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Original Article

Efficacy of integrating surgical interventions with chemoradiotherapy in managing stage IIIC cervical cancer

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Abstract: Objective: This research is principally dedicated to exploring the therapeutic outcomes of integrating surgical intervention with chemoradiotherapy in patients diagnosed with stage IIIC cervical cancer (CC). Methods: A cohort of 141 patients with stage IIIC CC admitted to Chongqing University Three Gorges Hospital were enrolled. Among them, 47 patients underwent radical chemoradiotherapy alone (control group), while 94 patients received surgical intervention in addition to radical chemoradiotherapy (research group). Treatment outcomes were comprehensively evaluated, including short-term therapeutic response, safety profiles, radiotherapy-related complications, long-term treatment efficacy - measured by progression-free survival (PFS) and overall survival (OS) and quality of life (QOL). Univariate and multivariate analyses were performed to identify independent predictors of long-term treatment outcomes. Results: The research group exhibited significantly superior short-term efficacy compared to the control group. Additionally, the research group showed a notably lower rate of treatment-associated adverse events, but radiotherapy-induced complications occurred at a similar frequency as in the control group. Long-term outcomes, including PFS, OS, and QOL scores, were also significantly better in the research group. Both univariate and multivariate analyses identified body mass index (BMI) and treatment modality as independent prognostic factors for long-term outcomes in patients with stage IIIC CC. Conclusions: The integration of surgical intervention with radical chemoradiotherapy yields superior therapeutic outcomes compared to chemoradiotherapy alone in the management of stage IIIC cervical cancer, highlighting its potential as a more effective treatment strategy.

Keywords: Surgery, radiochemotherapy, stage IIIC cervical cancer, therapeutic efficacy, clinical outcomes

Introduction

Cervical cancer (CC) remains one of the leading causes of cancer-related mortality among women worldwide, particularly in low- and middle-income countries, where persistent infection with high-risk human papillomavirus (HPV) serves as the principal etiological factor [1, 2]. Globally, CC ranks as the fourth most frequently diagnosed malignancy in women, following breast, colorectal, and lung cancers [3]. Recent epidemiological estimates indicate that approximately 600,000 new cases of CC are diagnosed each year, resulting in nearly 350,000 deaths, thereby underscoring its substantial global health burden [4]. Accurate disease staging plays a pivotal role in guiding treatment strategies and predicting patient outcomes, as it provides a foundation for clinical decision-making and prognostic evaluation [5]. The International Federation of Gynecology and Obstetrics (FIGO) 2018 staging revision introduced significant updates, notably the classification of lymph node metastases into stage IIIC, with pelvic involvement designated as IIIC1 and para-aortic involvement as IIIC2. Additionally, the revised system incorporates radiological (r) and pathological (p) qualifiers to confirm nodal status, thereby enhancing diagnostic accuracy and enabling more individualized therapeutic planning [6, 7].

Emerging evidence suggests that patients with stage IIIC1 CC exhibit survival rates that are superior to those of stage IIIA-IIIB patients and comparable to those observed in stage II disease, whereas patients with stage IIIC2 demonstrate outcomes more akin to stage IIIA-IIIB

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cases [8]. Standard therapeutic modalities for CC primarily include surgical intervention and radiotherapy, while chemotherapy is widely employed as part of comprehensive multimodal strategies - either in combination with surgery and radiotherapy or for the management of advanced recurrent CC [9]. Radical surgical approaches, such as radical hysterectomy combined with pelvic lymphadenectomy with or without para-aortic lymphadenectomy, serve multiple objectives: reducing tumor burden, preserving ovarian function in younger patients, and providing precise surgical-pathological staging to inform subsequent adjuvant therapy decisions [10]. Nevertheless, the optimal treatment strategy for stage IIIC CC - classified as a subset of locally advanced CC (LACC), encompassing FIGO stages IB3 to IVA - remains a matter of ongoing debate, particularly regarding the selection between primary radical chemoradiotherapy and surgical intervention [11]. According to Zhang W et al. [12], the reported 3-year overall survival (OS) rates for stage IIIC1 and IIIC2 patients treated with radical radiotherapy or chemoradiotherapy were 77.6% and 63.2%, respectively, while the corresponding 3-year disease-free survival (DFS) rates were 70.4% and 47.4%. These data highlight the ongoing need for improved clinical outcomes in this patient population. Previous studies have also indicated that LACC patients undergoing radical surgery may achieve better survival outcomes compared to those receiving non-surgical treatment, thereby suggesting the potential prognostic benefit of incorporating surgical intervention into the treatment of stage IIIC CC [13, 14].

