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Effects of extraperitoneal lymph node dissection vs. imaging methods on survival in staging before radiotherapy in advanced cervical cancer

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► ***Original article***

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ABSTRACT

Background: Effects of extraperitoneal lymph node (LN) dissection and imaging on survival were investigated in staging before primary radiotherapy in locally-advanced cervical cancer (LACC). ***Materials and Methods:*** This retrospective study included 145 LACC patients (IIB-IVA 2018 FIGO) between December 2010 and April 2024 at Selcuk University, Faculty of Medicine. Sixty-four patients undergoing surgical staging (Group 1) and 81 undergoing staging through magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography CT (PET-CT) (Group 2) were evaluated. Pelvic or extended-field radiotherapy treatment was administered for para-aortic LN positivity. The effects on survival were statistically analyzed using the staging method. ***Results:*** Mean age of 145 cases was calculated as 60.0±11.8 (33-93 years). Mean diameter of cervical primary mass was calculated as 51.3±16.4 mm. Histological type was determined as squamous cells in 134 cases (92.4%). Forty-eight (33.1%), 72 (49.7%), and 25 (17.2%) cases were determined as stages II, III, and IV, respectively; additionally, recurrence was detected in 38 cases (26.2%). In Group 1, removed median pelvic and paraaortic LNs were calculated as four (0-42) and nine (2-24), respectively. While para-aortic LN and isolated pelvic positivities were detected in one (1.6%) and 16 cases (25.0%) and respectively, both pelvic and para-aortic LN positivity was detected in 12 cases (18.8%). Surgical staging revealed a statistically significant difference regarding more locoregional-recurrence-free survival ($p=0.026$), distant-metastasis-free survival ($p=0.023$), progression-free survival ($p=0.035$), and overall survival ($p=0.016$) than imaging staging. ***Conclusion:*** We found that surgical staging had a better prognosis for survival than imaging methods in LACC staging.

INTRODUCTION

Particularly in low- and middle-income and emerging nations, cervical cancer ranks as the fourth most common cause of cancer-related morbidity and mortality among women globally. An estimated 604.127 novel cases and 341.831 deaths due to cervical cancer were reported annually in 2020 (1). The system by the International Federation of Obstetrics and Gynecology-2018 (FIGO) is used in staging lymph nodes (LN). Under the revised 2018 FIGO staging, imaging modalities or surgical pathological confirmation were declared to be utilized in the evaluation of LN (2).

About 40-50% of patients are diagnosed with locally advanced cervical cancer (LACC) at the time of diagnosis, and about 6% of cases have primary metastatic cancer, which is the primary cause of death (3). However, the involvement of para-aortic LN is found in 17–24% of the cases diagnosed with LACC (4). The therapeutic approach is difficult in LACC and depends on such factors as tumor volume, metastasis of LN, and clinical stage (5). Therefore, imaging techniques with high diagnostic accuracy are essential to stage the cases of cervical cancer. Used to image cervical cancers, diagnostic methods are composed of abdominal-pelvic magnetic resonance imaging (MRI), computed tomography (CT), and 18F-fluorodeoxyglucose positron emission tomography-CT (18F-FDG PET-CT) (5-7). Such imaging modalities have a high specificity of 97% for detecting the metastasis of LN, with a sensitivity rate ranging from 60 to 88% (8-10). In LACC (FIGO stage, IB3-IVA), pelvic external beam radiation therapy (EBRT) combined with chemoradiotherapy (CRT) is recommended in case of the metastatic pelvic but negative para-aortic LN; additionally, an extended radiation field is implemented to the metastatic para-aortic LN (2,5). In several international treatment guidelines, platinum-based concomitant CRT (CCRT) is also recommended as the standard treatment for LACC (11). However, about 35% of LACC cases experience recurrence, and the prognosis is dismal because the median survival following the recurrence is only about 10–12 months [12]. Specifically, it is expected that the 5-year overall survival (OS) rates for metastatic cervical cancer and LACC are roughly 17% and 65, respectively [13]. The rate of 5-year progression-free survival (PFS) is estimated to be approximately 57% in the LN-negative cases. However, the 5-year PFS decreases to 34 and 12% in the pelvic LN-positive and para-aortic LN-positive cases, respectively [14].

The surgical pathological evaluation of the LN involvement requires advanced surgical skills, regardless of the surgical method, and the histopathological confirmation of the LN involvement is the gold standard. There is no standard method of staging through surgery or any imaging technique recommended by FIGO [2]. Among the controversial issues are the initiation of extended-field radiotherapy treatment (EFRT), the time to start treatment after surgery or the delay of treatment by surgery, and possible complications after unnecessary further RT [15] based solely on imaging. A major challenge in LACC is to identify the patients with para-aortic LN metastases suitable for adjuvant treatment through EFRT, chemotherapy, or immunotherapy after the standard CRT [16-18]. Thus, the current study was designed to examine the impact on survival of extraperitoneal LN dissection and imaging in staging prior to primary RT in LACC. We consider that in the staging of LACC, the surgical method has a better prognosis for survival, compared to such imaging methods as MRI, CT, and PET-CT.

