Original Article

Risk factors for postoperative pelvic floor dysfunction in patients with cervical cancer: evidences for management strategies

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Background: It's necessary to evaluate the potential risk factors for postoperative pelvic floor dysfunction (PFD) in patients with cervical cancer, to provide insights into the treatment and nursing care of cervical cancer.

Methods: Our study was a case-control study design. Patients who underwent radical cervical cancer surgery in our hospital from January 2018 to January 2020 were included. We selected the patients with benign uterine lesions after hysterectomy at the same time as the control group. The patient characteristics of two groups were retrospectively compared and analyzed. Multiple logistic regression analyses were conducted to identify the potential risk factors.

Results: A total of 247 patients were included. The duration of surgery, estimated blood loss, duration of urinary catheter, and length of hospital stay in cervical cancer group were significantly more than that of control group (all $P<0.05$). The incidence of postoperative PFD was 63.93%. There were significant differences in the age, postoperative constipation, number of deliveries, duration of urinary catheter between PFD and no PFD patients (all $P<0.05$). Age ≥45y (OR 4.39, 1.05–9.83), duration of urinary catheter ≥7d (OR 4.31, 1.22–8.05), postoperative constipation (OR 3.17, 1.07–5.89) and number of deliveries ≥2 (OR 2.75, 1.22–5.43) were the risk factors for postoperative PFD in patients with cervical cancer.

Conclusions: Early measures targeted on those risk factors should be implemented for the prophylaxis of PFD.

Keywords: Cervical cancer; incontinence; pelvic floor; surgery; care

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Introduction

Cervical cancer is one of the most common gynecological malignant tumors, and its incidence is second only to breast cancer and currently ranks second in the global gynecological malignant tumors (1). From a global perspective, more than 50% of new cases and deaths occur every year in the Asia-Pacific region, especially in China (2). There are about 135,000 new cases of cervical cancer in China each year, accounting for about one-third of the total number of global cases (3). The current treatment of cervical cancer is based on the International Federation of Gynecology and Obstetrics (FIGO) staging with the options of operation in the early stage, radiotherapy combined with chemotherapy in the middle and late stage (4). Extensive hysterectomy plus pelvic lymph node dissection is an early surgical treatment for cervical cancer (5). Due to factors such as large surgical area, intraoperative nerve damage, parauterine tissue defects, ligament resection, and urinary tract infection, the patients

undergone surgery treatment may be associated with many postoperative complications, of which pelvic floor dysfunction (PFD) is the most common one, especially urinary retention (6). Because many PFDs are chronic diseases, the length of hospital stay is relatively longer, which not only increases the psychological and economic burden of patients, but also affects postoperative recovery and subsequent treatment (7). It's been reported that for some patients with non-gynecological malignant tumors who underwent total hysterectomy (8,9), patients can also undergo PFD after surgery. In recent years, the prevention and treatment of PFD-related diseases has gradually drawn many attentions from health care providers. The treatment of cervical cancer and the prevention of postoperative complications are still the focus of research.

PFD is a series of syndromes caused by weak support of the pelvic floor and the displacement of the pelvic organs, including pelvic organ prolapse (POP), urinary incontinence and genital tract fistula, etc. (10). PFD is a common disease in middle-aged and elderly women, and the incidence of PFD in this population ranges from 30% to 50% (11,12). In recent years, with the aging of the population, PFD has increasingly affected women's health and quality of life (13). At present, more and more health care providers have focused on the pathogenesis, pathophysiological changes, new auxiliary diagnostic and surgical methods of PFD (14). Moreover, many scholars have focused on the advantages and disadvantages of various surgical methods, but very few studies have focused on the complications after surgery. To the best of our knowledge, the risk factors for postoperative PFD in patients with cervical cancer remain unclear. Therefore, in this present study, we aimed to conduct a retrospective analysis to investigate the potential risk factors for postoperative PFD in patients with cervical cancer, to provide evidences to the management and nursing care of patients with cervical cancer. We present the following article in accordance with the STROBE reporting checklist (available at https://dx.doi.org/10.21037/tcr-21-365).