To refine treatment strategies and improve long-term outcomes in patients with stage IIIC CC, it is imperative to investigate the efficacy and safety of the combined surgical intervention and radical chemoradiotherapy, as well as to identify patient subgroups most likely to benefit from this multimodal approach. However, existing studies in this domain remain scarce, emphasizing the originality and clinical significance of the present study. By addressing these pivotal questions, this study aims to generate meaningful insights into the management of stage IIIC CC and support the development of more effective, evidence-based treatment paradigms.

Materials and methods

Case selection

This study included a total of 141 patients diagnosed with stage IIIC CC, all of whom received treatment between February 2019 and December 2024. Among them, 47 patients comprised the control group and received radical chemoradiotherapy alone, whereas 94 patients formed the research group and underwent a combined treatment regimen consisting of surgical intervention and radical chemoradiotherapy. All patient were enrolled in strict accordance with predefined inclusion and exclusion criteria. This study protocol was approved by the institutional ethics committee of Chongqing University Three Gorges Hospital.

Inclusion criteria: Patients were eligible for inclusion if they met all of the following criteria: (1) Age between 18 and 80 years. (2) Confirmed diagnosis of stage IIIC CC based on the 2018 FIGO staging system, verified through a combination of pathological examination and advanced imaging modalities, such as contrast-enhanced computed tomography (CT), contrast-enhanced magnetic resonance imaging (MRI), or positron emission tomography-CT (PET-CT) [15]. (3) Maximum tumor diameter ≤ 4 cm. (4) Presence of at least one measurable lesion as defined by the Response Evaluation Criteria in Solid Tumors (RECIST) version1.1 [16]. (5) No prior history of anti-cancer therapy, including chemotherapy, radiotherapy, or surgery. (6) Eastern Cooperative Oncology Group (ECOG) performance status score between 0 and 2. (7) Normal organ function, as evidenced by routine hematological and biochemical tests evaluating blood and urine parameters, as well as cardiac, hepatic, renal, and coagulation functions. (8) Child-Pugh liver function classification of Class A or a favorable Class B (score ≥ 7) [17]. (9) Female patients were excluded if pregnant or lactating at the time of enrollment.

Exclusion criteria: Patients were excluded from the study if they met any of the following conditions: (1) Presence of active infection or being in the acute phase of an inflammatory condition. (2) History or current evidence of thrombosis. (3) Abnormal hepatic, renal, or coagula-

tion function detected during baseline assessments. (4) Severe cardiovascular or pulmonary diseases that were not eligible for inclusion. (5) Concurrent malignancies located at anatomical sites other than the cervix. (6) Inability to tolerate surgical procedures or anesthesia. (7) Contraindications to any component of the treatment regimen.

Intervention methods

Prior to the initiation of treatment, all patients underwent standard clinical assessments to collect key clinical data, including age, body mass index (BMI), pathological classification, maximum tumor diameter, lymph node metastasis (LNM) status, and levels of squamous cell carcinoma antigen (SCCA). Patients were also instructed to abstain from sexual activity for at least three days before therapy initiation to minimize potential confounding factors.

