

ORIGINAL RESEARCH ARTICLE

Impact of pre-brachytherapy indwelling urinary catheters on comfort and psychological well-being patients with cervical cancer

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Abstract

This study aimed to explore the effects of indwelling urinary catheters before brachytherapy on patient comfort and psychological stress in cervical cancer patients. A total of 140 patients with stage IIA or higher cervical cancer were randomly assigned to two groups: The indwelling catheter group ($n = 70$) and the non-indwelling catheter group ($n = 70$). Radiation exposure risks were compared using dose-volume histograms. Brachytherapy, a high-dose-rate micro-radiation therapy, was performed using the Utrecht applicator. Tumor treatment efficacy and levels of norepinephrine (NE), cortisol (Cor), and adrenocorticotrophic hormone (ACTH) were measured. The patient's fear, psychological state, comfort, and quality of life were evaluated before and after the intervention. Results showed that radiation exposure to healthy tissues was lower in the indwelling catheter group ($P < 0.05$), with a reduced rate of excessive radiation exposure compared to the non-indwelling catheter group. Before the intervention, the indwelling catheter group had higher Fear of Progression Questionnaire-Short Form (FoP-Q-SF) scores, but no significant difference was observed between groups after the intervention. Tumor size was smaller in the indwelling catheter group, and treatment outcomes were significantly better. Levels of NE, Cor, and ACTH were higher in the indwelling catheter group. Comfort scores were lower in the indwelling catheter group, but their quality of life was better compared to the non-indwelling catheter group. In conclusion, the use of indwelling catheters in brachytherapy for cervical cancer improves treatment outcomes and quality of life. While it may cause temporary discomfort and psychological stress, no long-term negative effects were observed.

Keywords: Cervical cancer; Brachytherapy; Indwelling catheter; Comfort; Psychological stress

1. Introduction

Brachytherapy is a critical component of the treatment for locally advanced cervical cancer and is widely used due to its high tumor control rate.¹⁻⁴ The precision of radiotherapy significantly impacts treatment efficacy and patients' well-being, particularly in minimizing radiation-induced damage to surrounding health while ensuring accurate tumor-targeted dose administration. In this context, the use of indwelling catheters has been introduced as an adjunct to afterloading radiotherapy, aiming to improve positioning accuracy and dose control.⁵⁻⁷ The indwelling catheter assists in the design and implementation of radiotherapy plans by stabilizing and marking anatomical landmarks, helping clinicians more precisely calculate and locate the treatment area. This approach reduces the impact of radiation on healthy tissues, thereby reducing potential side effects.

In recent years, with the growing emphasis on patient-centered care, researchers and clinicians have become increasingly concerned with the impact of treatment on patients' quality of life.^{8,9} During radiotherapy, patients may experience various psychological stress reactions, such as pain, anxiety, fear, and concerns about their future health status.¹⁰⁻¹³ These reactions not only affect patients' emotional well-being but can also influence treatment adherence and outcomes. Investigating the impact of indwelling catheters on patient comfort and psychological stress is essential for optimizing radiotherapy strategies for cervical cancer. This study focuses on the application of indwelling catheters in cervical cancer afterloading radiotherapy and systematically evaluates their impact on patients' comfort and psychological stress. Using quantitative research methods, the study aims to provide empirical evidence to support clinical decision-making and reduce both the psychological and physical burden on patients.

2. Materials and methods

2.1. General information

This prospective study was conducted between June 2022 and December 2023. A total of 140 patients diagnosed with cervical cancer beyond stage IIA were selected from the oncology and radiology departments at our hospital. The participants' ages ranged from 31 to 64 years, with a mean age of 38.56 years and a standard deviation of 6.27 years. All patients had a pathological stage above stage IIA. The patients were divided into two groups: The indwelling catheter group ($n = 70$) and the non-indwelling catheter group ($n = 70$). Every participant provided informed consent upon enrollment in the study.

2.1.1. Inclusion criteria

The inclusion criteria were as follows: (i) Women aged 18–65. (ii) Diagnosis of cervical cancer by histopathological examination, with a pathological stage of stage IIA or above. (iii) Plan to receive brachytherapy as part of the treatment plan. (iv) Sufficient organ function and general health to tolerate the side effects of radiotherapy. (v) Ability to understand the nature and purpose of the study and voluntarily provide informed consent. (vi) Willingness to attend the hospital for regular treatment and follow-up visits as required by the study.