MATERIALS AND METHODS

Selection of the patients and design of the study

In the present study, with a retrospective design, a total of 145 cases who were followed up and treated for LACC under the criteria of FIGO 2018, IIB-IVA at the Faculty of Medicine of Selcuk University between December 2010 and April 2024 were evaluated. Age, use of smoking, pre-radiotherapy positron emission tomography-computed tomography (pre-RT PET-CT) imaging, pre-RT primary tumor size, pre-RT primary tumor standardized uptake value (SUV_{max}), method used for diagnosis, histological types of tumors, stage, the Karnofsky performance scores (KPS), type of RT, type of treatment protocol, history of brachytherapy, presence of recurrence, type of recurrence treatment, locoregional recurrence-free survival (LRFS), distant metastasis-free survival (DMFS), PFS, and OS times were recorded. After the pelvic and para-aortic LNs were recorded in surgical cases, the cases undergoing surgical staging were named Group 1, and those undergoing staging through the imaging methods were named Group 2. Suspected LNs on imaging were evaluated either surgically or by imaging. In surgical evaluation, retroperitoneal LNs located between and around the aorta and inferior vena cava in the para-aortic region were sampled and sent for histopathological evaluation. Then, the LN samples were evaluated in the pathology laboratory under the standard protocols after surgical removal. During macroscopic examination, each LN was measured, preserving capsule integrity, and its number was recorded. LNs were dissected in serial sections according to size: small LNs (<5 mm) were sliced whole, while larger LNs were sliced at 2–3 mm intervals and placed in cassettes. All sections were stained with hematoxylin-eosin (H&E) and evaluated for metastatic involvement under light microscopy.

EFRT was given to those with positive para-aortic LNs surgically or with imaging findings indicating metastasis. The inclusion criteria of the study were composed of the histological diagnosis of squamous, adenosquamous, adenocarcinoma, or undifferentiated cervical carcinoma with stage IIB-IVA under the FIGO 2018 staging system [19], the evaluation of tumor metastasis and involvement of LN by MRI, CT or PET-CT, and the cases receiving primary RT or CRT treatment (pelvic, or pelvic+para-aortic). The suspected LNs through the preoperative MRI, CT, or PET-CT imaging, the involvement of pelvic and/or para-aortic LNs after extraperitoneal LN dissection, histopathological findings (figure 1), and clinical data were evaluated for each case. The present study was approved by the Local Ethics Committee of Selcuk University (Decision number: 2022/508).

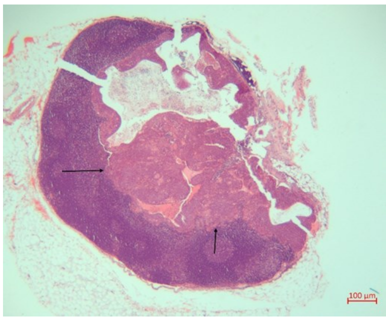

Figure 1. The image clearly revealing a LN section (H&E) and metastatic infiltration of cervical carcinoma.

Imaging protocol

All imaging procedures were performed based on clinical indication and staging requirements. Whole-body PET/CT scans were conducted using a Biograph mCT system (Siemens, Erlangen, Germany), which enables high-resolution imaging and accurate anatomical-functional correlation. SUVmax values of the primary tumour and lymph nodes were recorded. Pelvic MRI examinations were performed using a 3 Tesla MAGNETOM Skyra scanner (Siemens Healthineers AG, Erlangen, Germany) with a pelvic-phased array coil, including T2-weighted, diffusion-weighted (DWI), and dynamic contrast-enhanced (DCE-MRI) sequences for detailed tumour and nodal evaluation. Furthermore, CT scans were obtained using a Somatom Definition Flash scanner (Siemens Healthcare, Erlangen, Germany) without contrast,

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using standard parameters (100–120 kV, 3 mm slice thickness, automatic tube current modulation) during full inspiration in a supine position. The images of these procedures are illustrated in figure 2.

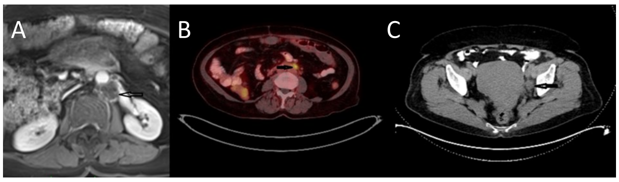

Figure 2. Imaging modalities through **(A)** MRI, **(B)** PET, **(C)** CT. Images obtained using magnetic resonance imaging (MRI), positron-emission tomography (PET), and computed tomography (CT), respectively, demonstrate the anatomical and functional characteristics of the lesion.

Chemoradiotherapy

As the RT treatment plan for 145 patients, the whole pelvic EBRT was administered with 50.4 Gy in 28 fractions using the intensity-modulated radiotherapy with the Varian DHX linear accelerator (Varian Medical Systems, Palo Alto, CA, USA). The cases received weekly cisplatin (Koçak Farma Drug and Chemistry Co., Istanbul, Turkiye) 30-40 mg/m^2 concurrently with RT. Following the treatment of EBRT, high-dose-rate brachytherapy (HDR-BRT) was delivered to the central disease with 28 Gy in 4 fractions using an Ir192 source GammaMed Plus BRT device (GammaMed, MDS Nordion, Hahn, Germany). Regarding the clinical protocol, each case was considered to receive at least 85 Gy for equivalent dose (EQD2) (EBRT+BRT) in 2 Gy fractions for 90% of the high-risk clinical target volume and at least 65 Gy for EQD2 for 90% of the intermediate-risk clinical target volume.

Statistical analysis

All statistical calculations were analyzed through the Standard Package for Social Sciences for Windows, version 21.0 (SPSS Statistics, IBM Corporation, Armonk, NY, USA). While the categorical variables were expressed as frequencies and percentages, the quantitative variables were defined as means and minimum-maximum. The categorical variables were analyzed using the chi-square or Fisher's exact tests; additionally, the continuous variables were analyzed using the student's *t*-test or Mann-Whitney U test for the groups of two continuous data. Statistical significance was set at $p<0.05$. The period of time between the conclusion of treatment and the diagnosis of metastasis or local recurrence was known as PFS. On the other hand, OS was defined as the interval between the last follow-up or the date of death and the end of treatment. The time between diagnosis and distant metastasis development is known as DMFS, whereas the time between diagnosis and locoregional recurrence development is known as LRFS. The log-rank test was used to compare survival curves, and the Kaplan-Meier method was used to summarize the data pertaining to the results.

