hysterectomy (RH), whereas the UI rate was only 8% in patients who underwent nerve-sparing RH (NSRH).

Hazewinkel et al. [24] found a UI rate of 30% in patients who underwent primary radiotherapy only with a follow-up of 12–132 months. Vistad et al. [19] also evaluated UI prevalence in patients who had only undergone radiotherapy, and found rates ranging from 5% to 24% with a follow-up of 66–131 months. Daily and constant UI symptoms were reported by 24% and 9% of the 91 patients, respectively, while 5% reported monthly symptoms.

Patients who required more than one modality of treatment were investigated in several studies. Hazewinkel et al. [24] found a UI rate of 29% in patients who underwent surgery and radiotherapy. Georg et al. [18] found a UI rate of 14% in patients who received radiotherapy, chemotherapy, and brachytherapy. Haie-Meder et al. [27] found a UI rate of 4% in patients who received surgery, radiotherapy, and brachytherapy based on history and general physical examination findings only. Additionally, Ceccaroni et al. [23] found a UI rate of 55% in patients who underwent RH in combination with either chemotherapy or EBRT, and a UI rate of 8% in patients who underwent NSRH in combination with either chemotherapy or EBRT.

Stress urinary incontinence: In seven studies in patients with cervical cancer, SUI rates ranged from 4% to 76% [23, 24]. Two cross-sectional studies [11, 12] investigated the baseline prevalence of SUI before any treatment for cervical cancer Bretschneider et al. [11] used a validated questionnaire and found a SUI rate of 24% in 17 patients. Thomas et al. [12] found a baseline SUI rate of 29% based on a nonvalidated questionnaire in 48 patients. In patients who had undergone treatment for cervical cancer, SUI rates of 6% [14], 13% [13], and 29% [15] were found using urodynamic studies (UDS). SUI was found in only 4% of patients who had undergone NSRH compared with 13% of patients who had undergone non-nerve-sparing RH based on UDS data 28 days after surgery [23]. The highest rates of SUI were found by Hazewinkel et al. [24] based on UDI data with follow-up ranging from

12 to 132 months. In a study of 242 patients, the SUI rate was 53% after primary radiotherapy, 60% after surgery, and 76% after surgery and radiotherapy [24].

Urgency urinary incontinence: In seven studies in patients with cervical cancer, UUI rates ranged from 3% to 59% [13, 20]. Thomas et al. [12] and Bretschneider et al. [11] found UUI in 8% and 18% of patients, respectively, before treatment. UUI was evaluated using UDS, and was found in 21% of patients at 12 months after neoadjuvant chemotherapy followed by surgery [15]. Manchana et al. [13], using data from the UDI questionnaire and UDS data, found a UUI rate of only 3% in patients who had undergone surgery with a follow-up for 24–132 months. A UUI rate of only 4% was found in patients who had undergone NSRH compared with 29% in those who had undergone non-nerve-sparing RH based on UDS data 28 days after surgery [23]. Hazewinkel et al. [24] also used data from the UDI questionnaire and found UUI rates as high as 45% after surgery only, 58% after surgery and radiotherapy, and 57% after radiotherapy only among 242 patients with a follow-up of 12–132 months. The highest UUI rate of 59% was found by Parkin et al. [20] based on a nonvalidated questionnaire distributed to 66 patients with a follow-up of 60–132 months after radiotherapy and brachytherapy.

Urinary retention: In six studies in patients with cervical cancer, urinary retention (UR) rates ranged from 0.4% to 39% [18, 23]. The definition of UR varied across studies. Benedetti-Panici et al. [15] defined UR as >30% of bladder capacity, and found a UR rate of 16% in 76 patients 12 months after receiving neoadjuvant chemotherapy followed by surgery. Charoenkwan and Pranpanas [22] defined UR as loss in bladder sensation, and found a UR rate of 8% in their cross-sectional study of 187 patients who had undergone surgery, chemotherapy and radiotherapy for cervical cancer. Ralph et al. [16], defined UR as >10% of maximum bladder capacity, and found a rate of 17% in their cross-sectional study of 121 women who had undergone radical abdominal or vaginal hysterectomy for treatment of early stage cervical cancer with a follow-up of 12–72 months [16]. Ceccaroni et al. [23] defined UR as a postvoid residual of >100 ml, and found a UR rate of 39% (the highest reported) in patients 28 days after non-nerve-sparing RH. In contrast, the UR rate was only 8% in those who had undergone NSRH [23].

Nocturia: In three studies in patients with cervical cancer, nocturia rates ranged from 11% to 35% [20, 22]. Manchana et al. [13] found nocturia in 27% of patients using the UDI questionnaire [29]. The other two studies used nonvalidated questionnaires.

Frequency: In five studies in patients with cervical cancer, frequency rates ranged from 6% to 71% [22, 24]. Hazewinkel et al. [24] found the highest frequency rates. Patients were evaluated using the UDI questionnaire 12–132 months after treatment. Frequency rates of 23%, 42%, and 71% were found after surgery alone, surgery and radiotherapy, and radiotherapy alone, respectively.

Dysuria: In six studies in patients with cervical cancer, dysuria rates ranged from 5% to 26% [19, 23, 24]. Hazewinkel et al. [24] found dysuria in 26% of 47 patients (the highest rate reported) evaluated using the UDI questionnaire 12–132 months after radiotherapy.

Ceccaroni et al. also found dysuria in 26% of patients who had undergone non-nerve-sparing RH [23].