2.1.2. Exclusion criteria

The exclusion criteria were as follows: (i) Patients with severe heart disease, kidney disease, or other chronic conditions that significantly affect life expectancy. (ii) Patients who had previously received pelvic radiotherapy. (iii) Patients with severe mental illness or cognitive impairment who were unable to understand the study or provide informed consent. (iv) Pregnant or breastfeeding patients.

2.1.3. Ethical considerations

This study was approved by the hospital's ethics research committee (approval number: SBQDL-2021-013). Informed consent was obtained from each patient or their guardian before participation.

2.2. Methods

All patients underwent a combination of extracorporeal and intracavitary irradiation. The extracorporeal irradiation dose was 50 Gy, while the intracavitary irradiation dose ranged from 20 to 30 Gy. Radical radiotherapy was administered using a combination of these two approaches, with an extracorporeal irradiation dose of approximately 50 Gy and a combined intracavitary irradiation dose of 30–36 Gy. The total final dose aimed to reach 80 Gy. Image-guided brachytherapy was implemented in this study.

This study employed brachytherapy, a form of high-dose-rate (HDR) micro-radiation therapy, using the standard source loading mode of the Utrecht applicator. The uterine tube was positioned so that its end intersected with the vaginal source, which typically has four to five dwell points on each side.

The detailed methods for three-dimensional intracavitary close-range therapy are as follows:

- (i) Preparation before radiotherapy. One day before treatment, intestinal preparation was performed. On the treatment day, gynecological examination was conducted to assess the shape of the residual vagina. Twenty patients with residual vaginal shape were

included, all of whom had cylindrical vaginas. The pre-evaluation of vaginal extensibility confirmed the suitability for placing either a single or double applicator. The patient was positioned in the lithotomy position, and a routine external genital examination was performed. After disinfection of the urethral opening, a urinary catheter was inserted, and the bladder was emptied. 100 mL of physiological saline was injected into the bladder with an empty needle, and a vaginal speculum was used to dilate the vagina. A single-tube cylindrical applicator (Beijing Aerospace Kaitian Medical Equipment Co., Ltd., set part number 084.350, China) or a double oval-ball applicator (Fletcher Williamson Asia Pacific Applicator Set, part number 085.260, China) was inserted, with the size chosen to be the largest the patient could comfortably tolerate, to minimize the impact of the air gap between the applicator and vaginal mucosa on dose distribution. The applicator was secured with gauze, the speculum was removed, and the patient was fixed using a vacuum pad. A computed tomography (CT; SIEMENS SOMATOM Emotion 16, US) scan was then performed to evaluate the applicator's placement. The scanning range was extended from the third lumbar vertebra to the lower edge of the perineum, with a reconstruction layer thickness of 3 mm. The CT images were transmitted to the Oncentra Brachy Planning System Version 4.3 (Oncentra Brachy Planning System Version 4.3: Elekta AB, Sweden) for posterior radiotherapy treatment planning.

- (ii) Radiation therapy target area and organs at risk (OAR) delineation. The clinical target volume (CTV) was delineated from the vaginal stump to 3 cm above the vagina. The OAR delineation followed Gay's standard: rectum – the entire outer wall of the intestine was delineated, with the upper boundary at the sigmoid colon curvature and the lower boundary being the anus (at the level of the ischial tuberosity); bladder – the outer wall of the bladder was outlined, from the base to the top of the bladder.
- (iii) Treatment planning. The Oncentra Brachy Planning System Version 4.3 (Oncentra Brachy Planning System Version 4.3: Elekta AB, Sweden) was used to create a three-dimensional HDR brachytherapy plan, following the "Groupe Européen de Curiethérapie" and the European Society for Radiotherapy & Oncology recommendations for applicator reconstruction. The step length of the radioactive source is 2.5 mm. The prescription doses CTV D90 = 600 cGy, single bladder D2ce < 500 cGy, single rectal D2 < 400 cGy. Optimization was performed using the direct drag-and-drop method.⁷ For combined external irradiation

and intracavitary close-range therapy, the D2 of each OAR was calculated using a linear quadratic equation (normal tissue α/β value = 3), and the equivalent biological dose (e-equivalent dose in 2 Gy/Fx, EQD2) was determined. The EQD2 for routine rectal segmentation was kept below 75 Gy, while the EQD2 for bladder segmentation was kept below 90 Gy.⁸