RESULTS

The mean age of 145 cases was calculated as 60.0±11.8 (33-93 years) (table 1). Twenty-eight cases (19.3%) were found to be smokers. While the diagnosis was performed by cervical biopsy in 122 cases (84.1%), 67 cases (46.2%) were detected to undergo PET-CT imaging before RT, and the mean diameter of the cervical primary mass was calculated as 51.3±16.4 mm. Based on the pathological evaluations, squamous cells, adenocarcinoma, and other types of cancers were found in 134 (92.4%), four (2.8%), and seven cases (4.8%), respectively. Of 145 cases, 48 (33.1%), 72 (49.7%), and 25 cases (17.2%) were detected to be stages II, III, and IV, respectively. KPS of 90-100 and 70-80 were detected in 99 (68.3%) and 46 cases (31.7%), respectively. In terms of RT, while 124 cases (85.5%) received pelvic RT, pelvic+para-aortic RT was administered to 21 cases (14.5%). CCRT+BRT was given to 140 cases (96.6%), and recurrence was detected in 38 cases (26.2%). The PFS and OS times of the cases were calculated as 93.1±6.0 (81.6-104.7 months) and 97.2±6.1 (85.3-109.2 months), respectively (figure 3). The mean ages of those followed up with surgical method (Group 1, n=64) and imaging methods (Group 2, n=81) due to LACC were calculated as 58.0±9.7 and 61.7±13.1 years (p=0.135), respectively. No statistically significant difference was found between the groups in terms of smoking status, histological diagnosis, PET mass size, stage, KPS, type of RT, treatment protocol, and recurrence (table 2). In Group 1, the number of removed pelvic and para-aortic LNs was calculated as four (0-42) and nine (2-24), respectively. In addition, isolated pelvic and para-aortic LN positivity was detected in 16 (25.0%) and one case (1.6%), respectively. Both pelvic and para-aortic LN positivities were also determined in 12 cases (18.8%). Compared to surgical and imaging staging methods, a statistically significant difference was found in favor of surgical staging in terms of OS [Hazard ratio (HR)=1,928 %95 CI 1,118-3,324, and p=0.016], PFS (HR=1,830 %95 CI 1,062-3,154, and p=0.035), LRFS (HR= 1,851 %95 CI 1,073-3,191, and p=0.026), and DMFS (HR= 1,984 %95 CI 1,098-3,265, and p=0.023) (table 3, figures 4 and 5).

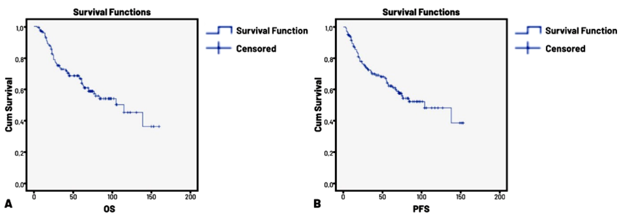

Figure 3. Graphs of overall survival **(A)** and progression-free survival **(B)** of the patients diagnosed with locally advanced cervical cancer.

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Table 1. The characteristics of the patients diagnosed with locally advanced cervical cancer.

Variables		(n=145)	(%)
Age (years)		60.0±11.8 (33-93)	
Smoking Status			
	Yes	28	19.3
	No	117	80.7
PET-CT before RT			
	Yes	67	46.2
	No	78	53.8
Primary mass size before RT (cm)		51.3±16.4	
Primary mass SUV_{max} before RT (cm)		20.4±8.0	
Type of Diagnosis			
	Biopsy	122	84.1
	Conization	23	15.9
Diagnosis of Histology			
	Squamous	134	92.4
	Adenocancer	4	2.8
	Others	7	4.8
Stages			
	II-B	48	33.1
	III-A	8	5.5
	III-B	14	9.7
	III-C1	34	23.4
	III-C2	16	11.0
	IV-A	25	17.2
KPS			
	90-100	99	68.3
	70-80	46	31.7
Type of RT			
	Pelvic	124	85.5
	Pelvik+para-aortic	21	14.5
Treatment Protocol			
	RT	5	3.4
	CCRT+BRT	140	96.6
BRT			
	Yes	140	96.6
	No	5	3.4
Recurrence			
	Yes	38	26.2
	No	105	72.4
	Unknown	2	1.4
Exitus			
	Yes	58	40
	No	87	60
PFS		93.1±6.0(81.6-104.7)	
OS		97.2±6.1(85.3-109.2)	

BRT: Brachytherapy, CCRT: Concomitant chemoradiotherapy, KPS: Karnofsky performance score, OS: Overall survival, PET-CT: Positron emission tomography-computed tomography, PFS: Progression-free survival, RT: Radiotherapy, SUVmax: Standard uptake value maximum.

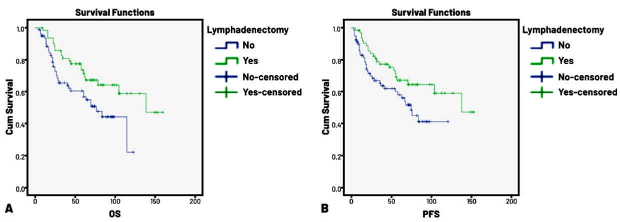

Figure 4. Comparisons of overall survival **(A)** and progression-free survival **(B)** times under the lymphadenectomy status of the cases.