Patients in the control group received radical chemoradiotherapy. The radiation field was meticulously delineated based on pre-treatment imaging studies. External beam radiation targeting the pelvic region was administered at a total dose of 45-50 Gy. For localized lesions, an incremental dose of 10-15 Gy was delivered using image-guided techniques to enhance precision. The para-aortic lymph node area, when involved, was irradiated with 45-50 Gy, followed by a localized boost of 10-15 Gy using a narrowed radiation field tailored to sites of involvement. For cervical lesions, a combination of brachytherapy and external beam radiation was employed to achieve a cumulative dose exceeding 85 Gy at point A. The complete radiotherapy regimen was delivered over a course of 7-8 weeks. Concurrent chemotherapy was administered using a cisplatin-based regimen, with cisplatin dosed at 75 mg/m^2 every three weeks.

Patients in the research group underwent a multimodal treatment regimen comprising surgery and radical chemoradiotherapy. Preoperative preparation included adherence to a bland liquid diet starting the day before surgery. At 17:00 on the same day, bowel preparation was initiated with the oral administration of two packets of polyethylene glycol electrolyte powder dissolved in 2,000 ml of warm water, consumed over a two-hour period. Cleansing enemas were performed both the night before and the morning of the treatment day. Patients were required to fast and abstain from water intake for at least 8 hours prior to the procedure. The operative field, encompassing the lower abdomen and vulva region, was shaved 24 hours preoperatively. To prevent infection, intravenous cefoxitin (2 g) was administered 30 minutes before the procedure. After standard anesthesia induction, surgical disinfection and draping were carried out according to established protocols. The surgical procedure adhered to the Querleu-Morrow (QM) classification, Type C, which corresponds to a comprehensive radical hysterectomy. This involved resection of the parametrial tissues medial to the internal iliac vessels, transection of the uterosacral ligaments at the rectal level, and division of the vesicocervical and vesicovaginal ligaments close to the bladder. The ureters were meticulously dissected and mobilized. Vaginal resection length was determined based on tumor extension. A systematic pelvic lymphadenectomy, including dissection of para-aortic lymph nodes, was performed. A pelvic drainage tube was placed through the lower abdominal wall for postoperative fluid management. For surgeries exceeding three hours, an additional intraoperative dose of prophylactic antibiotics was administered. Postoperative management included routine antibiotic prophylaxis, nutritional support, electrolyte monitoring, and wound care. Surgical dressings were changed on postoperative days 1, 3, and 5. Sutures were typically removed on postoperative day 7, providing satisfactory incision healing. The pelvic drainage tube was removed once drainage decreased to acceptable levels, generally within five days post-surgery. After sufficient postoperative recovery, patients proceeded to receive adjuvant chemoradiotherapy. Intensity-modulated radiotherapy (IMRT) was administered to the pelvic region at a total dose of 45-50 Gy. For patients with metastasis involving the common iliac or para-aortic lymph nodes, an additional dose of (50 ± 5) Gy was administered to the para-aortic region. Those with positive or close vaginal margins received supplementary brachytherapy. Using a vaginal cylinder applicator, radiation was delivered either as 5.5 Gy × 2 fractions at a depth of 0.5 cm beneath the vaginal mucosa, or as 6.0 Gy × 3 fractions to the mucosal surface. Concurrent chemotherapy consisted of cisplatin administered at a dose of 75 mg/m^2 every three weeks.

The entire adjuvant treatment course was completed within eight weeks after surgery.

All radiotherapy plans in this study were independently reviewed and approved by senior radiation oncologists. Chemotherapy protocols were strictly implemented in accordance with the most recent guidelines issued by the National Comprehensive Cancer Network (NCCN).

Data collection and outcome measures

(1) Short-term efficacy: Short-term efficacy was evaluated using two primary endpoints: objective response rate (ORR) and clinical benefit rate (CBR). Tumor response was assessed one month post-treatment via pelvic contrast-enhanced MRI or CT scans, following the RECIST 1.1 criteria. Response categories were defined as follows: Complete remission (CR): Disappearance of all identified target lesions. Partial remission (PR): At least 30% reduction in the sum of diameters of target lesions. Stable disease (SD): Tumor shrinkage less than 30% or growth less than 20%. Progressive disease (PD): At least 20% increase in tumor diameter or appearance of new lesions. ORR was calculated as the proportion of patients achieving either CR or PR relative to the total cohort, while CBR included patients achieving CR, PR, or SD.