Bowel dysfunction

Fecal incontinence: In five studies in patients with cervical cancer, FI rates ranged from 2% to 34% [18, 24]. Bretschneider et al. [11] found a baseline FI rate of 6% using the validated Rotterdam Symptom Checklist. Hazewinkel et al. [24] found an incontinence of liquid stool rate of 34% (the highest rate reported) in patients treated with radiotherapy alone using the validated Defecatory Distress Inventory (DDI) [30] with a follow-up of 12–132 months. Vistad et al. [19] found a daily FI rate of 6% and a constant FI rate of 4% in patients who had undergone radiotherapy using the LENT-SOMA scale with a follow-up of 66–131 months. Georg et al. [18] found a FI rate of only 2% in patients who had undergone radiotherapy and brachytherapy with chemosensitization using the LENT-SOMA scale with a follow-up of 3–84 months. Dunberger et al. [25] evaluated FI based on the question “Have you emptied all stools into clothing without forewarning during the past six months,” and found a FI rate of 15% among patients 86 months after treatment with multiple modalities that included combinations of surgery, radiotherapy, brachytherapy and chemotherapy.

Fecal urgency: In three studies in patients with cervical cancer, fecal urgency (FU) rates ranged from 3% to 49% [18, 24]. Similar to the findings for FI, Hazewinkel et al. [24] found the highest rates of FU. Similar FU rates were found in patients who had received surgery and radiotherapy (49%) and those who had received radiotherapy only (48%) [24]; the FU rate in patients who had undergone surgery was 36%. Vistad et al. [19] found a daily FU rate of 35% and a monthly FU rate of 9%.

Rectal bleeding: In the only study that evaluated rectal bleeding, Georg et al. [18] found a rectal bleeding rate of 11% in 225 patients using the LENT-SOMA questionnaire.

Straining: In the only study that evaluated straining, Hazewinkel et al. [24] found straining rates of 40%, 43%, and 33% in patients undergoing surgery only, surgery and radiotherapy, and radiotherapy only, respectively, using the DDI questionnaire [24].

Sexual dysfunction

Dyspareunia: Dyspareunia in patients with cervical cancer was evaluated in three studies. Both Haie-Meder et al. [27] and Bergmark et al. [26] found dyspareunia in 12% of patients using history and physical examination and a self-reported internally validated questionnaire, respectively. In contrast, Vistad et al. [19] found dyspareunia in 58% of patients using the Sexual Activity Questionnaire (SAQ), a validated questionnaire for evaluating dyspareunia [31].

Vaginal dryness: In three studies in patients with cervical cancer, vaginal dryness (VD) rates ranged from 22% to 47% [17, 26]. Only Bergmark et al. [26] assessed the occurrence of VD according to treatment. Using an internally validated questionnaire, they found VD in 25%, 22%, 15%, and 33% of patients receiving surgery only, radiotherapy only, surgery and radiotherapy, and surgery, radiotherapy and brachytherapy, respectively [26].

Hypoactive disorder: In the only study that evaluated hypoactive disorder, Bergmark et al. [26] found hypoactive disorder in 76%, 35%, 48%, 39%, and 35% of patients undergoing radiotherapy, surgery, surgery and radiotherapy, surgery and brachytherapy, and surgery, radiotherapy and brachytherapy, respectively [26].

Orgasmic dysfunction: In the only study that evaluated overall orgasmic dysfunction (OD), Bergmark et al. [26] found an overall OD rate of 9%.

Fistula—In four studies in patients with cervical cancer, fistula rates ranged from 0.6% to 6% [17, 18, 23, 27]. Fistulas included vesicovaginal, rectovaginal, and uterovaginal in patients who had undergone multiple treatment modalities including surgery, radiotherapy, brachytherapy and chemotherapy.

Prolapse—In the only study that evaluated prolapse in patients with gynecologic malignancy, Thomas et al. [12] found a prolapse rate of 16% at baseline.

Endometrial cancer

The prevalence of PFDs in 2,977 survivors of endometrial cancer was evaluated in ten studies [11, 12, 25, 32–38], as shown in Table 3. The SUI and UUI rates prior to treatment ranged from 29–36% and 15–25%, respectively [11, 12]. General UI, reported in four studies, ranged from 2% to 53% [35, 38]. White et al. found the highest rate of 53% in 532 patients, of whom approximately 38% (not reported in Table 3) had consulted a physician about their UI [38].

Treatment of endometrial cancer may include various combinations of surgery, EBRT, brachytherapy, and chemotherapy, depending on disease characteristics. Assessment of the individual and combined contribution of each modality is therefore often complicated. The Post-Operative Radiation Therapy in Endometrial Carcinoma 1 (PORTEC-1) trial was a multicenter randomized controlled trial in 714 patients which established a role for EBRT in patients with early-stage endometrial cancer with high-intermediate (but not low or intermediate) risk features.

QOL outcomes from PORTEC-1 included UI based on patient-reported day and night usage of pads approximately 13 years after treatment. UI affected 15% of patients who underwent surgery only and 43% of patients who underwent surgery and EBRT [34]. Erekson et al. [32] performed a cross-sectional study to evaluate SUI and UUI in 70 patients after surgery and radiotherapy using the UDI questionnaire with a follow-up of approximately 51 months. SUI occurred in 69% of patients after surgery alone, and in 84% after surgery and radiotherapy [32]. UUI occurred in 67% of patients after surgery alone and in 80% after surgery and radiotherapy [32]. PORTEC-3 was a multicenter randomized trial that included 686 patients with advanced endometrial carcinoma, and was designed to assess whether perioperative chemotherapy in addition to radiotherapy improves survival compared with radiotherapy alone. Primary outcome measures are still maturing, but using questionnaire data, De Boer et al. [35] found no difference in UI rates between the two treatment arms, suggesting that the addition of chemotherapy contributes little to UI.