Table 2. The comparison of patients' characteristics in terms of surgical and imaging stages due to locally advanced cervical cancer.

		Group 1 (n=64)	(%)	Group 2 (n=81)	(%)	*p*
Age (years)		58.0±9.7		61.7±13.1		0.135
Smoking Status						0.062
	Yes	16	25.0	11	13.6	
	No	48	75.0	70	86.4	
Diagnosis of Histology						
	Squamous	58	90.6	76	93.8	0.246
	Adenocancer	1	1.6	3	3.7	
	Others	5	7.8	2	2.5	
PET mass size (cm)		50.0±16.2		52.0±16.7		0.677
PET primary mass SUV_{max}		23.1±7.6		19.3±8.0		0.054
Stages (novel)						0.124
	II	19	29.7	29	35.8	
	III	37	57.8	34	42.0	
	IV	8	12.5	18	22.2	
KPS						0.157
	90-100	47	73.4	52	64.2	
	70-80	17	26.6	29	35.8	
Type of RT						0.063
	Pelvic	51	79.7	73	0.1	
	Pelvic+para-aortic	13	20.3	8	9.9	
Treatment Protocol						0.265
	RT (single)	1	1.6	4	4.9	
	CCRT+BRT	63	98.4	77	95.1	
Recurrence						0.170
	Yes	14	21.9	24	30.4	
	No	50	78.1	55	69.6	

BRT: Brachytherapy, CCRT: Concomitant chemoradiotherapy, KPS: Karnofsky performance score, PET: Positron emission tomography, RT: Radiotherapy, SUVmax: Standard uptake value maximum.

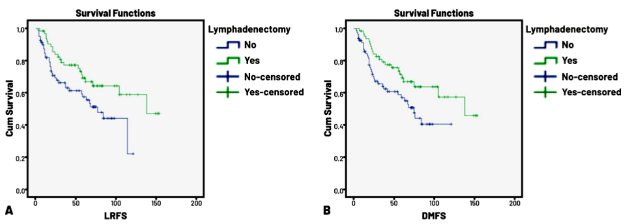

Figure 5. Comparisons of locoregional recurrence-free survival **(A)** and distant metastasis-free survival **(B)** under the lymphadenectomy status of cases.

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Table 3. The comparison of patients' surgical lymph nodes and survival analyses.

Variables		Group 1 (n=64)	(%)	Group 2 (n=81)	(%)	*P*
Number of Total Pelvic LN		4 (0-42)		-		
Number of Total Para-aortic LN		9 (2-24)		-		
Isolated Pelvic LN Positivity		16 (25.0%)		-		
Isolated Para-aortic LN Positivity		1 (1.6%)		-		
Pelvic&Para-aortic LN Positivity		12 (18.8%)		-		
Time of Overall RT Treatment		41.0±3.7		40.0±4.1		0.344
Response to Treatment						0.099
	Progression	3	4.7	3	3.8	
	<30% Regression	0	-	3	3.8	
	Between 30-60% Regression	3	4.7	8	10.0	
	Between 60-80% Regression	0	-	2	2.5	
	Tumor-free complete response	58	90.6	64	80.0	
Relapsed Metastasis						0.243
	Yes	17	26.6	27	33.3	
	No	47	73.4	54	66.7	
Site of Relapse or Metastasis						0.586
	No	48	75.0	54	66.7	
	Local	8	12.5	11	13.6	
	Distant	6	9.4	10	12.3	
	Local+distant	2	3.1	6	7.4	
Treatment for Relapsed Metastasis						0.135
	No	3	15.8	5	16.7	
	CT	8	42.1	10	33.3	
	CT+RT palliative	2	10.5	2	6.7	
	Surgical+CT	4	21.1	1	3.3	
	Supportive care	2	10.5	11	36.7	
	Palliative RT	0	-	1	3.3	
OS (months)		112.0±8.0 (96.1-127.7)		73.1±5.7 (62.0-84.3)		**0.016**
PFS (months)		106.2±8.0 (90.8-121.6)		71.0±6.0 (59.3-82.8)		**0.035**
LRFS		106.4±7.8 (91.0-121.7)		70.6±5.8 (59.1-82.0)		**0.026**
DMFS		106.2±8.0 (91.0-121.6)		70.7±6.0 (59.2-82.2)		**0.023**

CRT: Chemoradiotherapy, CT: Chemotherapy, DMFS: Distant metastasis-free survival, KPS: Karnofsky performance score, LRFS: Locoregional recurrence-free survival, LN: Lymph node, OS: Overall survival, PFS: Progression-free survival, RT: Radiotherapy.

DISCUSSION

Based on the literature, there is no standard method for staging in the management of LACC, either surgically or by imaging. In a Cochrane review, it is recommended that the decision for the preoperative evaluation of para-aortic LNs in LACC should be individualized [20]. In the present study, however, a significant difference was found in terms of local, distant metastasis, PFS, and OS in the long-term follow-up in LACC between surgical staging and other imaging staging methods.

