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Comparison of positron emission tomography, computed tomography, magnetic resonance imaging and surgical staging in para-aortic lymph node sampling in cervical cancer

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ABSTRACT

Aims: This study aimed to compare imaging-based evaluation of retroperitoneal nodal status with pathologic findings, and to identify the advantages and disadvantages of laparoscopy.

Methods: This retrospective study included patients with invasive cervical cancer who underwent laparotomy or extraperitoneal laparoscopy for evaluation of para-aortic nodal status between 2002 and 2006 at two tertiary care hospitals. The primary objectives were to compare the imaging modalities with pathological findings and laparoscopy with laparotomy.

Results: Forty-one women (mean age: 51±10 years) having invasive cervical cancer were included in the study. Laparoscopic extraperitoneal lymphadenectomy was performed in 26 patients [International Federation of Gynecology and Obstetrics (FIGO) stage IIB-III B], and laparotomic hysterectomy and para-aortic lymphadenectomy were performed in 15 patients (FIGO stage IB-II B). Operation times (115.1 minutes vs. 182.0 minutes, $p<0.001$), the average length of hospital stay (6.1 days vs. 12.6 days, $p<0.001$), and the need for narcotic analgesics in the postoperative period (34.6% vs. 80.0%, $p<0.005$) were better in laparoscopy group. Lymphadenectomy times were similar (56.6 minutes vs. 52.2 minutes, $p=0.07$). Sensitivities of computed tomography, magnetic resonance imaging, and positron emission tomography (PET) for the para-aortic lymphatic region were 20%, 25%, and 33.3%, respectively; specificities were 92.3%, 96.2%, and 100%, respectively. PET was found to have 100% positive predictive value for both pelvic and para-aortic lymphatic evaluations. Extraperitoneal laparoscopic lymphadenectomy was found to have lower morbidity as a minimally invasive procedure for locally advanced cervical cancer.

Conclusions: Surgical staging is the gold standard for the retroperitoneal evaluation in cervical cancer. Laparoscopy appears to be a favorable option for surgical staging due to lower morbidity and faster recovery while maintaining comparable oncologic adequacy. PET was the most specific imaging modality.



Introduction

Cervical cancer is the third most common gynecological cancer in women worldwide. In the first half of the 20th century, cervical cancer was a leading cause of death. A significant decrease in incidence and mortality rates was achieved through the application of colposcopy by Hinselmann in the 1920s and of Pap smear screening by Papanicolaou in the 1940s. In general, cervical cancer and mortality caused by cervical cancer are seen more frequently in underdeveloped and developing countries (1). Staging, which has a very important place in treatment planning, was previously done clinically, but today it is done surgically, and nodal involvement has been included in staging in 2018 (2). Accuracy and consistency of preoperative imaging and postoperative pathology in evaluating nodal status for staging help us to guide appropriate treatment planning. Imaging provides additional information for our clinical evaluation of staging. In this study, we compared nodal involvement assessed by preoperative imaging with histopathological data obtained from surgical specimens. During surgical evaluation, we compared minimally invasive, laparoscopic, extraperitoneal lymphadenectomy with para-aortic lymphadenectomy performed via laparotomy.

Methods

Study design and population

This multicentric, retrospective study included patients diagnosed with invasive cervical cancer between 2002 and 2006 at the Gülhane Military Medical Academy (GATA) Gynecology and Obstetrics Clinic and the University of Health Sciences, Türkiye, Etilik Zübeyde Hanım Women's Health Training and Research Hospital, Clinic of Gynecological Oncology. Ethics committee approval was obtained from Gülhane Military Medical Academy (approval no: 1491-227-06, date: 22.05.2006), and institutional approval was granted by the Education and Planning Committee of Etilik Zübeyde Hanım Women's Health Training and Research Hospital (approval no: 73, date: 24.05.2006).