PORTEC-2 was a multicenter randomized trial including 427 patients that established the efficacy of vaginal brachytherapy for local disease control with fewer side effects than EBRT in patients with disease of high-intermediate risk. Long-term effects after PORTEC-2 were reported by De Boer et al. [33] who evaluated bowel and urinary symptoms more than 7 years after treatment with either surgery and brachytherapy or surgery and EBRT using cancer-specific health-related QOL questionnaires. Among 196 survey respondents, UI rates were 41% and 44% in the brachytherapy and EBRT groups, respectively. Day-time frequency rates were 61% in both groups, while the dysuria rate was slightly lower in the brachytherapy group than in the EBRT group (6% and 9%, respectively). The FI and FU rates were higher in patients who received EBRT (24% and 55%, respectively) than in those who received brachytherapy (15% and 32%, respectively). Dunberger et al. [25] found FI in 11% of endometrial cancer and uterine sarcoma survivors 86 months after treatment with multiple modalities that included combinations of surgery, radiotherapy, brachytherapy and chemotherapy.

The overall number of patients evaluated for sexual dysfunction was low, ranging from 20 to 30 patients. VD was found in 40% of patients who received brachytherapy and in 48% of those who received EBRT, and dyspareunia was found in 37% and 23% of patients, respectively. Aerts et al. [36] in a prospective comparative study evaluated dyspareunia using self-designed nonvalidated questionnaires in patients who received surgery only. During the 2 years after surgery, entry dyspareunia rates ranged from 24% to 39% and deep dyspareunia rates ranged from 7% to 19% [36]. The study by Aerts et al. [36] was the only prospective cohort study in which sexual function in endometrial cancer survivors was evaluated. They evaluated sexual function 24 months after surgical treatment in endometrial cancer survivors compared with patients with benign gynecologic conditions and healthy controls. Of the endometrial cancer survivors, 46% had decreased sexual desire compared with 29% of patients with benign gynecologic conditions and 2% of healthy controls ($p < 0.01$). Entry dyspareunia occurred in 29%, 7% and 4% of patients, respectively ($p < 0.01$). Women with uterine cancer also had a higher rate of deep dyspareunia (18%) than healthy controls (2%; $p = 0.03$).

Thomas et al. found prolapse in 7% of patients with endometrial cancer prior to treatment [12]. The study by Nosti et al. [37] was the only study that evaluated prolapse in women with endometrial cancer after surgery. Using the Pelvic Floor Distress Inventory [39], they found pelvic organ prolapse in 44% of 25 women with endometrial cancer more than 6 months after surgery [37].

Ovarian cancer

The rate of PFDs in 375 survivors of ovarian cancer was evaluated in four studies [11, 12, 25, 40], as shown in Table 4. Baseline prevalence of SUI and UUI before treatment ranged from 32–42% and 15–39%, respectively [11, 12]. Dunberger et al. [25] found FI in 7% of survivors 86 months after treatment with multiple modalities that included combinations of surgery, radiotherapy, brachytherapy and chemotherapy. In a cross-sectional study to evaluate sexual dysfunction using the SAQ in 232 patients with epithelial ovarian cancer,

Carmack Taylor et al. [40] found dyspareunia in 62%, VD in 80% and OD in 75% of patients.

Vulvar cancer

The rate of PFDs in 604 survivors of vulvar cancer was evaluated in eight studies [11, 25, 41-46], as shown in Table 5. Bretschneider et al. found SUI and UI at baseline in 44% and 22% of patients, respectively [11]. Hoffman et al. [41] performed a retrospective cohort study in 90 patients and found UI in 4% and anal incontinence in 11% of patients who underwent modified radical vulvectomy, and UI in 16% and anal incontinence in none of those who underwent radical vulvectomy. In another comparative retrospective cohort study of 169 patients, Hopkins et al. [42] found SUI in 6% of patients who underwent radical vulvectomy, in 19% of patients who underwent radical vulvectomy using a technique involving three separate incisions, and in 20% of patients who underwent en bloc radical vulvectomy (butterfly technique). In a case series of 38 patients who underwent vulvar field resection with anatomical reconstruction, Höckel et al. [43] found UI in 26%, increased day-time frequency in 3%, spray-like voiding in 3%, disturbance in sexual life in 13%, and body image disturbance in 13% of patients using a nonvalidated questionnaire.

Hampl et al. [44] performed a case-control study in 40 patients who underwent surgery alone or multimodality therapy and evaluated UI using the International Incontinence Society standardized incontinence questionnaire, as well as UDS in some patients. They found UI in 25% and spraying in 25% of patients who underwent standard tumor resection with partial urethral resection (PUR), and UI in 5% and spraying in 10% of patients who did not undergo PUR [44]. However, they found UI in 29% and spraying in 14% of patients who underwent surgery with PUR plus chemoradiotherapy; none of these patients was found to be incontinent by UDS [44]. Magrina et al. [45] performed a retrospective cohort study in 225 patients. They found SUI in 8%, FI in 1%, rectocele in 2%, and cystocele in 1% of patients who underwent modified radical vulvectomy with or without radiotherapy, and SUI in 16%, FI in 2%, rectocele in 12%, and cystocele in 16% of patients who underwent radical vulvectomy with or without radiation therapy [45]. Dunberger et al. [25] evaluated five vulvar cancer survivors of whom 1 (20%) had FI. De Melo Ferreira et al. [46] performed a cross-sectional study in 28 women who underwent vulvectomy with bilateral lymphadenectomy with or without adjuvant chemoradiotherapy and used the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF) to assess incontinence. They found UI in 32% of these patients [46].

Discussion

This systematic review summarizes the prevalence of PFDs in survivors of gynecologic malignancies after treatment with various modalities. The prevalence of PFDs has broad range in cervical and endometrial cancer survivors due to differences in reported measures, type and timing of treatment. Data on ovarian and vulvar cancer are limited. Uterine cancer survivors have significantly higher rates of decreased sexual desire, and entry and deep dyspareunia 24 months after surgery than healthy women recruited in a gynecologic outpatient clinic. While our study suggests that all PFDs are highly prevalent in cancer

survivors, the lack of comparative studies specific to the type of gynecologic cancer limits further comments on the differences in PFD prevalence between cancer survivors and the general gynecologic population..