- (iv) Post-implantation therapy. Post-implantation therapy was carried out using an HDR Ir-192 radiation source for three-dimensional post-implantation therapy, administered once a week for a total of two sessions. After treatment, patients were monitored for 30 – 60 min to observe for any discomfort before being discharged after no complications were noted.

A survey questionnaire was administered weekly through telephone follow-up.

2.2.1. Risk assessment of radiation exposure

The radiation exposure risk of patients was assessed using dose-volume histograms (DVH). Three-dimensional images of the tumor and surrounding healthy tissues were obtained through CT to evaluate the radiation exposure.

2.2.2. Evaluation of tumor size

CT was used to assess the therapeutic effect on cervical cancer. Patients underwent CT scans before the intervention, immediately after the intervention, and during follow-up to ensure consistency and accuracy. Radiographic software was used to measure changes in the tumor's diameter and volume.

2.2.3. Psychological stress assessment

The patients' mental states were evaluated using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS). Both scales consist of 20 items, each rated on a 1 – 4 scale, with higher scores indicating more severe anxiety or depression. For both groups of patients, 5 mL of fasting venous blood was collected in the morning, both before and after the intervention. After centrifugation (3000 rpm for 10 min), the serum was stored for analysis. The levels of norepinephrine (NE), cortisol (Cor), and adrenocorticotrophic hormone (ACTH) were measured using a radioimmunoassay kit, which was purchased from Shanghai Enzyme-linked Biotechnology Co., Ltd (catalog no.: H102-1-2, China).

2.2.4. Fear analysis

Patients' anxiety levels were assessed using the Fear of Progression Questionnaire-Short Form (FoP-Q-SF) both before and after the intervention. This questionnaire consists of 12 items divided into two categories: Physical health and social/family concerns. The maximum possible

score is 60, with higher scores indicating greater levels of fear.

2.2.5. Comfort analysis

Patients' comfort was assessed using the General Comfort Questionnaire (GCQ) both before and after the intervention. This questionnaire consists of 28 items across four dimensions: psychological (10 items), physiological (five items), environmental (seven items), and social/cultural (six items), with each item rated on a scale of 1 – 4 points. Higher scores indicate greater comfort.

2.2.6. Quality of life questionnaire — cervical cancer module (QLQ-CX24) assessment

The QLQ-CX24 was utilized to assess the well-being of individuals diagnosed with cervical cancer. The QLQ-CX24 employs a 1 – 4 scale, where 1 represents “no problems at all” and 4 represents “many problems.” Data were collected six months after treatment to monitor changes in quality of life. Patients completed the questionnaire in a quiet, comfortable environment to minimize external interference. The data gathered were entered into statistical software to calculate the mean score for each aspect, which was then transformed into a standardized score ranging from 0 to 100. A higher score indicates a more serious problem.

2.2.7. Statistical analysis

All data were analyzed using SPSS 20.0 statistical analysis software (IBM, USA). The measurement data are presented as “mean \pm standard deviation” ($\bar{x} \pm s$). Inter-group comparisons were performed using one-way analysis of variance (ANOVA) or repeated measures ANOVA, with pairwise comparisons conducted using the least significant difference *t*-test. Categorical data are expressed as percentages (%), and inter-group comparisons were made using χ^2 analysis. A $P < 0.05$ was considered statistically significant.

3. Results

3.1. General data statistics

Based on the overall patient data from both groups, the mean age of individuals without indwelling catheters was 37.41 ± 4.25 years, with an average body mass index (BMI) of 22.76 ± 1.44 kg/m². In this group, there were 27 cases in stage IIA, 34 cases in stage IIB, and nine cases in stage IIIA. The average age of the indwelling catheter group was 39.63 ± 6.46 years, and the average BMI was 23.24 ± 2.05 kg/m². This group included 28 cases in stage IIA, 31 cases in stage IIB, and 11 cases in stage IIIA, with 13 cases of hypertension and 6 cases of diabetes. There were no significant differences between the two groups ($P > 0.05$) (Table 1).