Patients who underwent surgery for invasive cervical carcinoma and patients who underwent para-aortic lymphadenectomy by laparotomy or laparoscopy were included in the study. Patients who had not undergone surgery (received only radiotherapy), who had not been diagnosed with invasive cervical cancer (carcinoma *in situ*), who had undergone surgery but had not undergone para-aortic lymph node dissection, who had distant metastasis, or who had a condition that prevented surgery were not included in the study.

Surgical technique

Patients with locally advanced cervical cancer (staged IIB-IIIB) have undergone laparoscopic extraperitoneal lymphadenectomy, whereas patients with early-stage disease (IB-IIIB) have undergone hysterectomy with pelvic and para-

aortic lymphadenectomy via laparotomy. All laparoscopic extraperitoneal lymphadenectomy operations were performed by the same surgeon, and all extraperitoneal laparotomy operations were performed by the gynecological oncology team, using the same procedure and surgical technique.

Data collection and data assessment

Informed consent was obtained from all patients for the operation. Additional gynecological pathology was investigated through a detailed patient history and pelvic evaluation, including transvaginal ultrasonography (TVUSG). International Federation of Gynecology and Obstetrics (FIGO) clinical staging was performed on patients using hemograms, biochemical values, chest radiography, examination under general anesthesia, and cystoscopy.

Imaging methods

The retroperitoneal area was evaluated using one or more imaging modalities in the patients: computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET). The interval between imaging and surgery did not exceed 1 month. All imaging interpretations were performed blinded to other imaging methods and to pathology results. MRI and CT scans were evaluated by the same radiologist. For lymphatic evaluation on imaging, the common, external iliac, internal iliac, and obturator lymph nodes of the pelvic region and any lymph node between the renal vein and common iliac vessels of the para-aortic region were scanned. In lymph node evaluation on MRI and CT, a short-axis dimension greater than 1 cm was accepted as the threshold for malignancy.

PET imaging

On the day of the PET imaging, blood glucose levels of all patients were measured after 6-8 hours of fasting. Patients with serum glucose levels ≤ 150 mg/dL proceeded to imaging. All patients were injected intravenously with 300-400 MBq F-18 fluorodeoxyglucose (FDG) and were given hydration to reduce urinary tract activity. After 45 minutes, images from the base of the skull to the proximal femur were obtained in the supine position using a PET scanner (ECAT EXACT 47, Siemens CTI). All FDG-PET images were evaluated by the same nuclear medicine specialist, blinded to the other radiological and pathological results. Maximum standardized uptake values (SUV_{max}) were calculated for metabolic foci deemed non-physiological, and areas of metabolic activity with SUV_{max} values of 2.5 or greater were considered positive for malignancy.

Lymphadenectomy

The lymph nodes removed after the operation and those identified on imaging were divided into two groups: pelvic and para-aortic. In the laparoscopic group (n=26), 11 patients underwent para-aortic lymphadenectomy alone,

while 15 patients underwent both para-aortic and pelvic lymphadenectomies. In the laparotomy group (n=15), all patients underwent both pelvic and para-aortic lymphadenectomies.

After the removed lymph nodes were divided into pelvic and para-aortic regions, the diameters of the lymph nodes in both regions were recorded as the per-patient average (in millimeters). The relationship between lymph node diameter and pathology results was examined. All histopathological evaluations were performed by two pathologists experienced in gynecological oncology.

The laparoscopic extraperitoneal and laparotomic para-aortic lymphadenectomy techniques were compared in terms of blood loss, operative and lymphadenectomy times, length of hospital stay, need for narcotic analgesics, and complications.

Lymphadenectomy results were compared with the imaging findings, and sensitivity, specificity, and predictive values were calculated for each imaging modality.

Statistical Analysis

Statistical analyses were performed using SPSS, version 11.0 (SPSS Inc., Chicago, USA). In addition to descriptive statistical methods (mean, standard deviation), the distribution of variables was examined with the Shapiro-Wilk normality test; the independent t-test was used to compare normally distributed variables between two independent groups; the Kruskal-Wallis test was used to compare variables with non-normal distributions between groups; Dunn's multiple comparison test was used for subgroup comparisons; the Mann-Whitney U test was used to compare two independent groups; and the chi-square and Fisher's exact tests were used to compare qualitative data. A p-value of <0.05 was considered statistically significant in all calculations.