Methods

Ethical statement

This present study was a case-control study design. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Medical Research Ethics Committee of West China Second University Hospital, Sichuan University (No.201712068) and informed consent had been taken from all the patients.

Patients

Patients who underwent radical cervical cancer surgery in our hospital from January 2018 to January 2020 were identified as potential candidate. The inclusion criteria were: (I) age ≤60 years old; (II) undergone extensive hysterectomy due to cervical cancer and it's within 12 months after surgery; (III) the patients were well informed and agreed to participant in this present study. The exclusion criteria were: (I) age >60 years; (II) patients underwent preoperative radiotherapy and those with simple radiotherapy and chemotherapy; (III) didn't agree to participant in this study.

Meanwhile, we selected the patients with benign uterine lesions after total hysterectomy as the control group. The inclusion criteria were: (I) age ≤60 years old; (II) underwent total hysterectomy; (III) patients were well informed and agreed to participant in this present study. The exclusion criteria were: (I) those patients with cervical cancer; (II) those patients who didn't agree to participant in this study.

The key to radical hysterectomy was the complete removal of regional lymph nodes and extensive total hysterectomy. Pelvic lymph nodes must be removed thoroughly and meticulously, including the common iliac, external iliac, internal iliac, obturator, and main ligament groups. If necessary, we removed the abdominal aorta, anterior lumbosacral and deep groin groups. Two experienced doctors opened the side fossa of the bladder, separated and cut off the ligaments and connective tissues connecting the uterus on both sides, and removed the adipose tissue around the main ligament, and cut off near the pelvic wall. The incision margin was generally 3 to 4 cm away from the lesion.

All patients were tested for pelvic floor function 30 days after surgery. The test content included: free urine flow rate, pelvic floor electrophysiology, nerve injury measurement and anorectal kinetic examination. For the urine parameter analysis, the normal value of the maximum urine flow rate was greater than 20 mL/sec, the higher of the urine flow rate, the better of urination function. The normal value of average urine flow rate was greater than 25 mL/sec. The time to maximum urine flow was less than 3s.

Pelvic floor function assessment

All the included patients underwent the check of pelvic floor function 30 days after surgery. All the patients were kept on an empty stomach before the examination, and the

Table 1 The characteristics of participants

Items	Cervical cancer group (n=122)	Control group (n=125)	t	P
Age (y)	44.73±7.21	45.14±8.06	6.184	0.089
Weight (kg)	62.80±9.17	61.33±8.82	5.250	0.194
BMI	22.16±2.04	22.30±3.18	3.097	0.207
Age at first sex (y)	23.45±4.28	22.96±4.04	5.112	0.129
Number of pregnancy	3.76±0.60	3.68±0.59	1.125	0.101
Number of deliveries	2.83±0.56	2.97±0.71	1.992	0.147

BMI, body mass index.

Table 2 The preoperative urination and defecation condition between two groups

Items	Cervical cancer group (n=122)	Control group (n=125)	χ^2	P
Urinary retention	45 (36.89%)	43 (34.40%)	1.208	0.095
Urinary incontinence	113 (92.62%)	109 (87.20%)	1.164	0.189
Difficulty in defecation	40 (32.79%)	35 (28.00%)	1.082	0.066
Stool incontinence	121 (99.18%)	118 (94.40%)	1.747	0.134

pelvic floor function was examined in our hospital with the Phenix USB11(Germany). A professional doctor checked the patient's pelvic floor function, which included maximum urine flow rate, average urine flow rate, duration of urination and time to maximum urine flow, strength of muscle fiber I, fatigue of muscle fiber I, strength of muscle fiber II, fatigue of muscle fiber II and myoelectric potential. PFD was defined as the weakness of the pelvic floor support structure due to various reasons, and then the displacement of the pelvic organs, which causes the position and function of other pelvic organs to be abnormal. We excluded patients with voiding dysfunction including polyuria, frequent urination, oliguria, anuria, urinary obstruction, urinary leaching, urinary incontinence, painful urination, dysuria, urinary retention, etc., which was associated with the neurogenic causes.