In a multicentric study carried out with 634 cases of LACC by Köhler *et al*. in 2015, the mean age of the cases was detected as 51 (ranging between 42-60 years). Also, the recurrence rate was calculated as 28.3%. Of 634 cases, 87.5 and 21% were evaluated as stages II and III, respectively, and 79.9% were reported to be histologically squamous cell type [21]. In the present study, while the mean age of the cases was calculated as 60.0±11.8 (33-93 years), the recurrence rate was calculated to be 26.2%. Of 145 cases, 33.1 and 49.7% were evaluated as stages II and III, respectively; 92.4% of the cases had also squamous cell type. The differences between our findings and those stated in the study by Köhler et al. may have been due to the advanced stage of cancers, advanced age level, small number of sampling, and the fact that the majority of the cases had histologically squamous cell type. The first randomized study comparing the imaging methods (29 cases) and surgical staging (32 cases) of the para-aortic region in the management of LACC was conducted by Lai *et al.* in 2003 [22]. In the study by Lai *et al.*, no difference was found between the two groups in terms of perioperative outcomes after the interim analyses; however, the para-aortic metastatic LN was detected in 25% of the cases in the surgical staging group. The study was ended after a significantly shorter PFS was found in the surgery group, compared to the group evaluated through imaging methods. In addition, the lymphadenectomy in the study of LACC, which was conducted by Frumovitz *et al.* in a multicentric study including 600 patients with LACC stage IB2-IVA, that aimed to investigate the effects of CRT when compared with PET-CT imaging staging alone and then CRT after preoperative surgical staging was ended at an earlier

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period due to the slow increase in the number of patients included in the study [23]. However, in a retrospective study where 98 cases undergoing para-aortic evaluation through PET-CT were compared with 89 cases undergoing laparoscopic surgery by Pomel *et al.*, compared to imaging staging, para-aortic surgery staging was stated to delay the treatment, increase relapses, and be related to surgery-induced adverse immunological effects [24]. As opposed to the findings of the abovementioned studies, the only prospective, randomized, and completed study where the stage-specific percentage and staging rate of pelvic and para-aortic LN metastases in FIGO stage IIB-IVA cases diagnosed with LACC was evaluated in terms of imaging staging through CT and surgical staging is the UTERUS-11 study by German GOG and Radiation Oncology Group [25]. In the UTERUS-11 study, while a total of 255 patients with LACC [surgical arm (n=130) and clinical arm (n=125)] were randomized, 240 patients were evaluated, and the surgical approach was transperitoneal laparoscopy in most of the patients (96.6%). In the UTERUS-11 study, no difference was also found in terms of OS or PFS between the imaging and surgical staging groups after a mean follow-up of more than eight years; furthermore, a significant benefit was found in favor of laparoscopic staging in FIGO stage IIB cases in terms of PFS in post-hoc analysis. Christogiannis *et al.* declared various interpretations in light of this post-hoc analysis as a negligible scientific value [26]. Even so, the UTERUS-11 study is important in terms of reinforcing the lack of benefit of surgical staging in LACC. In a retrospective study evaluating hospital records from Mayo Clinic in 2020, 148 patients were identified, and after propensity score matching, 35 patients from the surgery group and 70 patients from the imaging group were included in the analysis. There was no statistical difference in baseline characteristics between the two groups. Median follow-up was 41 months (range, 7-218 months) in the surgery group and 51.5 months (range, 7-198 months) in the imaging group. However, no difference was found between the groups in terms of the 5-year PFS and OS, compared after the surgical and radiological staging (based mainly on a combination of CT, MRI, and PET-CT). In this study, the presence of para-aortic LN metastasis was detected as a prognostic factor in terms of adverse PFS and OS [27]. Moreover, in another retrospective study performed by Nasioudis *et al.*, 3540 LACC cases (FIGO 2009 IB2 to IVA) were evaluated in terms of surgical para-aortic LN staging via imaging staging methods [28]. In this study, para-aortic lymphadenectomy had been performed in 333 (9.4%) of the cases, and these patients were younger (median age, 46 *vs.* 52 years, $p<0.001$), less likely to have comorbidities (8.7% *vs.* 15.6%, $p<0.001$), more likely to have private insurance (48.9% *vs.* 37.8%, $p<0.001$), and more likely to receive brachytherapy (76.9% *vs.* 70.9%, $p=0.022$); additionally, more positive LNs were detected in the cases with surgical staging compared to those with imaging staging, and the finding was statistically significant (27.31% *vs.* 13.2%, $p<0.001$). No difference was determined in terms of OS between the groups after a mean follow-up of approximately 40 months. After controlling such factors as age, tumor stages, histology, comorbidities, and vaginal brachytherapy, surgical staging was determined not to reveal survival benefits. A total of 171 LACC patients were split into two groups in a study by Jiang *et al.* that assessed para-aortic and pelvic lymphadenectomy in patients with pelvic LN metastases. Of these, 58 patients underwent para-aortic and pelvic lymphadenectomy (surgical staging) with CCRT, and 113 patients underwent CCRT alone. RT was initiated 10.2 days (range: 9–12 days) later in the surgical staging group than in the imaging staging group. Of the patients in the surgical staging group, 12.07% (7/58) had pathology-negative pelvic LN, while 34.48% (20/58) had para-aortic LN metastases. There was no discernible difference in the two groups' PFS and OS rates across a median follow-up of 52 months [29]. As opposed to the findings of the abovementioned studies, in the retrospective study in which those with LACC were assessed by Gold *et al.,* while 555 patients underwent surgical para-aortic LN sampling (surgery group), 130 patients were exposed to radiographic evaluation alone (imaging group), and such parameters as age, race, histology, and tumor grade were found to be similar. Additionally, those in the radiography group had better performance status ($p<0.01$), less advanced stage ($p=.023$), and smaller tumor size ($p=.004$), compared with patients in the surgery group. Those evaluated only with an imaging method and undergoing para-aortic LN dissection were also revealed to have a better prognosis in terms of OS and PFS [30]. Similarly, in a retrospective study including 647 cases from 10 French university hospitals by Dabi *et al.* [31], the effects of surgical staging on survival were evaluated in those diagnosed with LACC (IB2 and above) and with no evidence of para-aortic LN metastasis on preoperative imaging. Of 647 patients, while 377 (58.3%) underwent surgical staging, 270 (41.7%) did not, with a mean follow-up of 38.1 months (QI 13.0-56.0), and the pathological analyses revealed positive LNs in 47 patients (12.5%). In the multivariate model analysis, surgical staging remained an independent prognostic factor for DFS (OR 0.64, 95% CI 0.46-0.89, $p=0.008$) and OS (OR 0.43, 95% CI 0.27-0.68, $p<0.001$). Supporting the study findings stated in the study by Dabi *et al.*, we also found a statistically significant difference in OS and PFS between surgical and imaging staging in our study [31]. In another study where the data from nine cohort studies including 2553 patients were evaluated to indicate the benefits of pretreatment surgical staging in patients with LACC by Xu *et al.*, the overall pooled results revealed no difference in PFS (HR 0.94, 95% CI 0.73-1.22,