Results

Socio-demographic characteristics

Forty-one patients diagnosed with invasive cervical cancer underwent surgery. Laparoscopic extraperitoneal lymphadenectomy was performed in 26 patients (FIGO stage IIB-IIIIB); laparotomy with pelvic and para-aortic lymphadenectomy, hysterectomy, and salpingo-oophorectomy, as indicated, were performed in 15 patients (FIGO stage IB-IIB). When the demographic characteristics of the patients were examined, no statistically significant difference was found between the groups. The most common presenting complaint among the patients was vaginal bleeding (31 cases, 75.6%). The average age of all patients was 51±10 years (range 30-69), median parity values were 4 (range 0-12), and average body mass index was 27.4±3.7.

Regarding histological type distribution, squamous cell carcinoma was the most frequent in our study, consistent with

the literature: 82.9% (34 cases). Adenocarcinoma was detected in 4 cases (9.8%), undifferentiated epithelial tumor in 2 cases (4.9%), and adenoma malignum in 1 case (2.4%).

When we examined the stages, 17.1% (7 cases) of the patients were stage IB, 7.3% (3 cases) were stage IIA, 61% (25 cases) were stage IIB, 4.9% (2 cases) were stage IIIA, and 9.8% (4 cases) were stage IIIB. 24.4% (10 cases) of patients were classified as stage IIA or lower, and 75.6% (31 cases) as stage IIB or higher.

Operative results

Operation times were found as 115.1±51.9 minutes (range 60-290 minutes) in the laparoscopy group and 182.0±60.5 minutes (range 120-320 minutes) in the laparotomy group. The difference between the two groups was statistically significant (p<0.001).

Lymphadenectomy times were found to be 56.6±8.3 minutes in the laparoscopy group and 52.2±4.6 minutes in the laparotomy group. No significant difference in lymphadenectomy times was detected between the two groups (p=0.07).

The average length of hospital stay was 6.1±3.8 days (2-17 days) in the laparoscopy group and 12.6±4.2 days (5-20 days) in the laparotomy group. The difference between the two groups was found to be statistically significant (p<0.001).

Narcotic analgesics in the postoperative period were required in only 9 of 26 patients (34.6%) in the laparoscopy group and in 12 of 15 patients (80.0%) in the laparotomy group. The difference between the two groups was statistically significant (p<0.005).

A total of 7 of 41 patients (17.1%) experienced complications. It developed in 7.7% (2 cases), of patients who underwent laparoscopy and in 33.3% (5 cases) of those who underwent laparotomy. Two complications in the laparoscopy group were identified as peritoneal ruptures, and both underwent laparotomy. In the laparotomy group, a bladder injury occurred in one patient and was repaired intraoperatively. Ureteral injury occurred in two cases, and a double-J catheter was placed intraoperatively. One patient developed peripheral nerve damage in the left lower extremity and experienced spontaneous regression within 3 weeks. In one patient, incision failure was observed at the Maylard incision site on the 7th day and was debrided and resutured on the 17th day. The difference between the two groups was not statistically significant (p=0.08).

Laparotomy was performed in 4 (4/26) patients who underwent laparoscopy. One was a peritoneal defect; another was due to both a peritoneal defect and a bulky tumor; and in the other two cases, the peritoneal defect prevented continuation of laparoscopy. Peritoneal defects occurred in 8 patients (8/26). In 6 of them, no laparotomy with intraoperative intervention was required.

The average follow-up period in the postoperative period was 18.2±14.9 months (1-44 months). Recurrence was observed in

2 of 41 patients (4.9%) during this follow-up period. One of the patients developed a central recurrence in the 17th month and received treatment with cisplatin and 5-fluorouracil. In the other patient, a 6 cm tumoral mass was observed in the vulvar region at the 16th month, and it was excised. In 12 (29.3%) cases, patients received chemotherapy. External pelvic radiotherapy was applied to 11 (26.8%) cases; external pelvic radiotherapy and brachytherapy were applied to 13 (31.7%) cases; and pelvic and para-aortic therapy was applied to 5 (12.2%) cases.