(2) Safety profile: Adverse events during and after treatment were systematically documented for both groups. This included radiation-induced toxicities such as proctitis, dermatitis, and cystitis, as well as hematologic toxicities including leukopenia, thrombocytopenia, and hemoglobin decline. Complications related to brachytherapy were also systematically recorded.

(3) Radiotherapy-related complications: Specific complications directly attributable to radiotherapy, such as bleeding, infections, and fistula formation, were carefully monitored and analyzed.

(4) Long-term efficacy: Long-term outcomes were assessed via progression-free survival (PFS) and OS. PFS was defined as the interval from treatment initiation to documented disease progression, death, or last follow-up prior to loss to follow-up. OS was defined as the time from treatment initiation to death or last follow-up.

(5) Quality of Life (QOL) assessment: Changes in patients' QOL were measured using the Karnofsky Performance Status (KPS) scale [18], where higher scores indicate better functional status and overall well-being. QOL changes were classified as: Improved QOL: Increase of > 10 points in KPS score. Stable QOL: Change of ≤ 10 points (increase or decrease). Declined QOL: Decrease of > 10 points in KPS score.

Statistical methods

Data analyses were conducted using SPSS 22.0 software. Categorical data were compared using the chi-square test for proportions between two independent groups. When the expected frequency ranged from 1 (inclusive) to 5 (exclusive), Fisher's exact test was utilized. Continuous variables were presented as means ± standard deviation and compared using the t-test within groups. Survival analysis was conducted using the Kaplan-Meier method, with inter-group differences assessed via the Log-Rank test. Multivariate survival analysis was carried out using the Cox proportional hazards regression model, reporting hazard ratios (HRs) and 95% confidence intervals (CIs). All statistical tests were two-sided, and significance was defined as $P < 0.05$.

Sample size estimation was based on expected 5-year OS rates. According to the Schoenfeld formula, assuming a 5-year OS of 35% in the control group versus 55% in the research group (HR = 0.58), a two-sided alpha of 0.05, 80% statistical power, and a 2:1 allocation ratio, a minimum of 120 patients (80 in the research group and 40 in the control group) was required. Considering a 10% anticipated loss to follow-up, the final sample size of 141 patients exceeded the calculated minimum, ensuring adequate statistical power for the study.

Results

Baseline characteristics

Baseline characteristics, including age, PD-L1 expression, BMI, pathological classification, maximum tumor diameter, LNM type, SCCA levels, number of positive lymph nodes, and short-axis diameter of lymph nodes, were well balanced between the two groups, with no sta-

Table 1. Baseline characteristics of the two groups

Factors	Control group (n = 47)	Research group (n = 94)	χ^2 value	*P* value
Age (years)			2.503	0.114
< 50.00 (n = 56)	23 (48.94)	33 (35.11)		
≥ 50.00 (n = 85)	24 (51.06)	61 (64.89)		
PD-L1			0.462	0.794
< 1.00% (n = 25)	7 (14.89)	18 (19.15)		
≥ 1.00% (n = 83)	28 (59.57)	55 (58.51)		
Unknown (n = 33)	12 (25.53)	21 (22.34)		
BMI (kg/m^2)			1.162	0.281
< 23.50 (n = 63)	18 (38.30)	45 (47.87)		
≥ 23.50 (n = 78)	29 (61.70)	49 (52.13)		
Pathological classification			2.848	0.092
Squamous cell carcinoma (n = 108)	40 (85.11)	68 (72.34)		
Adenocarcinoma (n = 33)	7 (14.89)	26 (27.66)		
Maximum tumor diameter (cm)			3.205	0.073
< 4.00 (n = 75)	30 (63.83)	45 (47.87)		
≥ 4.00 (n = 66)	17 (36.17)	49 (52.13)		
Lymph node metastasis type			1.763	0.184
Pelvic lymph node metastasis (n = 59)	16 (34.04)	43 (45.74)		
Paraaortic lymph node metastasis (n = 82)	31 (65.96)	51 (54.26)		
SCCA (μg/L)			2.066	0.151
< 2.70 (n = 63)	17 (36.17)	46 (48.94)		
≥ 2.70 (n = 78)	30 (63.83)	48 (51.06)		
Number of positive lymph nodes			0.904	0.342
< 4.00 (n = 117)	37 (78.72)	80 (85.11)		
≥ 4.00 (n = 24)	10 (21.28)	14 (14.89)		
Short-axis diameter of lymph nodes (cm)			0.135	0.713
< 1.50 (n = 87)	28 (59.57)	59 (62.77)		
≥ 1.50 (n = 54)	19 (40.43)	35 (37.23)		