3.2. Radiation exposure risk analysis

In this study, normal tissues included the bladder and rectum. The radiation exposure risk to healthy tissues was lower in the indwelling catheter group compared to the non-indwelling catheter group, as indicated by the DVH. The difference was statistically significant ($P < 0.05$). In addition, the rate of excessive radiation exposure was lower in the indwelling catheter group, with a statistically significant difference compared to the non-indwelling catheter group ($P < 0.05$) (Table 2).

3.3. Comparison of tumor treatment effects

CT showed no difference in tumor size between the two groups before the intervention ($P > 0.05$). After the intervention, the average tumor size in the indwelling catheter group was smaller than in the non-indwelling catheter group, with the difference being statistically significant ($P < 0.05$). In addition, the treatment effect in the indwelling catheter group was more significant compared to the non-indwelling catheter group, with the difference also statistically significant ($P < 0.05$) (Table 3).

3.4. Fear analysis

The FoP-Q-SF was utilized to assess patients' apprehension both before and after the intervention. Before the intervention, the FoP-Q-SF score was higher in the group with indwelling catheters compared to the group without indwelling catheters, with the difference being statistically significant ($P < 0.05$). After the intervention, no significant difference was observed in the FoP-Q-SF scores between the two groups ($P > 0.05$) (Table 4).

3.5. Psychological stress analysis

The SAS and SDS scales were used to evaluate mental state. There was no significant difference in SAS and SDS scores between the two groups ($P > 0.05$) (Table 5 and Figure 1).

3.6. Stress response index analysis

Levels of NE, Cor, and ACTH were measured by radioimmunoassay both before and after the intervention. Before the intervention, no significant differences in the levels of NE, Cor, and ACTH were found between the two groups ($P > 0.05$). After the intervention, the concentrations of NE, Cor, and ACTH were significantly higher in the indwelling catheter group compared to the non-indwelling catheter group, with the difference being statistically significant ($P < 0.05$) (Table 6).

3.7. Comfort analysis

The GCQ was used to assess patients' comfort levels both before and after the intervention. Before the intervention,

Table 1. General statistics

Parameter	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value/ χ^2 -value	P-value
Age (years)	37.41±4.25	39.63±6.46	3.178	0.629
BMI (kg/m ²)	22.76±1.44	23.24±2.05	2.619	0.335
Pathological staging				
IIA	27 (38.57%)	28 (40.00%)	1.404	0.258
IIB	34 (48.57%)	31 (44.29%)		
IIIA	9 (12.86%)	11 (15.71%)		
Hypertension	11 (15.71%)	13 (18.57%)	4.179	0.004
Diabetes	7 (10.00%)	6 (8.57%)	3.228	0.012

Abbreviation: BMI: Body mass index.

Table 2. Risk analysis of radiation exposure

Index	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value/ χ^2 -value	p-value
Average radiation dose of healthy tissues (Gy)	3.95±0.31	3.22±0.19	11.285	0.024
Overexposure event (%)	8 (11.43%)	2 (2.86%)	9.416	0.015

Note: The definition of excessive radiation is an effective dose that does not exceed 50 mSv within any given year. The radiation dose for a single X-ray irradiation is 0.01 – 0.02 mSv.

Table 3. Comparison of tumor treatment effects

Tumor size/treatment effect	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value/ χ^2 -value	P-value
Before intervention (cm)	4.36±1.22	4.45±1.18	3.009	0.285
After intervention (cm)	2.54±0.77	1.69±0.34	14.193	0.003
Reduction rate (%)	41.4±5.66	62.02±4.81	14.266	0.001

Table 4. Analysis of fear

Fear component	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value	P-value
Before intervention				
Physical health	20.34±3.61	26.57±4.05	14.207	0.014
Social family	18.56±1.43	23.88±1.51		
After intervention				
Physical health	21.55±3.11	22.45±2.88	2.511	0.668
Social family	20.34±2.65	21.34±2.24		

Table 5. Psychological stress analysis

Psychological stress scale	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value	P-value
SAS	35.26±4.77	37.51±4.45	2.593	0.332
SDS	43.18±5.26	44.36±4.38	0.867	0.144

Abbreviations: SAS: Self-rating anxiety scale; SDS: Self-rating depression scale.

there were no significant differences in comfort ratings between the two groups ($P > 0.05$). After the intervention, patients with indwelling catheters had lower comfort scores compared to patients without indwelling catheters, with the difference being statistically significant ($P < 0.05$) (Table 7).

