Identifying the risk factors and developing a predictive model for postoperative pelvic floor dysfunction in cervical cancer patients

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Contributions: (I) Conception and design: YY Liu, WH Zhu; (II) Administrative support: Q Shen; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Background: Pelvic floor dysfunction is a common complication after cervical cancer surgery, and the key to early prevention and treatment is the timely identification of risk factors and high-risk patients. The present study explored the risk factors of pelvic floor dysfunction in cervical cancer patients after surgery and established a predictive model.

Methods: A total of 282 cervical cancer patients admitted to Wuhan No.7 Hospital from January 2020 to June 2022 was retrospectively enrolled in this study. All patients underwent surgery and were followed up after surgery. The patients were divided into a pelvic floor dysfunction group (n=92) and a control group (n=190) according to whether they developed pelvic floor dysfunction or not at 6 months post-surgery. The differences in clinical features between the two groups were observed to identify the risk factors of pelvic floor dysfunction after cervical cancer, and a prediction model was established.

Results: There were significant differences in age, surgical method, surgical resection range, and radiotherapy between the two groups ($P<0.05$). Age greater than 65 years, open surgery, total hysterectomy, and radiotherapy were identified as the risk factors of postoperative pelvic floor dysfunction in patients with cervical cancer ($P<0.05$). The R4.0.3 statistical software was used to randomly divide the dataset into a training dataset (n=141) and a validation dataset (n=141). The area under the curve was 0.755 (95% confidence interval: 0.673–0.837) in the training set and 0.604 (95% confidence interval: 0.502–0.705) in the verification set. In the validation set, the model was tested with a Hosmer-Lemeshow Goodness-of-Fit test, with a chi-square value of 9.017 and a P value of 0.341.

Conclusions: Patients with cervical cancer have a high incidence of postoperative pelvic floor dysfunction. Age greater than 65 years, open surgery, total hysterectomy, and radiotherapy are risk factors of postoperative pelvic floor dysfunction in cervical cancer patients, and the present model helps to identify patients at high-risk of pelvic floor dysfunction.

Keywords: Cervical cancer; pelvic floor dysfunction; risk factors; predictive model

Introduction

The incidence of cervical cancer is approximately 4% and ranks sixth among all female malignancies in worldwide (1). While surgery is the main treatment for cervical cancer, postoperative pelvic floor dysfunction is a complication that can lead to severe impairment of a patient's quality of life. A previous meta-study showed that postoperative urinary incontinence and constipation rates were as high as 34.1% and 11.1% after cervical cancer surgery (2). Pelvic floor dysfunction leads to the displacement of pelvic organs, which is linked to the dislocation and dysfunction of other pelvic organs. It is one of the top five chronic diseases affecting women's quality of life, with clinical manifestations such as urinary incontinence and constipation (3,4). This current study explored the risk factors of postoperative pelvic floor dysfunction in cervical cancer patients. This information may be crucial in the prevention and treatment of patients with pelvic floor dysfunction. We present this article in accordance with the TRIPOD reporting checklist (available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-385/rc).

Methods

General patient information

A total of 282 cervical cancer patients who underwent surgery at the Wuhan No.7 Hospital from January 2020 to June 2022 was retrospectively enrolled. All patients were

followed up after surgery. Patients were divided into a pelvic floor dysfunction group (n=92) and a control group (n=190) according to whether they developed pelvic floor dysfunction or not at 6 months post-surgery. The following inclusion criteria were applied: (I) patients were diagnosed with cervical cancer; (II) patients underwent surgical treatment in the Wuhan No.7 Hospital; and (III) patients were aged 18 years or greater. The following exclusion criteria were applied: (I) previous pelvic floor dysfunction; (II) lumbar spine diseases; (III) presentation of other malignant tumors; and (IV) loss to follow-up. The present study was conducted in accordance with the Declaration of Helsinki (as revised in 2013), and was approved by the Ethics Committee of the Wuhan No.7 Hospital (No. 202200874). Due to the retrospective nature of the study, patient informed consent was waived.

Treatment method

Following admission, patients completed the relevant examinations and received surgical treatment. Adjuvant therapy such as radiotherapy and chemotherapy were administered according to the pathological results.

Data collection

The following information was collated: age, body mass index (kg/m^2), smoking history, history of alcoholism, hypertension, diabetes, hyperlipidemia, degree of tumor cell differentiation, pathological type, International Federation of Gynecology and Obstetrics (FIGO) stage, surgical methods, surgical resection range, radiation therapy, and chemotherapy.