Notes: BMI, body mass index; SCCA, squamous cell carcinoma antigen.

tistically significant differences (P > 0.05). Detailed data are presented in **Table 1**.

Short-term efficacy

The research group demonstrated improved short-term efficacy compared to the control group. Specifically, the ORR and CBR in the research group were 77.66% and 94.68%, respectively, both significantly higher than the control group's 53.19% and 74.47% (P < 0.05). Specific results are summarized in **Table 2**.

Safety profile

The incidence of radiation-induced proctitis, dermatitis, cystitis, leukopenia, thrombocytopenia, and hemoglobin decline, was notably lower in the research group (8.51%) than in the control group (29.79%) (P < 0.05). Further details are provided in **Table 3**.

Radiotherapy-related complications

Both groups experienced radiotherapy-related complications, including bleeding, infections, and fistula formation. However, the overall incidence of these complications did not differ significantly between groups (P > 0.05). A detailed comparison is provided in **Table 4**.

Long-term efficacy

At the 5-year follow-up, the OS and PFS rates for the entire cohort of 141 patients were 72.34% and 65.25%, respectively. Notably, the

Table 2. Short-term efficacy of the two groups

Factors	Control group (n = 47)	Research group (n = 94)	χ^2 value	*P* value
CR	9 (19.15)	33 (35.11)		
PR	16 (34.04)	40 (42.55)		
SD	10 (21.28)	16 (17.02)		
PD	12 (25.53)	5 (5.32)		
ORR	25 (53.19)	73 (77.66)	8.850	0.003
CBR	35 (74.47)	89 (94.68)	12.073	< 0.001

Notes: CR, complete remission; PR, partial remission; SD, stable disease; PD, progressive disease; ORR, objective response rate; CBR, clinical benefit rare.

Table 3. Safety profiles of the two groups

Adverse events	Control group (n = 47)	Research group (n = 94)	χ^2 value	*P* value
Radiation-induced proctitis	3 (6.38)	0 (0.00)		
Dermatitis	2 (4.26)	1 (1.06)		
Cystitis	2 (4.26)	1 (1.06)		
Leukopenia	3 (6.38)	3 (3.19)		
Thrombocytopenia	2 (4.26)	1 (1.06)		
Hemoglobin decline	2 (4.26)	2 (2.13)		
Total	14 (29.79)	8 (8.51)	10.772	0.001

Table 4. Radiotherapy-related complications in the two groups

Radiotherapy-related complications	Control group (n = 47)	Research group (n = 94)	χ^2 value	*P* value
Bleeding	3 (6.38)	2 (2.13)		
Infections	2 (4.26)	2 (2.13)		
Fistulas	1 (2.13)	0 (0.00)		
Total	6 (12.77)	4 (4.26)	3.444	0.064

research group exhibited significantly superior OS and PFS compared to the control group (P < 0.05). These survival outcomes are illustrated in **Figure 1**.

QOL assessment

Assessment using the KPS scale indicated comparable proportions of patients with improved or stable QOL between the research and the control groups (P > 0.05). Importantly, the research group experienced a significantly lower incidence of QOL decline relative to controls (P < 0.05). Detailed QOL outcomes are outlined in **Table 5**.