3.8. Quality of life assessment

The QLQ-CX24 scale was used to evaluate the quality of life of patients. The quality of life was higher in the indwelling catheter group compared to the non-indwelling catheter group, with the difference being statistically significant ($P < 0.05$) (Figure 2 and Table 8).

Table 6. Analysis of stress response indicators

Stress response marker	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value	P-value
Before intervention				
NE (pg/mL)	186.34±15.44	190.56±16.47	1.225	0.115
Cor (ng/mL)	11.25±3.33	10.41±2.18		
ACTH (pg/mL)	44.82±6.33	46.71±5.29		
After intervention				
NE (pg/mL)	197.56±16.11	248.09±18.51	13.604	0.023
Cor (ng/mL)	13.41±3.55	16.44±3.68		
ACTH (pg/mL)	46.27±3.88	56.25±6.37		

Abbreviations: ACTH: Adrenocorticotrophic hormone; Cor: Cortisol; NE: Norepinephrine.

Table 7. Comfort analysis

Comfort dimension	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value	P-value
Before intervention				
Mentality	33.26±2.67	34.67±2.41	1.224	0.686
Physiology	15.17±1.66	15.49±1.54		
Environment	23.15±2.41	22.63±3.35		
Social culture	20.05±2.41	21.53±2.27		
After intervention				
Mentality	30.45±2.44	25.30±2.15	11.275	0.013
Physiology	13.27±1.22	9.05±1.04		
Environment	20.35±2.14	14.28±1.15		
Social culture	18.39±1.09	13.75±0.88		

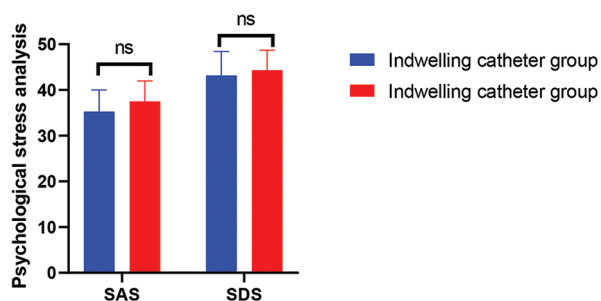


Figure 1. Psychological stress analysis for cervical cancer patients. The figure compares the psychological stress levels between the indwelling catheter group (blue) and the non-indwelling catheter group (red) using the SAS and SDS.

Note: ns indicates no statistically significant difference ($P > 0.05$) between the two groups.

Abbreviations: SAS: Self-rating anxiety scale; SDS: Self-rating depression scale.

4. Discussion

Cervical cancer intracavitary brachytherapy is a commonly used method for treating cervical cancer. The procedure generally follows these steps: (i) pre-operative preparation – patients undergo a detailed medical history review,

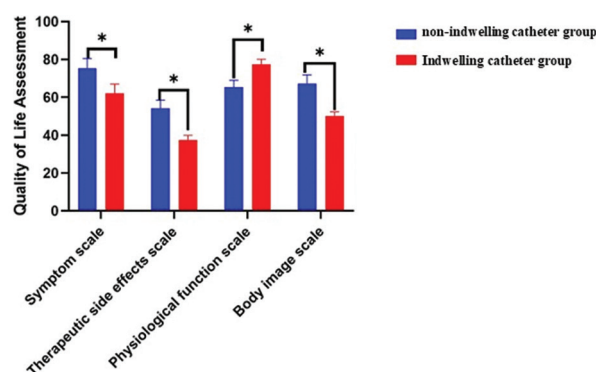


Figure 2. Quality of life assessment for cervical cancer patients. The figure compares the quality of life between the non-indwelling catheter group (blue) and the indwelling catheter group (red) across four scales: Symptom scale, therapeutic side effects scale, physiological function scale, and body image scale.