Diagnostic criteria

Diagnostic criteria for pelvic floor dysfunction were defined as a disorder caused by pelvic floor support structures, injuries, and dysfunctions, including pelvic organ prolapse, urinary incontinence, fecal incontinence, sexual dysfunction, recurrent urinary tract, genital tract infections, and chronic pelvic pain.

Statistical analysis

SPSS26.0 (IBM, Chicago, USA) software was used for statistical data analysis and differences with a P value <0.05 were considered statistically significant. The measurement

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Highlight box

Key findings
- Patients with cervical cancer have a high incidence of postoperative pelvic floor dysfunction. This study demonstrated that the risk factors for postoperative pelvic floor dysfunction in patients with cervical cancer included age greater than 65 years, open surgery, total hysterectomy, and radiotherapy.

What is known and what is new?
- Pelvic floor dysfunction is a common complication after cervical cancer surgery.
- We herein developed a predictive model to identify patients at high risk of pelvic floor dysfunction.

What is the implication, and what should change now?
- This model can help identify patients at high risk of developing pelvic floor dysfunction. Early management in such patients may be beneficial to reduce the incidence of pelvic floor dysfunction.
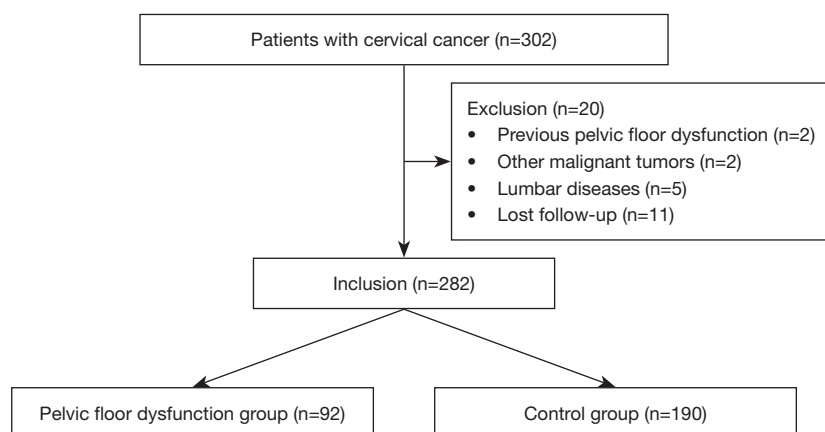

Figure 1 A flow chart showing the cervical cancer patient selection process.

data of the two groups were expressed as mean ± standard deviation, and the differences between the two groups were analyzed by independent sample *t*-test. The count data of the two groups were expressed by n (%), and the chi-square test was used to analyze the differences between the two groups. Multivariate regression was used to analyze risk factors of pelvic floor dysfunction in patients with cervical cancer. The receiver operating characteristic (ROC) curve was used to analyze the predictive value of different indicators on pelvic floor dysfunction. The R4.0.3 statistical software was used to establish a prediction model for postoperative pelvic floor dysfunction in cervical cancer patients.

Results

Clinical features of the patients

The flow chart in *Figure 1* shows the patient selection process. A total of 302 patients with cervical cancer were retrospectively analyzed. Two patients presented with previous pelvic floor dysfunction and were excluded. Another 2 patients were excluded due to presentation of other malignant tumors, 5 patients were excluded due to presentation of lumbar diseases, and 11 patients were lost to follow-up (*Figure 1*). Finally, 282 patients were included in the study, including 92 patients with pelvic floor dysfunction (*Figure 1*).

Analysis of the basic patient characteristics demonstrated that patients with and without pelvic floor dysfunction differed significantly in terms of age, surgical method, surgical resection range, and administration of radiotherapy (P<0.05; *Table 1*).

Predictive value of age on postoperative pelvic floor dysfunction in cervical cancer patients

The ROC curve showed that age has a certain predictive value for postoperative pelvic floor dysfunction in cervical cancer patients, with an area under the curve of 0.650 (95% confidence interval: 0.582–0.719; P<0.001; *Figure 2*).

Risk factors for postoperative pelvic floor dysfunction in cervical cancer patients

Age >65 years, open surgery, total hysterectomy, and radiotherapy were identified as risk factors of postoperative pelvic floor dysfunction in cervical cancer patients (P<0.05; *Table 2*).

