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The relationship of pre-operative laboratory parameters with endometrial cancer and prognostic factors

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Ethics Committee Approval
This study was approved by the Bursa Yüksek İhtisas Training and Research Hospital ethical committee with numbered 2011-KAEK-25 2020/06-20.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Endometrial cancer, like many other malignancies, is associated with an inflammatory process, and complete blood count parameters have been studied as markers numerous times. Our study aimed to evaluate whether pre-operative complete blood count and biochemical parameters are related to some prognostic markers and stage of the disease in patients who underwent surgery for endometrial cancer.
Methods: One hundred seventy-five patients diagnosed with endometrial cancer operated in our clinic between January 2017 and December 2019 were evaluated in this retrospective cross-sectional study. We analyzed complete blood count parameters including hemoglobin, white blood cell count, platelet count, neutrophil count and percentage, lymphocyte count and percentage, mean corpuscular volume, mean platelet volume, red blood cell distribution width (RDW), neutrophil-lymphocyte ratio (NLR), platelet lymphocyte ratio (PLR), and other biochemical parameters. Statistical methods were used to investigate their relationship with prognostic parameters such as tumor diameter, differentiation, and type, myometrial invasion, and FIGO stage. Long-term survival could not be examined because the long-term follow-up of patients was not available in the database.
Results: One hundred seventy-five patients were included in the study. The mean age of our patients was 61.3 (9.3) years. While the degree of myometrial invasion of the tumor was positively correlated with the patient's age, red cell distribution width, and NLR, it was negatively correlated with hemoglobin value, and lymphocytes percentage. We divided the patients into two groups as those with less and more than ½ thickness myometrial invasion. Age, red cell distribution width, NLR and PLR were higher in the group with more invasion ($P<0.05$ for all), and lower in type 1 endometrial cancer compared to type 2 ($P<0.05$ for all). MPV values were lower in grade 3 tumors compared to grades 1 and 2 ($P=0.022$), while neutrophil count was highest in patients with grade 3 tumors ($P=0.023$). According to our regression analysis, each 1-unit increase in the NLR predicted 1.06 times increased invasion of more than ½ of the myometrium ($P=0.05$).
Conclusion: The use of pre-operative complete blood count, liver, and kidney enzyme parameters may give an idea about the prognostic components, and stage of the disease in patients with a diagnosis or suspicion of endometrial cancer.

Keywords: Endometrial cancer, Complete blood count, Hemoglobin, Lymphocyte, Platelet

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Introduction

Endometrial cancer is the most common gynecological cancer in high-income countries, and the second most common gynecological cancer worldwide after cervical cancer [1].

Risk factors for endometrial carcinoma are an excess of endogenous or exogenous estrogen without sufficient opposition from progestin. Other risk factors include tamoxifen therapy, increasing age, early menarche, obesity, nulliparity, diabetes mellitus, and hypertension, as well as genetic risk factors, such as Lynch syndrome [2].

Malignant tumors of the female genital tract are important causes of death worldwide [3]. Immune cells, and the inflammatory system plays multifaceted roles [4]. Virchow demonstrated the presence of leukocytes in neoplastic tissue. In 1876, he showed that cancer is affected by a systemic inflammatory response [5]. The response to inflammation involves some alterations. One of these changes associated with the hematopoietic system is related to leukocyte, and platelet levels [6]. Tumor tissue hosts leukocytes which have crucial inflammatory roles, and platelets are important sources of angiogenetic cytokines. Both are critically essential in tumor progression and overall survival through the triggering of inflammatory mechanisms [5].

Studies show that absolute neutrophil count (ANC), absolute monocyte count (AMC), absolute lymphocyte count (ALC), NLR, monocyte-lymphocyte ratio (MLR), and PLR are significantly associated with different types of solid tumors like cervical, endometrial, and ovarian cancers [7, 8].

Complete blood count (CBC) is routinely performed during the pre-operative assessment of patients with cancer. ALC, AMC, NLR, PLR, Mean Platelet Volume (MPV), Mean Corpuscular Volume (MCV), Hemoglobin (Hb), Platelets (Plt), White Blood Cell (WBC), and RDW parameters reflect the inflammatory, and procoagulant states in cancer.

Increase in absolute neutrophil count and a decrease in absolute lymphocyte count results in NLR increase. Some studies found that NLR was associated with some types of cancer and progression of the disease [9–12].

PLR is defined as absolute platelet count divided by absolute lymphocyte count. Platelet count is a finding of systemic inflammation and can be used to distinguish cancer from benign pathologies. However the platelet-lymphocyte ratio (PLR) is an inflammatory marker and studied in malign tumors [13–16].

Platelets are studied in some studies on cancer. Thrombocytosis is reportedly associated with the development cancer and its progression [17, 18].

Fibrinogen is essential for coagulation cascade and inflammatory response. Plasma fibrinogen levels are correlated with systemic inflammatory diseases, tumors, and their progression [19–22].