Note: *indicates a statistically significant difference ($P < 0.05$) between the two groups.

physical examination, and imaging studies to assess the tumor's location, size, and stage. Virtual simulation is also performed to plan the radiation therapy and schedule. (ii) Positioning marker – before radiotherapy, a catheter is

Table 8. Quality of life assessment

Quality of life component	Non-indwelling catheter group (n=70)	Indwelling catheter group (n=70)	t-value	P-value
Symptom scale	75.34±5.23	62.19±4.88	12.084	0.014
Therapeutic side effects scale	54.21±4.30	37.54±2.45	9.446	0.026
Physiological function scale	65.34±3.71	77.42±2.69	13.025	0.005
Body image scale	67.33±4.55	50.24±2.12	11.713	0.011

Note: Therapeutic side effects include urinary tract infections and bladder dysfunction.

inserted to fill the patient's bladder, which helps accurately determine the position of the cervix. A metal ring is also placed in the perineum to facilitate subsequent positioning. (iii) Radiotherapy process – the patient is positioned on a treatment table, with the metal ring in the perineum used for alignment. A plastic catheter is then inserted through the vagina, and the radiation source is placed into the cervical cavity. This process typically takes only a few minutes. After the radiation source is in place, the patient must remain still to complete the entire radiotherapy procedure. (iv) Radiotherapy plan – the radiotherapy plan is determined based on the patient's condition and the severity of the lesion. Intracavitary brachytherapy for cervical cancer is usually delivered in multiple sessions, each lasting from a few minutes to half an hour, over the course of weeks to months. (v) Regular follow-up – following radiotherapy, patients require regular follow-up visits to evaluate the effectiveness of the treatment and monitor their physical condition. Cervical cancer intracavitary brachytherapy is a specialized medical procedure that requires skilled execution and monitoring by experienced clinicians. Patients must actively cooperate with the treatment plan and promptly report any discomfort or symptoms to their healthcare provider. Post-operative urinary catheterization following cervical cancer surgery is typically required for about 14 days. This period allows the bladder to recover, especially considering the large surgical area that may affect both the bladder and the ureters. The female uterus is located behind the bladder, and cervical cancer surgery can significantly impact the bladder, particularly if the uterus and surrounding tissues are extensively removed. During surgery, the bladder may be pushed downward to improve the visibility of the uterus completely, which can lead to damage to the bladder, ureters, and surrounding nerve tissues. Compared to other abdominal surgeries, cervical cancer surgery has a more substantial impact on the bladder, resulting in a longer post-operative recovery period. The indwelling catheter helps reduce pressure on the bladder, supporting its physiological function and aiding the recovery of the peripheral nervous system. For this reason, a urinary catheter should remain in place for 14 days post-surgery. During the catheterization period, it is important to release urine every 2 h to gradually restore

the bladder contraction function. If a patient is unable to urinate independently after the catheter is removed, further interventions, such as acupuncture, moxibustion, or hot compresses, can be used to stimulate bladder contraction and restore its physiological function as soon as possible. These measures aim to help the patient regain the ability to urinate autonomously. This study aims to investigate the impact of an indwelling catheter on the comfort and psychological stress of cervical cancer patients undergoing afterloading radiotherapy. The findings indicate that while the use of an indwelling catheter enhances treatment outcomes and minimize radiation exposure to healthy tissues; it also improves patients' quality of life. However, this treatment strategy can cause short-term discomfort, fear, and psychological stress.

In cervical cancer radiotherapy, accurate radiation localization and dose control are critical for improving therapeutic outcomes.^{14,15} The use of an indwelling catheter as a clinical tool can help precisely locate the treatment area, enabling radiation to focus more intensively on the tumor while reducing exposure to surrounding healthy tissues. By ensuring accurate radiation delivery, this approach not only increases the likelihood of tumor control but also diminishes the side effects associated with radiation, thereby optimizing treatment outcomes and improving patients' quality of life. The DVH is an essential tool for evaluating the quality of radiotherapy plans, providing a visual method for analyzing and comparing the radiation doses received by both tumors and healthy tissues under different treatment regimens. The study findings indicate that the radiation dose to healthy tissues is notably reduced in the group with an indwelling catheter compared to the group without one, as demonstrated by the DVH results. This significant difference suggests that the indwelling catheter controls and limits the radiation field more accurately, thereby protecting adjacent normal tissues from unnecessary radiation damage. Moreover, the indwelling catheter may enhance the overall accuracy of radiotherapy by stabilizing the treatment area and reducing potential errors due to patient movement or anatomical changes.^{16,17} This stability is particularly important in high-dose radiotherapy, ensuring that each treatment