Lymphadenectomy results

The average number of para-aortic lymph nodes removed in the laparoscopy group was 11.2±6.4, and the average number of para-aortic lymph nodes removed in the laparotomy group was 10.3±4.0. There was no significant difference between the laparotomy and laparoscopy groups in terms of the number of para-aortic lymph nodes removed (p=0.63).

Histopathologic results

The pathology results were reported as metastatic in 5 (12.5%) of 40 patients who underwent para-aortic lymphadenectomy, while 35 (87.5%) were reported as reactive. Pelvic lymphadenectomy pathology results showed metastasis in 7 (26.9%) of 26 patients, while 19 (73.1%) were reported as reactive (Figure 1). Three of the patients with metastatic para-aortic lymph nodes were stage IIB, and two were stage IIIB. Of the seven patients with metastatic pelvic lymph nodes, two were stage IIA, four were stage IIB, and one was stage IIIB. The distribution of lymph node status by stage is shown in Figure 2. When we look at the lymphatic metastasis rates according to stage: of 3 patients with stage IIA, 2 (66.7%) had pelvic metastases; of 25 patients with stage IIB, 4 (16.0%) had pelvic and 3 (12%) had para-aortic metastases; and of 4 patients with stage IIIB, 1 (25%) had pelvic and 2 (50.0%) had para-aortic metastases (Table 1).

While the average total number of lymph nodes collected in all patients was 21.8±15.5 (range 4-59), the number of para-

aortic lymph nodes was 10.8±5.6 (1-28), and the number of pelvic lymph nodes was 17.1±15.2 (1-48). In the pelvic group, lymph node diameters were 8.5±4.3 mm (range 3.6-18.6 mm) for reactive patients and 12.3±5.7 mm (range 9-25 mm) for metastatic patients (p=0.016). However, other studies found no relationship between lymph node metastasis and lymph node diameters. Because of this, studies with larger series are needed. In the para-aortic group, it was 8.5±4.2 mm (range 1.5-18.75 mm) for reactive patients and 10.4±2.9 mm (range 6.5-14.5 mm) for metastatic patients (p=0.13). While metastatic lymph node diameters were larger in the pelvic group, no significant association was found between lymph node diameters and pathology in the para-aortic group.

Imaging results

In examining the pelvic area; for CT (n=14) sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were found to be 16.7%, 87.5%, 50% and 58.3%; for MRI (n=19) sensitivity, specificity, PPV and NPV were found to be 40%, 92.9%, % 66.7 and 81.3%; for PET (n=7) sensitivity, specificity, PPV and NPV were found to be 60%, 100%, 100%, 50% respectively. In examining the para-aortic area; for CT (n=18) sensitivity, specificity, PPV and NPV were found to be 20%, 92.3%, 50%, 75%; for MRI (n=30) sensitivity, specificity, PPV, NPV were found to be 25%, 96.2%, 50%, 89.3%; for PET (n=8) sensitivity, specificity, PPV and NPV were found to be 33.3%, 100%, 100% and 71.4% respectively (Table 2).

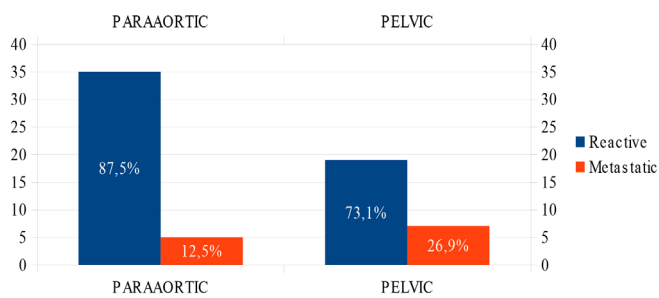


Figure 1. Metastatic and reactive lymph nodes rates of pelvic and para-aortic region according to pathologic findings