Establishment and validation of a postoperative pelvic floor dysfunction prediction model in cervical cancer patients

The R4.0.3 statistical software was used to randomly divide the dataset into a training dataset (n=141) and validation dataset (n=141). The area under the ROC curve was 0.755 (95% confidence interval: 0.673–0.837) for the training dataset, and 0.604 (95% confidence interval: 0.502–0.705) for the validation dataset. In the validation dataset, the model was tested with a Hosmer-Lemeshow Goodness-of-Fit test, with a chi-square value of 9.017 and a P value of 0.341 (*Figures 3-6*).

Discussion

Pelvic floor dysfunction is a common complication after cervical cancer surgery, with an incidence of up to 50% (2,5).

Table 1 A comparison of the basic clinical features of cervical cancer patients with and without pelvic floor dysfunction

Variables	Pelvic floor dysfunction group (n=92)	Control group (n=190)	t/χ^2 value	P value
Age (years)	60.93±11.77	54.37±11.54	4.451	<0.001
Age			8.979	0.003
>65 years	36 (39.13)	42 (22.11)		
≤65 years	56 (60.87)	148 (77.89)		
Body mass index (kg/m^2)	23.06±2.89	23.53±2.74	1.303	0.194
History of smoking	6 (6.52)	11 (5.79)	0.059	0.809
History of alcoholism	4 (4.35)	12 (6.32)	0.449	0.503
Hypertension	8 (8.70)	14 (7.37)	0.152	0.697
Diabetes	5 (5.43)	13 (6.84)	0.205	0.650
Hyperlipidemia	12 (13.04)	20 (10.53)	0.390	0.532
Tumor cell differentiation			0.299	0.584
Low	21 (22.83)	38 (20.00)		
Medium to high	71 (77.17)	152 (80.00)		
Type of pathology			0.188	0.664
Squamous	70 (76.09)	140 (73.68)		
Adenocarcinoma	22 (23.91)	50 (26.32)		
FIGO stage			0.814	0.367
Stage I	32 (34.78)	56 (29.47)		
Stage II	60 (65.22)	134 (70.53)		
Surgical methods			9.273	0.002
Open surgery	21 (22.83)	18 (9.47)		
Minimally invasive surgery	71 (77.17)	172 (90.53)		
Surgical resection range			8.279	0.004
Total hysterectomy	57 (61.96)	83 (43.68)		
Partial hysterectomy	35 (38.04)	107 (56.32)		
Radiotherapy			6.100	0.014
Yes	44 (47.83)	62 (32.63)		
No	48 (52.17)	128 (67.37)		
Chemotherapy			0.213	0.644
Yes	54 (58.70)	106 (55.79)		
No	38 (41.30)	84 (44.21)		

Data are presented as mean ± standard deviation or n (%). FIGO, International Federation of Gynecology and Obstetrics.

The results herein demonstrated that age greater than 65 years, open surgery, total hysterectomy, and radiotherapy were risk factors of postoperative pelvic floor dysfunction in patients with cervical cancer (P<0.05). Furthermore, the prediction model established based on these relevant risk factors was valuable in identifying patients at high-risk of
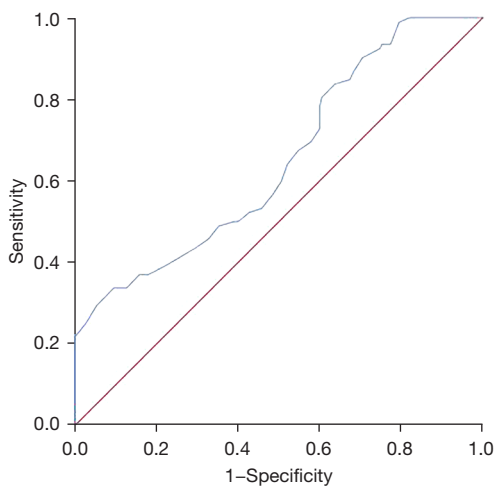
Figure 2 Predictive value of age for postoperative pelvic floor dysfunction in patients with cervical cancer.

pelvic floor dysfunction after cervical cancer surgery.