Data collection

We collected the general information about the patient, including age, body mass index (BMI), the history of sex, pregnancy and delivery, urinary retention, urinary incontinence, difficulty in defecation and stool incontinence. Besides, we collected the surgical details of cervical cancer, including the duration of surgery, estimated blood loss, time to first passage of flatus, duration of urinary catheter, length of hospital stay.

Statistical analysis

Statistical analysis was performed using SPSS 23.0 software. Continuous data were expressed as mean ± standard deviation, group *t*-test was used for comparison between two groups. Chi-square test was used for the comparison of binary data. Multiple logistic regression analyses were conducted to identify the potential risks. In this present study, $P<0.05$ was considered that the differences were statistically significant.

Results

The characteristics of patients

A total of 247 patients were included, of whom 122 patients in the cervical cancer group, 125 patients in the control group. As *Table 1* showed, there were no significant differences in the age, weight, BMI, age at first sex, number of pregnancy and deliveries between two groups (all $P>0.05$).

The preoperative urination and defecation condition between two groups

As *Table 2* presented, there were no significant differences in the urinary retention, urinary incontinence, difficulty in defecation, stool incontinence between two groups

Table 3 The surgical characteristic comparisons between two groups

Items	Cervical cancer group (n=122)	Control group (n=125)	t	P
The duration of surgery (min)	198.44±20.17	113.38±19.04	29.385	0.003
Estimated blood loss (mL)	230.08±15.27	156.85±10.45	17.140	0.019
Time to first passage of flatus (d)	3.18±1.02	2.94±1.12	1.775	0.082
Duration of urinary catheter (d)	6.49±1.66	2.95±1.04	1.284	0.021
Length of hospital stay (d)	12.28±3.19	6.86±2.01	2.668	0.006

Table 4 The postoperative urination and defecation condition between two groups

Items	Cervical cancer group (n=122)	Control group (n=125)	χ^2	P
Urinary retention	20 (16.39%)	17 (13.60%)	1.138	0.116
Urinary incontinence	41 (33.61%)	12 (9.60%)	1.087	0.041
Difficulty in defecation	54 (44.26%)	47 (37.60%)	1.644	0.092
Stool incontinence	21 (17.21%)	2 (1.60%)	1.273	0.006

Table 5 The postoperative urine flow condition between two groups

Items	Cervical cancer group (n=122)	Control group (n=125)	t	P
Maximum urine flow rate (mL/s)	26.48±8.34	27.12±7.06	5.284	0.071
Average urine flow rate (mL/s)	14.57±6.95	14.81±5.22	3.108	0.116
Duration of urination (s)	23.01±8.11	22.75±9.79	4.295	0.178
Time to maximum urine flow (s)	4.17±2.64	3.82±2.27	1.130	0.095

(all P>0.05).

The surgical characteristic comparisons among two groups

As *Table 3* showed, the duration of surgery, estimated blood loss, duration of urinary catheter, and length of hospital stay in cervical cancer group were significantly more than that of control group (all P<0.05). And there was no significant difference on the time to first passage of flatus (P=0.082).

The postoperative urination and defecation condition among two groups

As *Table 4* presented, the incidence of urinary and stool incontinence after surgery were significantly higher than that of control group (all P<0.05). And there were no significant differences in the urinary retention and difficulty in defecation after surgery between two groups (all P>0.05).

The postoperative urine flow condition between two groups

As *Table 5* showed, there were no significant differences in the maximum urine flow rate, average urine flow rate, duration of urination and time to maximum urine flow between two groups (all P>0.05).