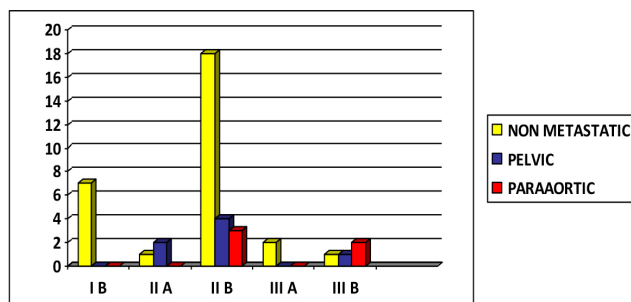


Figure 2. Lymph node status according to stages

Table 1. Pelvic and para-aortic metastasis rates according to stages (n=32)		
Lymphatic involvement according to the stages		
Stage	Pelvic (%)	Para-aortic (%)
IIA (n=3)	66.7	-
IIB (n=25)	16	12
IIIB (n=4)	25	50

Table 2. Sensitivity, specificity, PPV and NPV values of imaging methods for the pelvic and the para-aortic region

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Pelvic				
CT (n=14)	16.7	87.5	50	58.3
MRI (n=19)	40	92.9	66.7	81.3
PET (n=7)	60	100	100	50
Para-aortic				
CT (n=18)	20	92.3	50	75
MRI (n=30)	25	96.2	50	89.3
PET (n=8)	33.3	100	100	71.4

PPV: Positive predictive value, NPV: Negative predictive value, CT: Computed tomography, MRI: Magnetic resonance imaging, PET: Positron emission tomography.

Discussion

This study demonstrated that surgical staging remains the most valuable option for evaluating the nodal status of the retroperitoneum in cervical cancer. In particular, the laparoscopic approach stands out for enabling histopathological examination and faster recovery. Imaging methods, which offer an alternative way to evaluate the nodal status of the retroperitoneum, stand out as non-invasive methods. With technological advances in recent years, its effectiveness has increased, and PET/CT, in particular, has come to the fore in this field.

Surgical staging allows us to understand and accurately evaluate the spread of the disease in gynecological cancers. Because of the clinical staging used in previous years, staging errors could have occurred in patients with cervical cancer. In a recent study by Marnitz et al. (3), the operative staging showed an upstaging in 33% of the patients. Imaging methods such as CT, MRI, and PET were not included in the standard staging procedures in FIGO 2009 staging (4).

With FIGO 2018 (2), imaging methods have been included in staging procedures. This new staging system has introduced evaluation using appropriate ultrasonography and cross-sectional imaging methods, each of which may be superior in different stages and patients, rather than a single standard imaging method. Transrectal or TVUSG and cross-sectional imaging methods such as CT, MRI, and PET may be used (5). Today, hybrid molecular oncology imaging applications such as PET/MRI, where radiomic features are used, are also starting to enter our practical lives (6,7). PET technology, which has just begun to enter our lives in the 2000s, can further increase diagnostic performance in the oncological field with its rapid technological developments, such as the use of PET/MRI, time of flight-PET, and digital detectors (8). As imaging methods have developed, diagnostic parameters in MRI have changed. A meta-analysis conducted by Xiao et al. (9), showed that MRI imaging is consistent in determining stromal infiltration and parametrial invasion, but is limited in diagnosing lymph node involvement.

Woo et al. (10) evaluated the results of a meta-analysis comparing conventional and advanced imaging methods in

cervical cancer. MRI was found to be superior in determining local spread, but for nodal metastasis, CT, MRI, and PET were found to have low sensitivity and high specificity. This limitation in recognizing micro metastases still cannot replace lymphatic sampling for high-risk patients (10).