Female pelvic floor dysfunction, including urinary incontinence and sexual dysfunction, is caused by pelvic floor support structure injuries and dysfunction, affecting approximately 50% of adult women (6). With the increase of the age, the pelvic floor support structure gradually deteriorates, and damage to the pelvic floor structure is further aggravated during cervical cancer surgery, resulting in pelvic floor dysfunction (7-10). A previous study demonstrated that increased age was a risk factor of pelvic floor dysfunction after cervical cancer surgery (3), which is consistent with the results of our present study. Pelvic surgery has a limited field of view, while the range of operation is deep and narrow. Furthermore, the nerves that affect pelvic function are often concentrated, and thus, surgical injuries that cause pelvic floor dysfunction

Table 2 Risk factors of postoperative pelvic floor dysfunction in cervical cancer patients

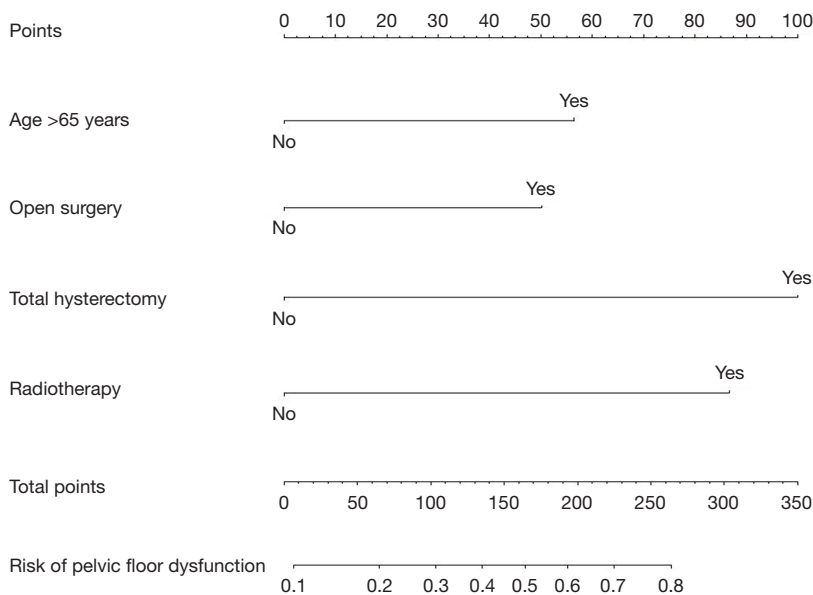| Variables	B value	Standard error	Wald value	P value	Relative risk (95% CI)
Age >65 years	0.617	0.292	4.456	0.035	1.854 (1.045–3.289)
Open surgery	0.933	0.375	6.177	0.013	2.541 (1.218–5.302)
Total hysterectomy	0.833	0.273	9.315	0.002	2.301 (1.347–3.929)
Radiotherapy	0.595	0.275	4.694	0.030	1.813 (1.058–3.105)
Constant	−4.226	1.021	17.144	<0.001	0.015

CI, confidence interval.

Figure 3 A nomogram of postoperative pelvic floor dysfunction prediction for cervical cancer patients

are common. Open surgery for cervical cancer is more traumatic, and excessive stretching of the pelvic floor support structures for surgical visibility often results in pelvic floor dysfunction (11-13). Patients with total hysterectomy, who have a wide range of surgery, tend to have a late stage of FIGO, requiring extensive dissection of regional lymph nodes. Therefore, patients with total hysterectomy are more prone to structural and neurological damage, resulting in pelvic floor dysfunction (4,14). In
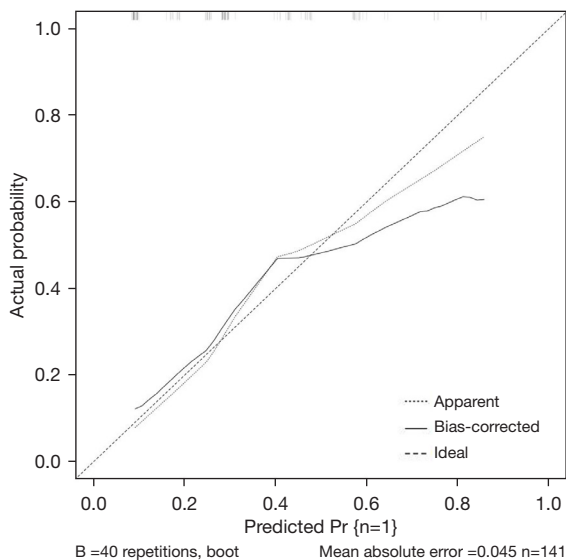
recent years, with the development of minimally invasive technology, robotic surgery may be beneficial for reducing the incidence of pelvic floor dysfunction in patients with cervical cancer, but further research is still needed. Adhesions in the large intestine and pelvic wall may occur after radiotherapy for cervical cancer, further exacerbating the local inflammatory response after cervical cancer surgery, resulting in adhesions (15).