accurately targets the same area. In terms of therapeutic efficacy, patients in the indwelling catheter group showed more significant tumor reduction compared to those in the non-indwelling catheter group. This finding may be attributed to the increased precision in radiation targeting and dose control facilitated by the indwelling catheter. The DVH results further support this interpretation, revealing that radiation exposure to healthy tissues is significantly lower in the indwelling catheter group, suggesting that this approach effectively minimizes radiation-induced damage to surrounding healthy tissues.

By systematically assessing the QLQ-CX24 scale, it was found that patients with indwelling catheters had higher quality of life scores compared to those without, emphasizing the beneficial effects of optimizing treatment on patient well-being. The improvement in quality of life includes several aspects. Reduced radiation exposure to healthy tissues decreases the occurrence of side effects, such as gastrointestinal reactions and skin injuries, which often significantly affect patients' daily lives and comfort.¹⁸⁻²⁰ Effective tumor control boosts patients' confidence in treatment outcomes, reduces their psychological burden, and improves their emotional state, positively impacting their mental health. In addition, a lower recurrence rate and prolonged disease-free survival provide patients with more time to spend time with their families and engage in social activities, directly enhancing their social functioning and sense of social participation.^{21,22}

The presence of a catheter during radiotherapy for cervical cancer has significantly improved patient outcomes and quality of life, although it may also cause temporary discomfort and psychological stress. The FoP-Q-SF score showed that patients in the indwelling catheter group exhibited higher psychological resistance or anxiety before treatment. This anxiety may stem from concerns about unfamiliar treatment methods and worries about additional pain or discomfort. However, this psychological conflict appears to have been alleviated with the treatment. Following the intervention, there was no notable difference in the FoP-Q-SF scores between the two groups, suggesting that the patient's tolerance of the indwelling catheter increased over time. The higher levels of NE, Cor, and ACTH in the indwelling catheter group post-treatment suggest that the use of these catheters may exacerbate patients' physiological stress. These changes in hormone levels indicate the body's response to stress or discomfort. Such physiological alterations could be associated with pain, unease, or anxiety related to concerns about treatment efficacy during therapy.^{21,22} It is important to note that, although there is an immediate physiological and psychological stress response, the long-

term psychological effects, as measured by SAS and SDS, were similar between the indwelling catheter and non-indwelling catheter groups. This observation suggests that the psychological response to indwelling catheters may be temporary. Over time, patients are likely to adjust to this treatment, and their psychological well-being improves. In clinical practice, these findings emphasize the importance of providing detailed explanations and appropriate psychological support when using indwelling catheters and other treatment measures.²³⁻²⁵ By explaining the necessity, procedure, and potential sensations associated with the indwelling catheter in advance, and offering psychological counseling or anxiety management strategies, healthcare providers can help patients better prepare for and cope with treatment. This particular effort, in turn, may reduce psychological discomfort and improve overall treatment satisfaction. The results suggest that while the application of indwelling catheters in cervical cancer afterloading radiotherapy can induce short-term physiological and psychological stress, these reactions can be managed and alleviated over time without leading to long-term psychological effects.²⁶

5. Conclusion

The use of indwelling catheters in post-loading radiotherapy for cervical cancer is an effective method that can improve patients' quality of life, while it may cause short-term discomfort and psychological stress, there is no evidence to suggest that it has long-term negative effects.

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Conflict of interest

The authors declare no conflict of interest.

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Ethics approval and consent to participate

The study was approved by the Medical Ethical Committee of Shanxi Bethune Hospital (IRB No. SBQDL-2021-013), and all participants provided written informed consent.

Consent for publication

All the participants gave consent to participate in this study.

Availability of data

The original contributions presented in the study are included in the article.

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