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p=0.65) or OS (HR 1.00, 95% CI 0.74-1.35, p=0.99) between the two approaches to the staging of LN. However, the subgroup analyses found the superiority of surgical staging in PFS in patients with FIGO stage II (HR 0.68, 95% CI 0.49-0.95, p=0.02). Additionally, in those with no evidence of LN metastases on imaging, surgical staging was associated with significantly improved PFS (HR 0.69, 95% CI 0.56-0.86, p=0.001) and OS (HR 0.56, 95% CI 0.36-0.87, p=0.01). In the subgroup of the patients with suspicious large LNs on imaging, surgical staging based on LN reduction was seen not to improve PFS significantly (HR 0.97, 95% CI 0.72-1.31, p=0.31) or OS (HR 1.16, 95% CI 0.68-1.99, p=0.59), compared with imaging staging. Surgical staging may not be appropriate for all patients with LACC. However, for those with FIGO II disease or those with no suspected LN involvement on imaging, nodal surgical staging may provide a survival benefit [32].

PET-CT is widely used for the detection, prognosis, and treatment planning of cancers and is also the most reliable method in detecting metastatic LNs in cervical cancer, playing an important role in staging and treatment planning [33]. However, based on the literature, while the rate of para-aortic LN showing no PET or PET-CT involvement but histopathologically positive (false-negative rate) is 12%, the rate of detecting pelvic LNs is 22% [34]. Additionally, it has been established that up to 9% of patients with LACC will receive an inadequate diagnosis and treatment due to PET-CT-only staging [35]. Therefore, surgical staging is still considered in cases with negative 18F-FDG PET-CT before surgery at the para-aortic level, and surgical staging demonstrates the benefits of surgery [36]. In a study in which 60 patients with stage IB2-IVA cervical cancer underwent preoperative PET-CT and laparoscopic extraperitoneal lymphadenectomy, the involvement of histopathologically positive para-aortic LNs was detected in six (22%) of 27 cases with positive pelvic but negative para-aortic LNs on PET-CT [37]. Likewise, in another multicentric study where the findings of surgical lymphadenectomy and the detection of LNs on PET-CT were compared by Díaz-Feijoo *et al.*, an alteration in the RT area was detected in 34% of the cases due to over- or under-treatment. In this study, the diagnostic accuracy of para-aortic LN metastases was calculated as 65.4% (57.6-72.7%) for PET-CT in the study group. Also, in the subgroup analysis performed in terms of LN positivity in the present study, the involvements of para-aortic LN (75%) and pelvic LN (80%) were detected in three and in four cases out of 20 cases where PET-CT was performed for LN positivity, and surgery was performed. In the LN involvement, false negativity was detected at a rate of 20% in the pelvic region and 25% in the para-aortic region. If the decision had been made considering PET-CT, the cases would have been undertreated at the rate of 25% [35].

In the study where para-aortic involvement was evaluated with PET-CT by Gouy *et al.*, since the rate of false-negativity was stated to be very low in the cases, surgical LN dissection was considered in those without pelvic LN involvement on PET-CT. However, on condition that PET-CT involvement exists in the pelvic region, especially if bilateral, the risk of false negative findings in the para-aortic LN is higher, and so surgical dissection may be preferred [38]. In a recent retrospective multicentric study related to the prediction of LACC progression and normogram, PET-CT was proposed for the early and accurate assessment of long-term prognosis in LACC cases receiving CCRT with a validated clinical-radiomic prediction model [39]. Furthermore, although the therapeutic effects of surgical removal of large LNs before standard therapy have been reported in a few retrospective studies, the number of well-designed randomized clinical trials is limited. However, Yun *et al.* planned to investigate the therapeutic effects of surgical debulking of metastatic LNs in cervical cancer IIICr in a phase III, multicenter, randomized controlled trial (KGOG1047/DEBULK) in 2010 because the size or number of lymph node metastases was yet to be reflected in the staging system and treatment strategy [40].

The Limitations of the present study are as follows: its retrospective design, absence of a single imaging method, and conducting the study in a single center. Additionally, surgical staging was not performed in each case who were evaluated with imaging staging, metastatic LN diameter was not evaluated, and the number of cases in the study was also small. On the other hand, the strengths of the study are that the cases were both surgically evaluated and pathologically staged through imaging methods in the same center, and the treatment regimes were decided by discussing the clinical outcomes in a multidisciplinary council.

CONCLUSION

In conclusion, the findings of imaging and surgical staging and the contribution of RT and EFRT treatments to long-term survival were investigated. In the staging of LACC, the surgical method has a better prognosis for survival than such imaging methods as MRI, CT, and PET-CT.