Prognostic factors for 5-year PFS: univariate and multivariate analysis

Univariate analysis identified PD-L1 expression, body mass index (BMI), SCCA levels, short-axis diameter of lymph nodes, and treatment modality as significant predictors of 5-year PFS (P < 0.05), whereas age, maximum tumor diameter, LNM type, and number of positive lymph nodes showed no significant association (P > 0.05). Cox multivariate regression analysis further confirmed BMI and treatment modality as independent prognostic factors for 5-year PFS (P < 0.05). Comprehensive results are presented in **Tables 6** and **7**.

Discussion

According to the revised FIGO staging system, a subset of stage IIIC CC patients includes individuals with early-stage disease (2009 FIGO stages IA-IIA) who concurrently present with pelvic LNM. Traditionally, such cases have been primarily managed by radical surgery followed by adjuvant therapies [19]. For stage IIIC patients with locally resectable tumors and pelvic lymph node involvement, previous studies have reported favorable outcomes associated with surgical intervention [20]. However, the updated staging guidelines, which endorse definitive concurrent chemoradiotherapy (CCRT) as the standard treatment, have generated ongoing debate regarding the optimal approach-radical CCRT versus surgery. To clarify this clinical controversy, our study comprehensively evaluated the feasibility and efficacy of combining surgery with radical chemoradiotherapy in managing FIGO 2018 stage IIIC CC. The results provide valuable evidence to guide treatment decision-making and support the development of standardized therapeutic strategies for this patient subgroup.

Our findings revealed that the combination of surgery and radical chemoradiotherapy significantly improved outcomes (94.68%) compared to radical chemoradiotherapy alone (74.47%) in stage IIIC CC patients. Moreover, the combined

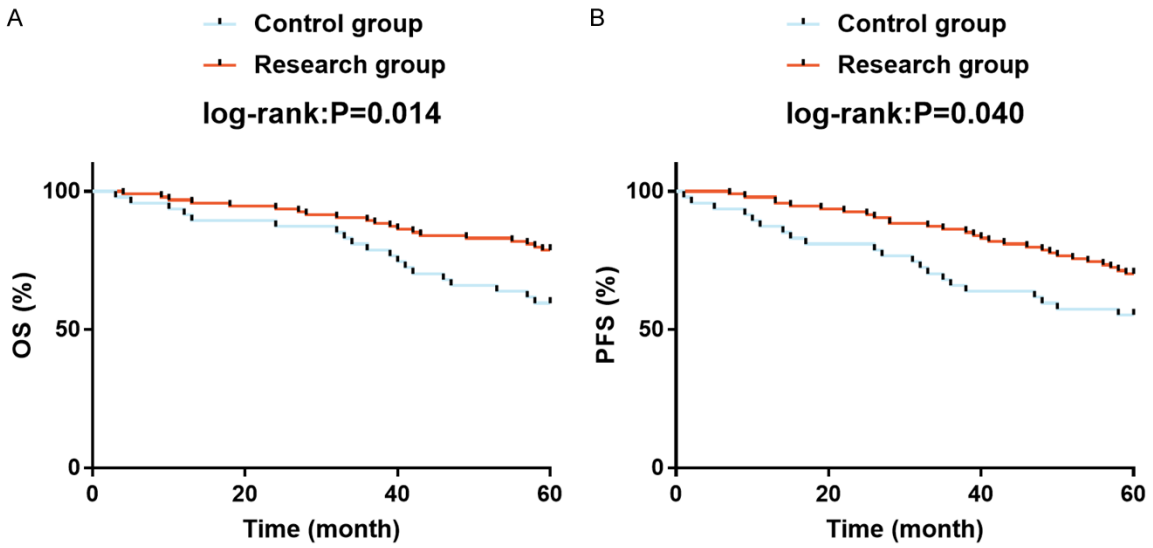

Figure 1. Long-term efficacy comparison between the two groups. A. Five-year overall survival (OS) rates in the research and control groups. B. Five-year progression-free survival (PFS) rates in the research and control groups.