The prevalence of UI in the general population ranged from 3.5% to 38.2% and FI from 2.6% to 21% [5]. In comparison, in patients with cervical cancer, the prevalence of SUI ranged from 4% to 76%, UUI from 3% to 59%, and FI from 2% to 34% after treatment. While it is well-established that the prevalence of PFDs increases with age in the general population [5], factors that affect rates of PFDs in the gynecologic cancer population are affected by the timing and type of treatment received. In patients who undergo surgical management of cervical cancer, UI rates tend to be highest in the early post-operative period. Ceccaroni et al. found a UI rate of 55% approximately 1 month after surgery [23], while Naik et al. found UI rates of 48% and 17% 1.5 months and after 12 months after surgery, respectively [14].

As advances in treatment improve survival in cancer survivors, the impact of specific treatment modalities on QOL is an important aspect of pretreatment counseling. While high-quality comparative data are limited, Ceccaroni et al. [23], Hazewinkel et al. [24], and Bergmark et al. [26] evaluated the impact of various treatment types on the prevalence of PFDs in cervical cancer survivors. Ceccaroni et al. suggest that the type of surgery affects the prevalence of PFDs. Nerve-sparing surgical techniques tended to be associated with lower rates of SUI, UUI and UR than the non-nerve-sparing approach [23]. In studies evaluating different modalities of treatment, patients with cervical cancer who underwent radiotherapy alone or in combination with other forms of treatment had higher rates of urinary, bowel and sexual dysfunction. In a cross-sectional study investigating PFDs up to 132 months after treatment, Hazewinkel et al. found that patients who underwent radiotherapy alone or in conjunction with surgery had higher rates of UUI, urinary frequency, FI, FU, and straining than those who underwent surgery alone [24]. Similarly, Bergmark et al. [26] found higher rates of hypoactive sexual disorder in patients who underwent radiotherapy (76%) than in those who underwent surgery only (35%). Pretreatment counseling by clinicians should consider changes over time, as radical surgical interventions result in immediate symptoms with the potential for improvement with time, whereas radiation tends to elicit late effects that manifest over many months.

In patients with endometrial cancer, long-term follow-up of the randomized controlled PORTEC trials has shed some light on the prevalence of PFDs. Specifically, in the follow-up study to PORTEC-2, a comparative study in which patients underwent surgery followed by either brachytherapy or radiotherapy; both treatment modalities were associated with high rates of urinary dysfunction, urinary frequency, dyspareunia and VD at 84 months after treatment [33]. Comparative data on sexual dysfunction between uterine cancer survivors and the general population are minimal. A national study on adult sexual behavior in the USA showed a 43% prevalence of sexual dysfunction in the general female population [47]. Aerts et al. [36] found that patients with endometrial cancer experienced higher rates of sexual dysfunction than the general population: entry dyspareunia in 36% and deep dyspareunia in 18% of patients with endometrial cancer 2 years after surgery compared with only 4% and 2% in the general population, respectively. Similarly, in a comparative study by

Rutledge et al. [7], survivors of gynecologic malignancies reported significant problems with sexual dysfunction, including lower rates of desire and less ability to climax than patients with benign gynecologic conditions. However, rates of sexual dysfunction were not reported in relation to cancer type. While it is evident that sexual dysfunction is a significant problem in survivors of gynecologic malignancies, future studies should compare appropriately matched healthy subjects and cancer patients stratified by gynecologic cancer type.

The data on PFDs in ovarian cancer survivors are extremely limited, probably because the majority of patients present with stage III/IV disease which is associated with 5-year survival rates of only 20–35% [48]. There were no posttreatment studies identified by this review that reported on rates of urinary or bowel dysfunction. Carmack Taylor et al. [40] evaluated sexual dysfunction in ovarian cancer survivors. While the type of treatment received and time from treatment are unclear, extremely high rates of dyspareunia, VD and OD were noted [40].

The current literature on vulvar cancer focuses mostly on posttreatment urinary and bowel dysfunction with little or no mention of sexual dysfunction. The most commonly reported PFDs among patients with vulvar cancer were UI and FI, although several patients did experience spraying or splitting on urination. In general, the rates of PFDs were higher in patients who underwent surgery in addition to EBRT than in those who underwent surgery alone [44, 45]. But even varied surgical techniques alone led to differing rates of PFDs, with differences being seen mostly in rates of UI [42, 44, 45]. In the only study investigating sexual dysfunction, Höckel et al. [43] found body image and sexual life disturbances in 13% of patients with vulvar cancer after surgery.

While studies investigating the prevalence of PFDs after treatment predominate in the literature, it is important to consider baseline prevalence prior to any interventions. Bretschneider et al. [11] and Thomas et al. [12] determined the presence of urinary and bowel dysfunction in patients with cervical, endometrial, ovarian and vulvar cancer. While the studies had small sample sizes, the reported baseline prevalences were comparable to the prevalences of UI and FI in the general population, which further suggests the need to evaluate the impact of treatment and disease progression on the evolution of PFDs in this population.

We aimed to compare the prevalence of PFDs in gynecologic cancer survivors to the prevalence of PFDs in the general population. Aerts et al. [36] found that uterine cancer survivors 24 months after surgical treatment had decreased sexual desire and higher rates of entry dyspareunia than patients with benign gynecologic conditions and healthy controls, respectively. Women with uterine cancer also had higher rates of deep dyspareunia than healthy controls. There were no other studies that evaluated the prevalence of PFDs in gynecologic cancer survivors by cancer type in comparison with the rates in the general population. Although Rutledge et al. [7] did compare the prevalence of PFDs in women with ovarian, endometrial, cervical, and vulvar cancers, we were not able to separate the data according to each individual type of gynecologic cancer. Among cancer survivors in this study, the most prevalent gynecologic cancer was endometrial (45%), followed by ovarian (29%) and cervical (22%). The most common intervention was surgery (87%), followed by

radiotherapy (35%) and chemotherapy (35%). The presence of PFD symptoms before the diagnosis of cancer was reported by 25% of the survivors of cancer. Most of the patients with cancer (62%) had completed their treatment within the previous 1–4 years. Of control patients and survivors, respectively, 56% and 70% reported any UI, and 26% and 42% reported moderate-to-severe UI (both $p > 0.05$). The authors reported a higher rate of FI (43%) in cancer survivors than in the general gynecologic population in the clinic (32%; $p = 0.02$).