Postoperative electrophysiological function of pelvic floor

As *Table 6* presented, there were significant differences in the strength of muscle fiber I, fatigue of muscle fiber I, strength of muscle fiber II, fatigue of muscle fiber II and myoelectric potential between two groups (all P<0.05).

The characteristics of PFD and no PFD patients with cervical cancer

Among the 122 patients with cervical cancer, there were 78 patients had sign of PFD and 44 patients had no sign

Table 6 Postoperative electrophysiological function of pelvic floor

Items	Cervical cancer group (n=122)	Control group (n=125)	t	P
Strength of muscle fiber I (N·m)	2.18±1.01	3.69±1.18	1.046	0.031
Fatigue of muscle fiber I (%)	−3.38±1.14	1.22±1.09	1.191	0.048
Strength of muscle fiber II (N·m)	1.50±0.87	2.84±1.03	1.227	0.025
Fatigue of muscle fiber II (%)	−0.64±0.18	−0.21±0.19	1.094	0.034
Myoelectric potential (μV)	7.84±2.05	10.27±3.11	1.168	0.049

of PFD, the incidence of postoperative PFD was 63.93%. As *Table* 7 presented, there were significant differences on the age, postoperative constipation, number of deliveries, duration of urinary catheter between PFD and no PFD patients with cervical cancer (all P<0.05), no significant differences on the BMI, number of pregnancy, surgical anatomical range, pathology and postoperative radiotherapy between PFD and no PFD patients with cervical cancer were found (all P>0.05).

Logistic regression analysis

As *Table 8* presented, age ≥45y (OR 4.39, 1.05–9.83), duration of urinary catheter ≥7d (OR 4.31, 1.22–8.05), postoperative constipation (OR 3.17, 1.07–5.89) and number of deliveries ≥2 (OR 2.75, 1.22–5.43) were the risks factors for postoperative PFD in patients with cervical cancer.

Discussion

Principal findings

In recent years, female PFDs have caused widespread concern in the clinical field of obstetrics and gynecology. With the intensification of aging, the proportion of middle-aged and elderly women in the social demographic structure has increased, and the prevention and treatment of related PFD diseases need to be resolved urgently (15,16). The cause of PFD disease involves iatrogenic factors, especially pelvic and abdominal surgery, and total hysterectomy as a common abdominal surgery, with pelvic and abdominal cavity involved, is an important factor associated with PFD (17). The incidence of postoperative PFD in this present study was 63.93%, which is similar to previous related reports (18,19). Furthermore, we have found that age ≥45y, duration of urinary catheter ≥7d, postoperative constipation and number of deliveries ≥2 were the independent risk factors for postoperative PFD in patients with cervical cancer, targeted intervention and nursing care are needed for patients with those risk factors to prevent the PFD in clinical settings.

Results

In the pelvic cavity, the uterus is located behind the bladder and before the rectum (20). Extensive hysterectomy involves the removal of the cervix, uterus, and supporting tissues, as well as part of the pelvic lymph nodes and vagina (21). The three-dimensional ring around the cervix is an anatomical structure closely related to gynecological and obstetric surgery (22). It refers to the anatomical structure and tissue surrounding the cervix in the range of 3 to 4 cm. The three-dimensional ring around the cervix contains three organs, three pairs of main ligaments, seven gaps, a pair of para-tissues, and several important blood vessels and nerves (23). The hysterectomy not only needs to cut off the main and sacral ligaments in the center of the pelvic floor, but also needs to push down the bladder and rectum. According to reports (24,25), 40% hysterectomy patients have anxiety symptoms of varying degrees, and about 20% have symptoms of urinary and stool disorders and incontinence. These symptoms interfere with their daily lives to varying degrees, which warrants attentions from health care providers.