Table 5. Quality of life assessment

Category	Control group (n = 47)	Research group (n = 94)	χ^2 value	*P* value
Improved quality of life	22 (46.81)	48 (51.06)	0.227	0.634
Stable quality of life	12 (25.53)	35 (37.23)	1.931	0.165
Declined quality of life	13 (27.66)	11 (11.70)	5.649	0.018

approach demonstrated a more favorable safety profile, with the overall incidence of adverse events - including radiation-induced proctitis, dermatitis, cystitis, leukopenia, thrombocytopenia, and hemoglobin decline - reduced from 29.79% to 8.51%. Notably, the incidence of radiotherapy-related complications, such as bleeding, infections, and fistula formation was comparable between groups, suggesting that the addition of surgery did not increase these risks. In our cohort of 141 patients, the 5-year OS and PFS rates were 72.34% and 65.25%, respectively, closely aligning with previously reported data by Li Z et al. [21], who documented a 5-year OS of 74.3% and PFS of 68.0%. Furthermore, the combined treatment group exhibited significantly higher 5-year OS (78.72% vs. 59.57%) and PFS (70.21% vs. 55.32%) compared to radical chemoradiotherapy alone. These results corroborate findings from Sala P et al. [22], who reported superior survival outcomes for LACC patients undergoing radical surgery followed by adjuvant therapy versus radical CCRT alone. Similarly, Qin F et al. [23] observed improved 5-year OS in early-stage CC patients with LNM treated with surgery followed by CCRT, further validating our results. In addition, the combined treatment approach was associated with improved QOL, as evidenced by higher overall QOL scores. Univariate analysis identified PD-L1 expression, BMI, SCCA levels, short-axis diameter of lymph nodes, and treatment modality as significant predictors of 5-year PFS. Multivariate Cox regression analysis confirmed BMI and treatment modality as independent prognostic factors for 5-year PFS. These findings are consistent with Fan X et al. [24], who reported that a lack of postoperative adjuvant therapy, a lymph node ratio (LNR) exceeding 0.3, and a preoperative neutrophil-to-lymphocyte ratio (NLR) greater than 3.8 were independent risk factors for OS and DFS in stage IIIC1p CC patients.

Extensive investigations have been conducted to evaluate optimal treatment approaches for patients with stage IIIC CC. For example, Kagabu M et al. [25] reported that postoperative adjuvant chemotherapy and CCRT yielded comparable 5-year survival outcomes in patients with FIGO 2018 stage IIIC1 CC. Similarly, Soochit A et al. [26] highlighted that sequential chemoradiotherapy following sur-

Table 6. Univariate analysis of prognostic factors for 5-year PFS

Factors	Poor prognosis group (n = 49)	Good prognosis group (n = 92)	χ^2 value	*P* value
Age (years)			1.565	0.211
< 50.00 (n = 56)	16 (32.65)	40 (43.48)		
≥ 50.00 (n = 85)	33 (67.35)	52 (56.52)		
PD-L1			7.780	0.020
< 1.00% (n = 25)	14 (28.57)	11 (11.96)		
≥ 1.00% (n = 83)	22 (44.90)	61 (66.30)		
Unknown (n = 33)	13 (26.53)	20 (21.74)		
BMI (kg/m^2)			7.885	0.005
< 23.50 (n = 63)	14 (28.57)	49 (53.26)		
≥ 23.50 (n = 78)	35 (71.43)	43 (46.74)		
Pathological classification			5.339	0.021
Squamous cell carcinoma (n = 108)	32 (65.31)	76 (82.61)		
Adenocarcinoma (n = 33)	17 (34.69)	16 (17.39)		
Maximum tumor diameter (cm)			1.179	0.278
< 4.00 (n = 75)	23 (46.94)	52 (56.52)		
≥ 4.00 (n = 66)	26 (53.06)	40 (43.48)		
Lymph node metastasis type			0.032	0.859
Pelvic lymph node metastasis (n = 59)	21 (42.86)	38 (41.30)		
Paraaortic lymph node metastasis (n = 82)	28 (57.14)	54 (58.70)		
SCCA (μg/L)			10.010	0.002
< 2.70 (n = 63)	13 (26.53)	50 (54.35)		
≥ 2.70 (n = 78)	36 (73.47)	42 (45.65)		
Number of positive lymph nodes			2.966	0.085
< 4.00 (n = 117)	37 (75.51)	80 (86.96)		
≥ 4.00 (n = 24)	12 (24.49)	12 (13.04)		
Short-axis diameter of lymph nodes (cm)			5.144	0.023
< 1.50 (n = 87)	24 (48.98)	63 (68.48)		
≥ 1.50 (n = 54)	25 (51.02)	29 (31.52)		
Treatment modality			13.152	<0.001
Radical chemoradiotherapy (n = 47)	26 (53.06)	21 (22.83)		
Surgery combined with radical chemoradiotherapy (n = 94)	23 (46.94)	71 (77.17)		