Donovan et al. [49] estimated the prevalence of bladder and bowel symptoms in survivors of endometrial and cervical cancer in comparison with the prevalence in women without cancer. In a cohort of 104 survivors matched with the same number of controls, 97% underwent surgery, 30% underwent chemotherapy and 52% underwent radiotherapy. Significantly higher rates of SUI (73% vs. 50%), UUI (72% vs. 49%), nocturia (46% vs. 24%), and urgency (83% vs. 52%) were found in cancer survivors ($p = 0.02$). Yeoh et al. [50] evaluated anorectal function using questionnaire and manometry data in 15 patients who had received radiotherapy 5 to 10 years previously for cervical and uterine cancer. Of these 15 patients, 67% had FU and 33% had FI, and these rates were higher than in normal control patients. Of the nine control patients, one (11%) had FU and none had FI.

The strengths of this review include broad search terms, transparency in data reporting and a systematic review of available literature. These factors contribute to its robust methodological approach. There are, however, several limitations. As with any systematic review, we were limited by the available literature and the overall poor quality of published data on this topic. While there are numerous published studies, there are no high-quality studies. Most studies were cross-sectional or retrospective in design, so it is difficult to comment on the prevalence of PFDs before and after treatment. Also, there was no consistency in the type of validated tools used for objective assessment of PFDs. Many studies used nonvalidated questionnaires, so that the reliability and reproducibility of the data published remain in question. Furthermore, studies were excluded if the reported prevalences of PFDs were not separated according to specific gynecologic cancer types. The lack of comparative studies evaluating the impact of specific treatment types on PFDs is another significant limitation. Because the type of treatment modality is dependent on cancer type and stage, many patients may receive multiple modalities of treatment, so it is difficult to comment on the impact of specific treatment modalities on the development of PFDs.

In conclusion, PFDs are widely prevalent in gynecologic cancer survivors and should be addressed with patients. Future studies should focus on prospective assessment of baseline prevalence and the impact of specific oncologic treatment modalities on PFDs using validated questionnaires. Our systematic review underscores the need for more comparative data on PFDs among gynecologic cancer survivors and the general population. Future research should focus on improving QOL in cancer survivors using oncologic treatments that cause less damage to the pelvic floor and lead to lower rates of PFDs. Gynecology oncologists should consider incorporating screening for PFDs at the time of diagnosis of cancer prior to initiation of therapy and should continue monitoring PFDs during treatment to determine the ideal time for intervention if clinically indicated. Early recognition and

diagnosis of PFDs in gynecologic cancer survivors would allow comprehensive care in these women, which can help ameliorate morbidity from therapy and improve overall QOL.

Appendix A:: PFD search terms

bladder outflow obstruction, acontractile detrusor, detrusor underactivity, non-functioning pelvic floor muscles, underactive pelvic floor muscles, overactive pelvic floor muscles, urinary tract infections, vulvar pain, absent bladder sensation, reduced bladder sensation, bladder oversensitivity, increased bladder sensation, lower urinary tract symptoms, lower urinary tract dysfunction, nocturnal polyuria, nocturnal enuresis, nocturia, irritative voiding symptoms, voiding dysfunction, retention of urine, urinary retention, pudendal neuralgia, cyclical pelvic pain, dysmenorrhea, perineal pain, vaginal pain, urethral pain, bladder pain, pelvic pain, vaginal dryness, vaginal atrophy, vaginal laxity, obstructed intercourse, dyspareunia, sexual dysfunction, autonomic dysreflexia, hematuria, detrusor sphincter dyssynergia, dysfunctional voiding, urethral sphincter obstruction, bladder neck obstruction, rectal bleeding, rectal prolapse, constipation, diminished rectal sensation, straining to defecate, fecal flatal urgency, fecal rectal urgency, fecal incontinence, bladder spasms, painful bladder, cystitis, interstitial cystitis, urethral diverticulum, urethral caruncle, urethral prolapse, vaginal wall prolapse, vaginal vault prolapse, vaginal apex prolapse, enterocoele, uterovaginal prolapse, cervical prolapse, uterine prolapse, perineocoele, rectocoele, cystocoele, pelvic pressure, vaginal bulge, pelvic organ prolapse, dysuria, post micturition dribble, post micturition leakage, need to immediately re-void, splitting of urinary stream, spraying of urinary stream, terminal dribble, straining to void, slow stream, daytime urinary frequency, involuntary detrusor contraction, detrusor incontinence, detrusor overactivity, detrusor instability, urethral hypermobility, incomplete bladder emptying, urinary bladder neurogenic, urinary bladder overactive, neurogenic bladder, overactive bladder, urinary incontinence, incontinence, pelvic floor disorders.

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Fig. 1.