This study aimed to determine the best predictor of clinicopathological features between pre-operative CBC-derived inflammatory biomarkers and endometrial cancer.

Materials and methods

We conducted this retrospective cross-sectional study at Health Sciences University Bursa Yüksek İhtisas Training and Research Hospital, Department of Obstetrics and Gynecology, Bursa, Turkey. The study groups consisted of patients who were treated for endometrial cancer between September 2016 and June 2019. This study was approved by Bursa Yüksek İhtisas Training and Research Hospital Ethics Committee with the number 2011-KAEK-25 2020/06-20.

Patients with incomplete pre-operative complete blood count data, a history of other cancers, splenectomy, chemotherapy and radiotherapy, steroid use, chronic systemic diseases, known myeloproliferative diseases and those with documented vitamin B12 or folate deficiencies were excluded from the study.

We analyzed one hundred and seventy-five patients diagnosed with endometrial cancer and evaluated hemoglobin values, white blood cell, thrombocyte, neutrophil, lymphocyte, mean erythrocyte volume, mean platelet volume, and erythrocyte distribution volume, which were examined within the last month before the operation. Also, the relationship between NLR, which is the division of neutrophil count to lymphocyte count, and PLR, which is the division of the platelet count to the lymphocyte count, with prognostic parameters such as tumor diameter, tumor differentiation, tumor type, myometrial invasion and FIGO stage were studied using statistical methods.

We classified endometrium cancer histomorphologically as Type-1 and Type-2 according to the Bokhman classification [23].

Statistical analysis

Windows-based SPSS 24.0 statistical analysis program (SPSS Inc., USA) was used for statistical analyses. Variables were examined visually (histograms, probability charts) and using analytical methods (Shapiro-Wilk test) to determine whether the data showed normal distribution. In descriptive analyses, variables were presented as mean (standard deviation), median (minimum-maximum (min-max)), U value, frequency (n), and percentage (%) at 95% confidence interval (95% CI). Student t-test and Mann-Whitney U tests compared normally and non-normally distributed variables, respectively, in the two-group analysis. ANOVA and Kruskal Wallis tests analyzed variables involving more than two groups. Pearson and Spearman's tests were performed to show the correlations between normally and non-normally distributed variables, respectively. First, univariate analyses were used to determine the degree of myometrial invasion of the endometrial tumor, tumor type, and variables predicting differentiation. Independent predictors were examined by including variables with $p < 0.25$ in univariate analyses into multivariate analyses, in which the ENTER method was used. The compatibility of the models with the data was evaluated with the Hosmer-Lemeshow test. A multivariate linear regression model was used to evaluate the effect of parameters on tumor size. Ordinal regression model evaluated the effects of the parameters on tumor stage according to FIGO classification. The cases where the type 1 error level was below 5% were considered statistically significant.

Results

The demographic and laboratory characteristics and descriptive analyses of the patients are presented in Table 1. The mean age of one hundred seventy-five patients included in the study was 61.3 (9.3) years.

Table 1: Descriptive analysis of data

	Endometrial cancer (n=175)
Characteristics and Laboratory data	Mean (SD) Median (min-max)
Age*	61.26 (9.3)
Duration of hospitalization (day)	7 (45-3)
Hemoglobin (g/dl)	12.6 (17.3-6.3)
Mean corpuscular volume (fl)	84.2 (58.6-97.5)
Mean platelet volume (fl)*	9.11 (1.2)
Red cell distribution width (%)	14.1 (30.7-11.6)
Neutrophil count (10^3/ml)	5.2 (23.9-1.6)
Lymphocyte count (10^3/ml)	2 (8-0.3)
Neutrophil percentage (%)*	66.8 (11.2)
Lymphocyte percentage (%)	25.9 (67.6-2.4)
White blood cell (mcl)*	9.800 (7.700)
Platelets (mcl)	287.000 (728.000-135.000)
Creatinine (mg/dl)	0.8 (9-0.3)
Alanine Transaminase (ALT) (u/l)	16 (114-1)
Aspartate Transaminase (AST) (u/l)	20 (375-4)
Plasma glucose level (mg/dl)	113 (286-67)
Fibrinogen	346 (712-167)
Neutrophil/Lymphocyte Ratio	2.5 (45.3-0.7)
Platelet/Lymphocyte Ratio	140 (703-36)
Tumor Diameter (cm)	4 (30-0.3)

g/dl: gram/deciliter, fl: femtolitre, ml: milliliter, mcl: microliter, %: percent, cm: centimeter, SD: standard deviation, min: minimum, max: maximum. Descriptive analyses were performed using mean and standard deviation, marked as * for normally distributed data, and median and minimum-maximum values (median (min-max)) for non-normally distributed data.