PFD is a disease caused by multiple factors. According to previous reports, the possible influencing factors include pregnancy, childbirth, age and BMI (26-28). At the same time, PFD may be associated with increased abdominal pressure caused by ascites, chronic cough, long-term constipation, and continuous weight bearing (29). In addition, studies (30,31) have reported that the incidence of PFD in patients with menopause and low estrogen levels is significantly higher. There are reports (32,33) that age can be used as an independent risk factor for postpartum urinary

Table 7 The characteristics of patients with cervical cancer

Items	PFD patients (n=78)	No PFD patients (n=44)	t	P
Age				
≥45y	38 (48.72%)	11 (25.00%)	2.187	0.024
<45y	40 (51.28%)	33 (75.00%)		
BMI				
≥22	58 (74.35%)	34 (77.27%)	1.645	0.091
<22	20 (25.64%)	10 (22.73%)		
Postoperative constipation				
Yes	61 (78.21%)	20 (45.45%)	2.904	0.017
No	17 (21.79%)	24 (54.55%)		
Number of pregnancy				
≥3	48 (61.54%)	22 (50.00%)	1.104	0.115
<3	30 (38.46%)	22 (50.00%)		
Number of deliveries				
≥2	56 (71.79%)	23 (52.27%)	1.217	0.019
<2	22 (28.21%)	21 (47.72%)		
Surgical anatomical range				
With abdominal aortic lymph node dissection	8 (10.26%)	4 (9.09%)	1.094	0.076
Without abdominal aortic lymph node dissection	70 (89.74%)	40 (90.91%)		
Pathology				
Squamous cell carcinoma	76 (97.45%)	44 (100%)	1.088	0.116
Adenocarcinoma	2 (2.55%)	0 (0%)		
Duration of urinary catheter (d)				
≥7	51 (65.38%)	4 (9.09%)	2.081	0.002
<7	27 (31.62%)	40 (90.91%)		
Postoperative radiotherapy				
Yes	4 (5.13%)	1 (2.27%)	1.125	0.097
No	74 (94.87%)	43 (97.73%)		

PFD, pelvic floor dysfunction; BMI, body mass index.

incontinence. As the age increases, the prevalence of urinary incontinence is higher. At the same time, studies (34-36) have shown that estrogen receptors exist in the external anal sphincter and pelvic muscles, and estrogen is effective in the treatment of postmenopausal women's reproductive tract fistula, which can promote vaginal epithelial hyperplasia, and is conducive to wound healing. Thus, the estrogen level may also be the influencing factor of PFD. Due to the lack of relevant data, this study failed to analyze the effect of estrogen, further research is needed to analyze the role of estrogen in the future.

Several limitations should be considered in this present study. Firstly, this study was a retrospective study design, we could not include many potentially associated factors that reported in many previous studies, making us difficult to analyze those indicators. Secondly, the follow-up period

Table 8 Logistic regression analysis on the risk factors for postoperative PFD in patients with cervical cancer

Variables	β	SE	OR	95% CI	P	Rank
Age ≥45y	0.59	0.24	4.39	1.05–9.83	0.031	1
Duration of urinary catheter ≥7d	0.94	0.33	4.31	1.22–8.05	0.039	2
Postoperative constipation	1.15	0.21	3.17	1.07–5.89	0.044	3
Number of deliveries ≥2	0.95	0.38	2.75	1.22–5.43	0.029	4

of this study was short. Previous studies (37,38) have shown that PFD may have a greater incidence and impact in the long-term postoperative period. We will extend the follow-up period based on this study to explore the long-term impact of PFD in the future.

Conclusions

In conclusions, postoperative PFD is very common in patients with cervical cancer, and age ≥45y, duration of urinary catheter ≥7d, postoperative constipation and number of deliveries ≥2 are the independent risk factors for postoperative PFD in patients with cervical cancer. Clinical medical workers should take early warning and intervention measures against these risk factors to reduce the occurrence of PFD and improve the quality of life of patients.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://dx.doi.org/10.21037/tcr-21-365

Data Sharing Statement: Available at https://dx.doi.org/10.21037/tcr-21-365

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/tcr-21-365). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Medical Research Ethics Committee of West China Second University Hospital, Sichuan University (No.201712068) and informed consent had been taken from all the patients.

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