Although sensitivity and specificity have increased over the years, the order of the imaging methods has not changed. While CT has the lowest rate, PET has the best performance. With the advances in molecular imaging technology, fusion of PET and MRI has begun to give more detailed images with higher sensitivity and specificity; 84% and 90% for PET/CT and 9% and 93% for PET/MRI, respectively (11). In the literature, reported sensitivity and specificity for all three methods vary widely. The preoperative evaluation provided by imaging for detecting metastases remains suboptimal. Although it approaches the gold-standard test for pelvic evaluation, it remains far below the expected performance for the para-aortic region. In our study, PET imaging yielded the highest sensitivity and specificity values in both the pelvic and para-aortic regions. This was followed by MRI and CT. Sensitivity was slightly better in the pelvic region, while specificity was slightly better in the para-aortic region. The number of patients who underwent PET (n=8 for para-aortic evaluation) was very small. This small sample size limits statistical power, particularly for estimating sensitivity and PPV. Although PET demonstrated 100% specificity, its sensitivity was relatively low (33.3%). This may be due to small nodal size, micrometastases, or absence of the CT component.

There have been advances in both imaging and surgical methods. Primary surgical treatment is suitable for patients with early-stage disease. However, the majority of patients are at advanced stages. These patients with advanced-stage disease do not require surgical treatment, except for evaluation of nodal involvement. The laparoscopic approach prevents patients from experiencing the morbidity associated with laparotomy. Blood loss, major trauma, intraoperative and postoperative complications, immobilization, long-term hospitalization, prolonged recovery, delay in adjuvant treatment, and psychological effects are some of the extra burdens that major surgery brings to patients.

Extraperitoneal laparoscopic lymphadenectomy, introduced in the mid-1990s, shed new light on the staging of cervical cancer. The technique described by LeBlanc et al. (12) is a technique that can be quickly adapted, especially for those with experience in transperitoneal laparoscopic lymphadenectomy. Laparoscopic application is a method that should be preferred because it is more cosmetically acceptable, involves shorter hospitalization, allows quicker recovery, and facilitates final treatment planning.

In our study, we found shorter operation time, shorter hospitalization period, and a reduced need for narcotic analgesics in the laparoscopy group. Even with respect to the lymphadenectomy time and the number of para-aortic lymph nodes collected, the results were similar in both groups. These findings support the advantages of minimally invasive surgery.

In the study of Kerbage et al. (13), laparoscopic transperitoneal and extraperitoneal, robotic transperitoneal and extraperitoneal, and laparotomy were compared. They found that laparoscopy was associated with less blood loss, shorter operative time, and shorter hospitalization. Fewer complications were seen in the transperitoneal group than in the extraperitoneal group. Most complications were seen in the laparotomy group. Lymphoceles were the most common complication caused by the extraperitoneal approach, and they were commonly treated by marsupialization.

In our study, lymphocele formation was not observed in any patient because peritoneal marsupialization was performed routinely after the operation. However, we observed peritoneal defects in approximately 1/3 of the patients who underwent laparoscopy. Intraoperative intervention was sufficient in most cases, but we had to convert to laparotomy because the peritoneal defect adversely affected the procedure. Transfusion due to blood loss was more likely to occur during major surgery. The transfusion rate in the laparoscopy group was less than half that in the laparotomy group.

Disadvantages of laparotomy also include the formation of intestinal adhesions, intestinal complications due to immobilization resulting from radiotherapy, delays in initiating post-op radiotherapy while awaiting recovery, and difficulty in resection in obese patients. In the extraperitoneal laparoscopic approach, these problems do not exist because there are no intestines in the field (14).

Surgical staging has helped us detect upstaging, especially in locally advanced cervical cancer. Puga et al. (15), showed stage migration in 24% of the patients and change of the initially planned radiotherapy areas in 43% of the patients.

Thelissen et al. (16), reported upstaging in 11% of patients after negative imaging by para-aortic dissection. This rate increased to 21% in patients with para-aortic dissection with positive pelvic nodes but negative para-aortic nodes on imaging.

Marnitz et al. (3), found upstaging in 33% of patients through operative staging in the UTERUS-11 study. Laparoscopy did not delay the initiation of primary chemoradiotherapy because recovery after laparoscopy was rapid. Despite upstaging in 33% of patients with locally advanced cervical cancer, disease-free and overall survival rates were similar between surgical and clinical staging. The only benefit from surgical staging prior to primary chemoradiation was found in the patient group of FIGO stage IIB.