Flow chart of the study selection process

*: three included manuscript reported data on more than one malignancy

Table 1

Prevalence of PFDs in patients with gynecologic malignancy before and after treatment

Cancer	No. of patients	Treatment status	Prevalence (%)					
			SUI	UUI	UR	FI	Dys	POP
Cervical	2,875	Before	24–29	8–18	NR	6	NR	16
		After	4–76	3–59	0.4–39	2–34	12–58	NR
Uterine	2,977	Before	29–36	15–25	NR	3	NR	7
		After	69–84	67–80	NR	11–24	7–39	44
Ovarian	375	Before	32–42	15–39	NR	4	NR	17
		After	NR	NR	NR	7	62	NR
Vulvar	604	Before	44	22	NR	0	NR	NR
		After	6–20	NR	NR	1–20	NR	1–16 ^a

SUI stress urinary incontinence, UUI urgency urinary incontinence, UR urinary retention, FI fecal incontinence, Dys dyspareunia, POP pelvic organ prolapse, NR not reported

^aIncludes cystocele and rectocele

Table 2

Prevalence of PFDs in patient with cervical cancer

	Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment (n)	Follow-up (months)	Urinary (%)		
											UI	SUI	UII
Gynecologic malignancy prior to treatment	[11]	USA	2012–2013	Cross-sectional	C	17	58.1 ($\pm$ 13.3)	ICIQ-FLUTS, RSC	NA ^a	NA ^a	24	18	
	[12]	USA	2010–2011	Cross-sectional	C	48	59.6 ($\pm$ 0.9)	Nonvalidated questionnaire	NA ^a	NA ^a	29	8	
Surgery $\pm$ neoadjuvant chemotherapy	[13]	Thailand	1997–2006	Prospective cohort	C	30	51 (36–65)	UDI, UDS	Surgery	24–132	48	13	3
	[14]	UK	NR (published 2001)	Prospective and cross-sectional	C	396	NR	Nonvalidated questionnaire, UDS (for some patients)	Surgery	1.5 by 3 12 >12	30 by 31 17 6 by 6 UDS		
	[15]	Italy	1998–2000	Case series	C	76	51 (31–69)	UDS, 3-day bladder diary, ten-point VAS scale, cough stress test	Neoadjuvant chemotherapy and surgery	12	29 by 21 by UDS		
Radiotherapy $\pm$ brachytherapy $\pm$ chemotherapy	[16]	Germany	1978–1984	Cross-sectional	C	121	NR	UDS	Surgery (RH or RVH)	12–72			
	[17]	Austria	2008–2013	Uncontrolled investigational	C	588	59 (22–92)	CTCAE	Radiotherapy ^b + brachytherapy ^b $\pm$ chemotherapy	1–49			
	[18]	Austria	1998–2008	Cross-sectional	C	225	58 (26–92)	LENT-SOMA	Radiotherapy + brachytherapy ^c $\pm$ chemotherapy	3–84	14		
	[19]	Norway	1994–1999	Cross-sectional	C	91	62 (37–92)	LENT-SOMA, SAQ	Radiotherapy + brachytherapy ^d	66–131 Monthly Weekly Daily Constant	5 7 24 9		
	[20]	UK	1974–1980	Cross-sectional	C	66	All <75	Nonvalidated questionnaire	Radiotherapy ^e + brachytherapy ^e	60–132	32	59	

Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment (n)	Follow-up (months)	Findings		
										Urinary (%)		
										UI	SUI	UUI
Multiple treatment modalities reported	China Thailand	2007–2010 2002–2005	Cross-sectional Cross-sectional	C C	140 187	45.6 ($\pm$ 7.8) 44.6 (19–75)	FSFI Nonvalidated questionnaire	Surgery $\pm$ radiotherapy Surgery (62), surgery + chemotherapy (9), surgery + radiotherapy ^f (3), surgery + radiotherapy ^f + chemotherapy (26)	NR NR	9		
[23]	Italy	1997–2009	Retrospective cohort	C	56	51 (30–77)	UDS, internally validated questionnaire	RH only (13), neoadjuvant chemotherapy (3), surgery + radiotherapy ^f (11), surgery + chemotherapy (4)	<1	55 13 29		
										8 4 4		
[24]	Netherlands	1997–2007	Cross-sectional	C	242	47 ($\pm$ 9) 50 ($\pm$ 10) 52 ($\pm$ 12)	UDI, DDI	Surgery (146) Surgery + radiotherapy ^f (49) Radiotherapy ^f (47)	12–132 12–132 12–132	24 60 45 29 76 58 30 53 57		
[25]	Sweden	1991–2003	Cross-sectional	C	141	65.8	Nonvalidated questionnaire	Surgery, radiotherapy ^g , brachytherapy, chemotherapy	86.2			

Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment (n)	Follow-up (months)	Findings		
										Urinary (%)		
										UI	SUI	UUI
[26]	Sweden	1991–1992	Cross-sectional	C	247	51.5 ($\pm$ 0.8)	Internally validated questionnaire	Surgery (93) Radiotherapy (22) Surgery + brachytherapy ^b (57) Surgery + radiotherapy (24) Surgery + radiotherapy + brachytherapy ^b (55)	NR			
[27]	Europe	1985–1988	Randomized controlled trial	C	204	39 (mode)	History and physical examination	Surgery + radiotherapy ^h $\pm$ brachytherapy ^h	1–78	4		
Total												
2,875												

Findings												
Urinary (%)					Bowel (%)				Sexual (%)			
UR	Noct	Freq	DU	FI	FI	RB	ST	Dys	VD	HD	OD	Other (%)
Gynecologic malignancy prior to treatment					6							Prolapse 16
Surgery $\pm$ neoadjuvant chemotherapy	27	27										
16 ^j												
17 ^k												
Radiotherapy $\pm$ brachytherapy $\pm$ chemotherapy		7	1	2		11			47			Fistula 0.6 (0.5 VVF, 0.1 RVF) Fistula 1 (RVF)

Int Urogynecol J. Author manuscript; available in PMC 2020 July 01.