To better identify the patients at high-risk of postoperative pelvic floor dysfunction in cervical cancer patients, we established a nomogram prediction model for postoperative pelvic floor dysfunction. Nomograms are based on multivariate regression analysis and integrating multiple predictors, so as to express the interrelationship between various variables in a prediction model. Nomograms have been widely used in the diagnosis and prognosis of various diseases (16-21). In the present study, the area under the ROC curve of the training set of the predictive model was 0.755 (95% confidence interval: 0.673–0.837), indicating that the model has predictive valuable for postoperative pelvic floor dysfunction in cervical cancer patients. For patients who have developed pelvic floor dysfunction, both conservative treatment and surgery may be beneficial for improving their clinical symptoms (22).

Limitations

There were certain limitations to this study. First, this was a retrospectively clinical study and second, there were relatively few patients in the pelvic floor dysfunction group.
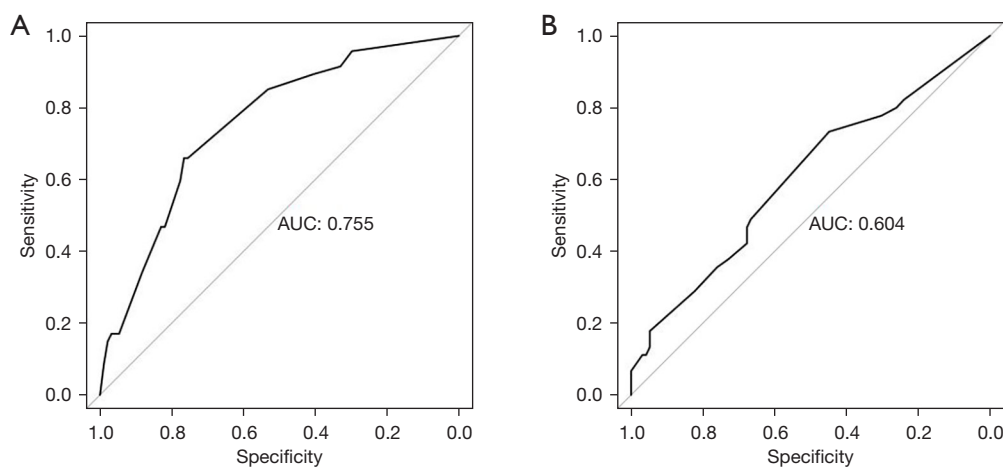

Figure 4 The calibration curve of the postoperative pelvic floor dysfunction prediction model in cervical cancer patients. Pr, probability.

Figure 5 The predictive value of the predictive model for postoperative pelvic floor dysfunction in cervical cancer patients (training set on the left, validation set on the right). AUC, area under the curve.
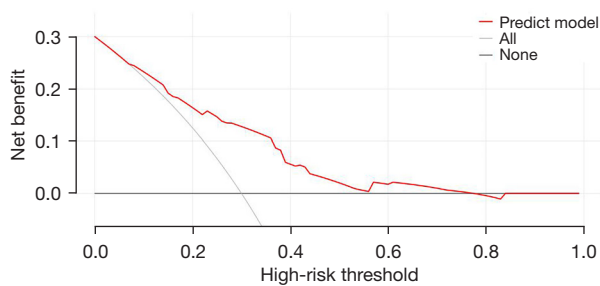
Figure 6 Clinical decision curve of postoperative pelvic floor dysfunction prediction model in cervical cancer patients.

Conclusions

Prognosis and related indicators of different diseases are the focus of current research (23-26). The incidence of postoperative pelvic floor dysfunction in cervical cancer patients is high. Age greater than 65 years old, open surgery, total hysterectomy, and radiotherapy were identified as risk factors of postoperative pelvic floor dysfunction in cervical cancer patients. The prediction model developed herein is helpful for identifying patients at high-risk of pelvic floor dysfunction. Early management of such high-risk patients may be beneficial to reducing the incidence of pelvic floor dysfunction.

Acknowledgments

Footnote

Reporting Checklist: The authors have completed the TRIPOD reporting checklist. Available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-385/rc

Data Sharing Statement: Available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-385/dss

Peer Review File: Available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-385/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-385/coif). 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 present study was conducted in accordance with the Declaration of Helsinki (as revised in 2013), and was approved by the Ethics Committee of the Wuhan No.7 Hospital (No. 202200874). Due to the retrospective nature of the study, patient informed consent was waived.

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(English Language Editor: J. Teoh)