Notes: BMI, body mass index; PFS, progression-free survival; SCCA, squamous cell carcinoma antigen.

Table 7. Multivariate analysis of prognostic factors for 5-year PFS

Factors	B	SE	Wald	P	Exp (B)	95% CI
PD-L1	-0.231	0.225	1.051	0.305	0.794	0.511-1.234
BMI (kg/m^2)	0.688	0.321	4.595	0.032	1.989	1.061-3.730
Pathological classification	0.574	0.318	3.265	0.071	1.776	0.953-3.312
SCCA (μg/L)	0.635	0.339	3.504	0.061	1.888	0.971-3.672
Short-axis diameter of lymph nodes (cm)	0.374	0.296	1.598	0.206	1.453	0.814-2.595
Treatment modality	0.721	0.299	5.815	0.016	2.056	1.145-3.695

Notes: BMI, body mass index; PFS, progression-free survival; SCCA, squamous cell carcinoma antigen.

gery resulted in significantly improved survival rates compared to radiotherapy alone in patients with FIGO 2018 IIICp CC. Moreover, Ferrandina G et al. [27] investigated CC pa-

tients spanning stages IB2 to IVA, including those with stage IIIC disease and found no significant differences in recurrence rates, mortality, or complication profiles between minimally invasive radical surgery and open radical surgery.

This study has several limitations that warrant consideration. First, its retrospective design inherently carries a risk of selection bias, and the relatively small sample size limited the feasibility of propensity score matching or comprehensive multivariate adjustments. Prospective, randomized controlled trials with larger cohorts are needed to minimize potential biases and further validate the clinical benefits of the combined therapy. Second, the limited sample size also precluded subgroup analyses differentiating between stage IIIC1 and IIIC2 patients, potentially obscuring heterogeneity in treatment effects across these subpopulations. Finally, detailed information regarding radiotherapy parameters-such as IMRT field design and brachytherapy dosing schedules-as well as chemotherapy adherence metrics (e.g., cisplatin completion rates) was not available. Future studies should aim to prospectively capture these data to strengthen the robustness of our findings.

In conclusion, the integration of surgery with radical chemoradiotherapy for patients with stage IIIC CC offers a dual benefit of enhanced therapeutic efficacy and a favorable safety profile. This combined approach significantly increases 5-year OS and PFS, while also contributing to better QOL outcomes. Our study further identified elevated BMI and exclusive reliance on radical chemoradiotherapy as independent risk factors associated with poor prognosis. These findings emphasize the importance of implementing evidence-based clinical guidelines targeting nutritional status and physical activity to address obesity within this patient population. Additionally, our results advocate for broader adoption of the combined surgical and chemoradiotherapy approach in patients currently managed with chemoradiotherapy alone, as this strategy has the potential to substantially improve long-term survival outcomes.

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Disclosure of conflict of interest

None.

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