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^g Baseline assessment prior to surgery

^g External beam radiotherapy included 3D conformal or intensity-modulated radiotherapy to 45–50 Gy in 1.8-Gy fractions over 50 days with a boost to 60 Gy to pathologic lymph nodes; brachytherapy consisted of a pulse-dose rate or high-dose rate with MRI or CT guidance

^c External beam radiotherapy included the four-field box technique or intensity-modulated radiotherapy to 45 Gy in 25 fractions to patients receiving concomitant chemotherapy, and 50.4Gy in 28 fractions to patients without chemotherapy; brachytherapy consisted of MRI-guided high-dose rate intracavitary or interstitial administration of 2 Gy in four fractions

^d External beam radiotherapy to 45 Gy to whole pelvis in 25 fractions with boost to 50 Gy to uterus/tumor; for tumors >8 cm boost to 60 Gy to uterus/tumor; intracavitary radiotherapy 4.2 Gy per fraction

^e Patients with stage I/II disease received brachytherapy at 0.55 Gy/h to 60 Gy then external beam radiotherapy to a total dose of 76.5 Gy to point A and 49.5 Gy to point B; patients with stage III/IV disease received 42.5 Gy in 20 fractions then a single intracavitary insertion giving point A a further 33.5 Gy to a total dose of 76 Gy to point A and 50 Gy to point B

^f Radiotherapy regimen not reported

^g Adjuvant radiotherapy; target dose 40–50 Gy at 1.6–2.0 Gy per fraction, 5 days per week

^h Preoperative low dose rate 0.4 Gy/h versus high-dose rate 0.8 Gy/h brachytherapy; postoperative external beam radiotherapy to 45 Gy for positive lymph nodes

ⁱ By postvoid residual

^j Urinary retention defined as 30% of bladder capacity

^k >10% of maximum bladder capacity

^l Loss of bladder sensation

Table 3

Prevalence of PFDs in patients with endometrial cancer

	Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment (n)	Follow-up (months) (n)	Urinary (%)		
											UI	SUI	UUI
Gynecologic malignancy prior to treatment	[11]	USA	2012–2013	Cross-sectional	C	94	58.1 ($\pm$ 13.3)	ICIQ-FLUTS, RSC	NA ^a	NA ^a	29	25	25
	[12]	USA	2010–2011	Cross-sectional	C	186	59.6 ($\pm$ 0.9)	Nonvalidated questionnaire	NA ^a	NA ^a	36	15	15
	[32]	USA	2007–2008	Cross-sectional	C	70	60.1 ($\pm$ 12.1)	SSI, UDI, IIQ-7	Surgery (45) Surgery + radiotherapy ^b (25)	51.6	69	67	84
	[33]	Netherlands	2002–2006	RCT	B	196	68.1 (46–85)	EORTC, IOC	Surgery + brachytherapy ^c (108)	84	44		
Surgery $\pm$ radiotherapy $\pm$ brachytherapy	[34]	Netherlands	1990–1997	RCT	C	714	67.1 (51–84)	EORTC	Surgery + radiotherapy ^c (88)		41		
							75.5 (56–94)		Surgery (133)	159	15		
									Surgery + radiotherapy ^d (113)		43		
	[35]	Netherlands	2006–2013	RCT	C	686	62.5 (56.5–68)	EORTC	Surgery + radiotherapy ^e + chemotherapy	6 (327) 12 (305)	2	3	
Surgery	[36]	Belgium	2015	Prospective cohort	C	84	61.9 (55.9–68.1)	SSFS, SSPQ	Surgery + radiotherapy ^e	6 (324) 12 (304)	2	3	
	[37]	USA	2008–2009	Cross-sectional	C	25	62.95 ($\pm$ 8.64)	PFDI	Surgery	0 (45) 6 (31) 12 (28) 24 (22)			
									Surgery	>6			

Int Urogynecol J. Author manuscript; available in PMC 2020 July 01.

Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment (n)	Follow-up (months) (n)	Findings
Urinary (%)										
UI SUI UII										
modalities reported										
Unknown										
Total:										
<p><i>UI</i> urinary incontinence, <i>SUI</i> stress urinary incontinence, <i>UUI</i> urgency urinary incontinence, <i>UR</i> urinary retention, <i>Noct/</i>nocturia, <i>Freq</i> increased day-time frequency, <i>DU</i> dysuria, <i>FI</i> fecal incontinence, <i>FU</i> fecal urgency, <i>RB</i> rectal bleeding, <i>ST</i> straining, <i>Dys</i> dyspareunia, <i>VD</i> vaginal dryness, <i>HD</i> hypoactive disorder, <i>OD</i> orgasmic dysfunction, <i>NA</i> not applicable, <i>NR</i> not reported, <i>RCT</i> randomized controlled trial, <i>ICIQ-FLUTS</i> International Consultation on Incontinence Questionnaire-Female Lower Urinary Tract Symptoms, <i>RSC</i> Rotterdam Symptom Checklist, <i>SSI</i> Sandvik Severity Index, <i>UDI</i> Urinary Distress Inventory, <i>IIQ-7</i> Incontinence Impact Questionnaire-7, <i>EORTC</i> European Organization for Research and Treatment of Cancer, <i>IOC</i> Impact of Cancer questionnaire, <i>PFDI</i> Pelvic Floor Distress Inventory, <i>SSFS</i> Short Sexual Functioning Scale, <i>SSPQ</i> Specific Sexual Problems Questionnaire</p> <p>^a Baseline assessment prior to surgery</p> <p>^b Radiotherapy regimen not reported</p> <p>^c Radiotherapy, 46 Gy in 23 fractions; brachytherapy, 21 Gy high-dose rate in three fractions, or 30 Gy low-dose rate</p> <p>^d 46 Gy with 2 Gy of daily fractions</p> <p>^e 48.6 Gy in 1.8-Gy fractions, 5 days per week for 5.5 weeks</p> <p>^f Adjuvant radiotherapy: target doses 40–50 Gy at 1.6–2.0 Gy per fraction, 5 days per week</p>										