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REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F (2021) Global cancer statistics: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin, **71**(3): 209-249*.
2. Bhatla N, Berek JS, Cuello Fredes M, Denny LA, Grenman S, Karunaratne K, *et al.* (2019) Revised FIGO staging for carcinoma of the cervix uteri. *Int J Gynaecol Obstet, **145**(1): 129-135*.
3. Gennigens C, Jerusalem G, Lapaille L, De Cuypere M, Streel S, Kridelka F, *et al.* (2022) Recurrent or primary metastatic cervical cancer: current and future treatments. *ESMO Open, **7**(5): 100579*.
4. Benito V, Chiva L, Silva P, Esparza M, Arencibia O, Federico M, *et al.* (2017) Should the presence of metastatic para-aortic lymph nodes in locally advanced cervical cancer lead to more aggressive treatment strategies? *J Minim Invasive Gynecol, **24**(4): 609–616.*
5. Koh WJ, Abu-Rustum NR, Bean S, Bradley K, Campos SM, Cho KR, *et al.* (2019) Cervical cancer, version 3.2019, NCCN clinical practice guidelines in oncology. *J Natl Compr Canc Netw, **17**(1): 64-84*.
6. Liu B, Gao S, Li S (2017) A comprehensive comparison of CT, MRI, positron emission tomography or positron emission tomography/CT, and diffusion-weighted imaging-MRI for detecting the lymph node metastases in patients with cervical cancer: a meta-analysis based on 67 studies. *Gynecol Obstet Investig, **82**(3): 209–222*.
7. Fischerova D, Froyman W, Burgetova A, Haldorsen IS, Gatti E, Cibula D (2024) The role of imaging in cervical cancer staging: ESGO/ESTRO/ESP guidelines. *Cancers (Basel), **16**(4): 775*.
8. Selman TJ, Mann CH, Zamora J, Appleyard TL, Khan KS (2008) Diagnostic accuracy of tests for lymph node status in primary cervical cancer: a systematic review and meta-analysis. *CMAJ, **178**(7): 855-862*.
9. Choi HJ, Ju W, Myung SK, Kim Y (2010) Diagnostic performance of computer tomography, magnetic resonance imaging, and positron emission tomography or positron emission tomography/computer tomography for detection of metastatic lymph nodes in patients with cervical cancer: meta-analysis. *Cancer Sci, **101**(6): 1471-1479*.
10. Balleyguier C, Sala E, Da Cunha T, Bergman A, Brkljacic B, Danza F, *et al.* (2011) Staging of uterine cervical cancer with MRI: guidelines of the European Society of Urogenital Radiology. *Eur Radiol, **21**(5): 1102-1110*.
11. Pujade-Lauraine E, Tredan O, Leary A, Mirza MR, Enomoto T, Takyar J, *et al.* (2022) Comparison of global treatment guidelines for locally advanced cervical cancer to optimize best care practices: a systematic and scoping review. *Gynecol Oncol, **167**(2): 360-372*.
12. Cibula D, Pötter R, Planchamp F, Avall-Lundqvist E, Fischerova D, Haie-Meder C, *et al.* (2018) The ESGO/ESTRO/ESP guidelines for the management of patients with cervical cancer. *Radiother Oncol, **127**(3): 404-416*.
13. Salani R, Khanna N, Frimer M, Bristow RE, Chen LM (2017) An update on post-treatment surveillance and diagnosis of recurrence in women with gynecologic malignancies: Society of Gynecologic Oncology (SGO) recommendations. *Gynecol Oncol, **146**(1): 3-10*.
14. Kidd EA, Siegel BA, Dehdashti F, Rader JS, Mutch DG, Powell MA, Grigsby PW (2010) Lymph node staging by positron emission tomography in cervical cancer: relationship to prognosis. *J Clin Oncol, **28**(12): 2108-2113*.
15. Zhang W, Cao Y, Ni X, Tong Y (2022) Study on the physical factors related to the exposure dose to organs at risk from radiotherapy for cervical cancer patients. *Int J Radiat Res, **20**(3): 587-591*.
16. Cohen PA, Jhingran A, Oaknin A, Denny L. (2019) Cervical cancer. *Lancet, **393**(10167): 169-182*.
17. Ciulla S, Cicchetti G, Aiello AA, Gigli S, Ninkova R, Miceli V, *et al.* (2022) Post-treatment imaging in patients with locally advanced cervical carcinoma. *Front Oncol, **12**: 1003930*.
18. Zhang H, Kong W, Chen S, Zhao X, Luo D, Xie Y (2022) Surgical staging of locally advanced cervical cancer: current status and research progress. *Front Oncol, **12**: 940807*.
19. Pecorelli S (2009) Revised FIGO staging for carcinoma of the vulva, cervix, and endometrium. *Int J Gynaecol Obste, **105**(2): 103-104*.
20. Brockbank E, Kitchener F, Bryant A, Pomel C, Reynolds K (2013) Pre-treatment surgical para-aortic lymph node assessment in locally advanced cervical cancer. *Cochrane Database Syst Rev, **2013**(3): CD008217*.
21. Köhler C, Mustea A, Marnitz S, Schneider A, Chiantera V, Ulrich U, *et al.* (2015) Perioperative morbidity and rate of upstaging after laparoscopic staging for patients with locally advanced cervical cancer: results of a prospective randomized trial. *Am J Obstet Gynecol, **213**(4): 503.e1-7*.