In our study, lymphatic metastasis was detected in 20% of early-stage and 25.8% of advanced-stage disease cases. These results are somewhat similar to the 33% staging error reported by Marnitz et al. (3,5).

The presence of para-aortic metastasis is important for determining the radiotherapy field. Radiology is less useful than histopathological examination for diagnosing small or microscopic diseases. Detailed microscopic examination and ultrastaging techniques can reveal micrometastatic disease. The term "low-volume metastases" refers to micrometastases and isolated tumor cells. Its incidence varies from 4% to 20% (17). In the SENTICOL 1 and 2 studies, serial sectioning for ultrastaging identified low-volume metastases in 7.5% of the patients. But there was no statistically significant difference in disease-free survival between the node-negative group and low volume metastases group (18). Buda's study reported the same result for relapse and disease-free survival. And they found micro metastases or isolated tumor cells in 3.6% of patients (19). On the contrary, Guani et al. (18) and Kocian et al. (20) have found negative effects on disease-free survival in the low-volume metastases group. This controversial situation has not yet been resolved. However, since ultra staging cannot be performed systemically on all lymph nodes, lower uptake may be observed in low-volume disease (21). Therefore, surgical staging and careful pathological evaluation are necessary to determine the extent of the disease and plan treatment.

With information obtained from the surgical-pathological examination, treatment can be personalized and clinical outcomes improved. Determining the para-aortic lymph node status prevents unnecessary or inadequate treatment of the para-aortic region. Contrary to previous studies showing that prophylactic extended-field radiotherapy does not improve survival and increases morbidity, recent studies suggest that the widespread use of PET/CT and advances in radiotherapy techniques make it unlikely that surgical identification and removal of microscopic nodal involvement will clearly improve oncological outcomes. The increasing use of intensity-modulated radiotherapy is associated with less toxicity and leads to questioning the future place of surgical staging (22).

Study Limitations

The limitations of the study are a small sample size and heterogeneity among the imaging groups. This may affect the sensitivity and specificity rates. Not all patients had undergone the same imaging method. Because PET scan was newly introduced for use in malignancies, there was no standard protocol for preoperative staging using imaging. Since it was not statistically powered, no comparisons were made between the imaging modalities. A striking aspect of the study is that it is one of the first to use laparoscopic extraperitoneal lymphadenectomy and oncologic PET scanning in Türkiye.

Conclusion

This study examined radiological and surgical methods for evaluating retroperitoneal lymphatic status in patients with cervical cancer. Para-aortic lymphatic involvement may affect the staging and treatment of locally advanced cervical cancer. Among the imaging methods, PET was found to be the most effective, followed by MRI and, finally, CT. Sensitivity and specificity were higher in the pelvic area, whereas imaging accuracy was lower in the para-aortic area. Although MRI and PET/CT are prominent imaging methods, surgical evaluation of the para-aortic area and histopathological results will continue to be the gold standard. Since lymphatic evaluation alone is sufficient in patients with advanced cervical cancer, minimally invasive laparoscopic extraperitoneal lymphadenectomy should be performed to surgically evaluate the para-aortic area and avoid exposing patients to the stress and trauma of major surgery.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from Gülhane Military Medical Academy (approval no: 1491-227-06, date: 22.05.2006), and institutional approval was granted by the Education and Planning Committee of Etilik Zübeyde Hanım Women's Health Training and Research Hospital (approval no: 73, date: 24.05.2006).

Informed Consent: This retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: T.Ç., F.K., M.C.Y., Concept: T.Ç., F.K., M.C.Y., Design: T.Ç., F.K., M.C.Y., Data Collection or Processing: T.Ç., F.K., M.C.Y., Analysis or Interpretation: T.Ç., F.K., M.C.Y., Literature Search: T.Ç., F.K., M.C.Y., Writing: T.Ç., F.K., M.C.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

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