Table 4

Prevalence of PFDs in patients with ovarian cancer

	Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (±SD)	Outcome definition	Treatment	Follow-up (months)	Findings		
											Urinary (%)		
											UI	SUI	UUI
Gynecologic malignancy prior to treatment	[11]	USA	2012–2013	Cross-sectional	C	26	58.1 (±13.3)	ICIQ-FLUTS, RSC	NA ^a	NA ^a	42	39	
Multiple treatment modalities reported	[12]	USA	2010–2011	Cross-sectional	C	72	59.6 (±0.9)	Non-validated questionnaire	NA ^a	NA ^a	32	15	
	[25]	Sweden	1991–2003	Cross-sectional	C	45	65.8	Non-validated questionnaire	Surgery, radiotherapy ^b , brachytherapy, chemotherapy	86.2			
Unknown	[40]	USA	NR (published 2004)	Cross-sectional	C	232	56.6 (±10.2)	SAQ	NR	0–358			
Total						375							
Findings													
	Urinary (%)			Bowel (%)			Sexual (%)			Other (%)			
	UR	Noct	Freq	DU	FI	FU	RB	ST	Dys	VD	HD	OD	
Gynecologic malignancy prior to treatment					4								
Multiple treatment modalities reported					7								
Unknown									62	80		75	
Total													

Prolapse
17

UI urinary incontinence, SUI stress urinary incontinence, UUI urgency urinary incontinence, UR urinary retention, Noct nocturia, Freq increased day-time frequency, DU dysuria, FI fecal incontinence, FU fecal urgency, RB rectal bleeding, ST straining, Dys dyspareunia, VD vaginal dryness, HD hypoactive disorder, OD orgasmic dysfunction, NA not applicable, NR not reported, ICIQ-FLUTS International Consultation on Incontinence Questionnaire-Female Lower Urinary Tract Symptoms, RSC Rotterdam Symptom Checklist, SAQ Sexual Activity Questionnaire

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Baseline assessment prior to surgery
Adjuvant radiotherapy, target doses 40–50 Gy at 1.6–2.0 Gy per fraction, 5 days per week

Table 5

Prevalence of PFDs in patients with vulvar cancer

Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment	Follow-up (months)	Findings		
										Urinary (%)		
										UI	SUI	UUI
Gynecologic malignancy prior to treatment	[11]	USA	2012–2013	Cross-sectional	C	9	58.1 ($\pm$ 13.3)	ICIQ-FLUTS, RSC	NA ^a	NA ^a	44	22
	[43] [41]	Germany USA	2006–2010 1980–1990	Case series Retrospective cohort	C C	38 90	66 (39–87) 60–65	Nonvalidated questionnaire NR	Surgery ^b Surgery (MRV) Surgery (RV)	19 (3–50) 12–116	26 4 16	
	[42]	USA	1975–1989	Retrospective cohort	C	169	NR	NR	Surgery (RV) Surgery (3/1 RV) ^c Surgery (en bloc RV, butterfly technique)	NR	6 19 20	
Multiple treatment modalities reported	[44]	Germany	2002–2007	Case-control	C	40	50.4–60.1	International Incontinence Society standardized incontinence questionnaire, UDS (for some patients)	Surgery ^d (with PUR) Surgery ^d (without PUR) Surgery ^d (with PUR) + radiotherapy ^e $\pm$ chemotherapy	19.3–21.6 25 ^h 5 ^h 29 ^h		
	[25]	Sweden	1991–2003	Cross-sectional	C	5	65.8	Nonvalidated questionnaire	Surgery, radiotherapy, ^f brachytherapy, chemotherapy	86.2		
	[45]	USA	1976–1990	Retrospective cohort	C	225	68.2 (20–95)	NR	Surgery (MRV) $\pm$ radiotherapy ^e Surgery (RV) $\pm$ radiotherapy ^e	92.4 (0–198)	8	16
[46]	Brazil	NR (published 2012)	Cross-sectional	C	28	66.9 ($\pm$ 4.7)	ICIQ-SF	Surgery ^g $\pm$ radiotherapy ^e $\pm$ chemotherapy	NR	32		

Reference	Country	Study period	Study type	Grade of evidence	No. of patients	Age (years), mean (range or $\pm$ SD)	Outcome definition	Treatment	Follow-up (months)	Findings
Urinary (%)										
UI SUI UUI										
Total										
604										
Findings										
Urinary (%)										
UR										
Noct Freq DU FI FU RB ST Dys VD HD OD										
Other (%)										
Gynecologic malignancy prior to treatment										
3										
Surgery $\pm$ neoadjuvant chemotherapy										
Splitting/spraying 3, disturbance in sexual life 13, body image disturbance 13										
Anal incontinence 11										
Anal incontinence 0										
Spraying 25										
Multiple treatment modalities reported										
Spraying 10										
Spraying 14										
Rectocele 2, cystocele 1										
Rectocele 12, cystocele 16										
Total										

UI urinary incontinence, *SUI* stress urinary incontinence, *UUI* urgency urinary incontinence, *UR* urinary retention, *Freq* increased day-time frequency, *DU* dysuria, *FI* fecal incontinence, *FU* fecal urgency, *RB* rectal bleeding, *ST* straining, *Dys* dyspareunia, *VD* vaginal dryness, *HD* hypoactive disorder, *OD* orgasmic dysfunction, *NA* not applicable, *NR* not reported, *ICIQ-FLUTS* International Consultation on Incontinence Questionnaire-Female Lower Urinary Tract Symptoms, *RSC* Rotterdam Symptom Checklist, *UDS* urodynamic study, *ICIQ-SF* International Consultation on Incontinence Questionnaire-Short

Form, *RV* radical vulvectomy, *PUR* partial urethral resection, *MRV* modified radical vulvar surgery treated with vulvar excision alone or with lymphadenectomy via separate groin incisions (unilateral or bilateral)

^aBaseline assessment prior to surgery

^bSurgery included vulvar field resection with anatomical reconstruction

^cRadical vulvectomy technique using three separate incisions

^dStandard tumor resection with or without partial urethral resection

^eRadiotherapy regimen not reported

^fAdjuvant radiotherapy: target doses 40–50 Gy at 1.6–2.0 Gy per fraction, 5 days per week

^gVulvectomy with bilateral lymphadenectomy with triple incision or unilateral lymphadenectomy with double incision

^hBy questionnaire, and all these patients were continent by urodynamic measurements (one patient's measurement was inconclusive because of noncompliance)