22. Lai CH, Hsueh S, Hong JH, Lee CL, Chou HH, Chang TC, *et al.* (2003) Randomized trial of surgical staging (extraperitoneal or laparoscopic) versus clinical staging in locally advanced cervical cancer. *Gynecol Oncol, **89**(1): 160-167*.
23. Frumovitz M, Querleu D, Gil-Moreno A, *et al.* (2014) Lymphadenectomy in locally advanced cervical cancer study (LiLACS): phase III clinical trial comparing surgical with radiologic staging in patients with stages IB2–IVA cervical cancer. *J Minim Invasive Gynecol, **21**(1): 3–8*.
24. Pomel C, Magaud L, Bourgin C, Beguinot M, Benoit C, Naik R, *et al.* (2017) Survival effect of laparoscopic para-aortic staging in locally advanced cervical cancer: a retrospective cohort analysis. *BJOG, **124**(7): 1089-1094*.
25. Marnitz S, Tsunoda AT, Martus P, *et al.* (2020) Surgical versus clinical staging prior to primary chemoradiation in patients with cervical cancer FIGO stages IIB–IVA: oncologic results of a prospective randomized international multicenter (UTERUS-11) intergroup study. *Int J Gynecol Cancer, **30**(12): 1855-1861*.
26. Christogiannis C, Nearchou S, Pandis N, *et al.* (2022) The self-fulfilling prophecy of post-hoc power calculations. *Am J Orthod Dentofacial Orthop, **161**(3): 315-317*.
27. Yang J, Dowdy SC, Magrina JF, Magtibay PM, Yi J, Langstraat CL, *et al.* (2020) Comparing survival outcomes between surgical and radiographic lymph node assessment in locally advanced cervical cancer: a propensity score-matched analysis. *Gynecol Oncol, **156**(2): 320-327*.
28. Nasioudis D, Ramirez PT, Taunk NK (2022) Oncologic outcomes of surgical para-aortic lymph node staging in patients with advanced cervical carcinoma undergoing chemoradiation. *Int J Gynecol Cancer, **32**(6): 823-827*.
29. Jiang W, Zhong ML, Wang SL, Chen Y, Wang YN, Zeng SY, Liang MR (2024) Para-aortic and pelvic lymphadenectomy in locally advanced cervical cancer with pelvic lymph node metastasis. *World J Surg Oncol, **22**(1): 262*.
30. Gold MA, Tian C, Whitney CW, Rose PG, Lanciano R (2008) Surgical versus radiographic determination of para-aortic lymph node metastases before chemoradiation for locally advanced cervical carcinoma: a Gynecologic Oncology Group Study. *Cancer, **112**(9): 1954-1962*.
31. Dabi Y, Schaeffer V, Carcopino X, Bendifallah S, Ouldamer L, Lavoue V, *et al.* (2018) The therapeutic value of surgical para-aortic staging in locally advanced cervical cancer: a multicenter cohort analysis from the FRANCOGYN study group. *J Transl Med, **16**(1): 326*.
32. Xu H, Zhang Q, Luo C, Wang M, Tian M, Sun X, Qin Q (2025) Survival benefit of surgical staging before radiotherapy in locally advanced cervical cancer: a pooled analysis. *Cancer Sci. Epub ahead of print*,
33. Molnar O, Suteu O, Mihutiu S, Lazar L (2024) Impact of PET/CT imaging with FDG in locally advanced cervical carcinoma—a literature review. *Curr Oncol, **31**(5): 2508-2526*.
34. Gouy S, Morice P, Narducci F, Uzan C, Gilmore J, Kolesnikov-Gauthier H, *et al.* (2012) Nodal-staging surgery for locally advanced cervical cancer in the era of PET. *Lancet Oncol,**13**(5): e212-e220*.
35. Díaz-Feijoo B, Tejerizo Á, Benito V, Hernández A, Ruiz R, Domingo S, *et al.* (2020) Prognostic value and therapeutic implication of laparoscopic extraperitoneal paraaortic staging in locally advanced cervical cancer: a Spanish multicenter study. *Ann Surg Oncol, **27**(8): 2829-2839*.
36. Puga O, Rojas N, Saez N, Urzúa M, Saavedra M, Pérez MV, *et al.* (2022) The role of pre-treatment paraaortic surgical staging for cervical cancer in the EMBRACE criteria. *Ecancermedicalscience*, **16**:1463.
37. Ramirez PT, Jhingran A, Macapinlac HA, Euscher ED, Munsell MF, Coleman RL, *et al.* (2011) Laparoscopic extraperitoneal para-aortic lymphadenectomy in locally advanced cervical cancer: a prospective correlation of surgical findings with positron emission tomography/computed tomography findings. *Cancer, **117**(9): 1928-1934*.
38. Gouy S, Samouelian V, Chargari C, Terroir M, Grimaldi S, Ilenko A, *et al.* (2021) False negative rate at 18F-FDG PET/CT in para-aortic lymph node involvement in patients with locally advanced cervical cancer: impact of PET technology. *BMC Cancer, **21**(1): 135*.
39. Liu H, Chen Y, Chang C, Zhou Z, Zhang Y, Ma C, *et al.* (2024) Development and validation of an 18F-FDG PET/CT radiomics nomogram for predicting progression-free survival in locally advanced cervical cancer: a retrospective multicenter study. *BMC Cancer, **24**(1): 150*.
40. Yun BS, Lee KB, Lee KH, Chang HK, Kim JY, Lim MC, *et al.* (2024) Korean gynecologic oncology group (KGOG) ınvestigators. Therapeutic effects of surgical debulking of metastatic lymph nodes in cervical cancer IIICr: a trial protocol for a phase III, multicenter, randomized controlled study (KGOG1047/DEBULK trial). *J Gynecol Oncol, **35**(5): e57*.