As shown in Table 2, the patients' pre-operative hemoglobin level and erythrocyte distribution width (RDW) were correlated with FIGO staging, tumor size, myometrial tumor invasion, tumor differentiation, and tumor type (P<0.05 for each). Tumor invasion of myometrium was correlated with patient age, lymphocyte percentage, and NLR (P<0.05 for each), and lymphocyte percentage, NLR, alanine transaminase, and fasting blood glucose levels were significantly correlated with tumor differentiation (P<0.05 for each).

Table 2: Correlation analysis between tumor characteristics and patient findings

	FIGO stage		Tumor Size		Differentiation		Tumor Type		Myometrial Invasion	
	r	*P*	r	*P*	r	*P*	r	*P*	r	*P*
Age*	0.13	0.08	-0.01	0.89	0.12	0.10	0.16	0.02	0.18	0.02
Duration of hospitalization (day)	0.06	0.41	0.01	0.84	0.2	0.009	0.07	0.36	0.06	0.39
Hemoglobin (g/dl)	-0.025	0.001	-0.15	0.04	-0.29	<0.001	-0.15	0.05	-0.22	0.004
Mean corpuscular volume (fl)	-0.08	0.34	-0.13	0.08	-0.1	0.20	-0.06	0.45	-0.1	0.19
Mean platelet volume (fl)*	0.06	0.43	-0.08	0.29	-0.12	0.11	0.001	0.98	0.01	0.84
Red cell distribution width (%)	0.16	0.03	0.2	0.008	0.27	<0.001	0.19	0.01	0.18	0.02
Neutrophil count (10^3/ml)	0.10	0.17	0.03	0.69	0.11	0.14	0.07	0.36	0.12	0.09
Lymphocyte count (10^3/ml)	-0.13	0.08	-0.08	0.32	-0.10	0.15	0.06	0.45	-0.11	0.14
Neutrophil percentage (%)*	0.1	0.19	0.03	0.66	0.13	0.09	0.02	0.98	0.12	0.11
Lymphocyte percentage (%)	-0.16	0.03	-0.09	0.25	-0.18	0.02	-0.01	0.89	-0.17	0.03
White blood cell (mcl)	0.1	0.19	0.02	0.79	0.1	0.21	0.09	0.24	0.08	0.29
Platelets (mcl)	0.08	0.28	0.02	0.81	0.08	0.30	0.02	0.81	0.05	0.47
Creatinine (mg/dl)	0.03	0.70	0.07	0.32	0.004	0.96	0.004	0.96	0.11	0.13
Alanine Transaminase (ALT) (u/l)	-0.25	0.001	-0.16	0.04	-0.21	0.004	-0.14	0.07	-0.12	0.09
Aspartate Transaminase (AST) (u/l)	-0.09	0.26	-0.07	0.33	-0.1	0.23	-0.07	0.38	0.003	0.97
Plasma glucose level (mg/dl)	-0.08	0.27	-0.03	0.69	-0.23	0.002	-0.09	0.24	-0.1	0.19
Fibrinogen	0.02	0.81	-0.14	0.07	0.01	0.90	-0.03	0.72	0.02	0.77
Neutrophil/Lymphocyte Ratio	0.13	0.08	0.08	0.29	0.15	0.05	-0.01	0.87	0.17	0.03
Platelet/Lymphocyte Ratio	0.18	0.02	0.10	0.15	0.17	0.02	-0.01	0.84	0.14	0.06

gr: gram, ml: milliliter, dl: deciliter, mcl: microliter, u: unit, r: correlation coefficient. P<0.05 was considered significant. (*: Pearson test, other Spearmen test)

As shown in Table 2, the type of endometrial tumors (Types 1 and 2) and the patient's age were correlated (P=0.02). Alanine transaminase enzyme was correlated with tumor size and FIGO stage, and lymphocyte percentage and PLR were correlated with the stage in endometrial cancers (P<0.05 for each).

The probability of tumoral invasion of more than ½ of the myometrium increases with age. Hemoglobin and RDW also affect myometrial invasion. As the percentage of lymphocytes increases, the possibility of myometrium invasion decreases. This reflects in the NLR and the PLR, creating a significant difference (P<0.05 for each) (Table 3).

Table 3: Comparison of laboratory parameters in terms of myometrial invasion

	Myometrial Invasion is less than ½ (n = 90) Mean (SD) Median (min-max)	Myometrial Invasion is more than ½ (n = 85) Mean (SD) Median (min-max)	*P*-value
Age*	59.7 (8.9)	62.9 (9.5)	0.02
Duration of hospitalization (day)#	7 (3-45)	7 (3-22)	0.39
Hemoglobin (g/dl)#	13.1 (7.4-15.6)	12 (6.3-17.3)	0.02
Mean corpuscular volume (fl)#	84.7 (58.6-94.5)	83.7 (63.8-97.5)	0.18
Mean platelet volume (fl)*	9.0 (1.3)	9.1 (1.1)	0.79
Red cell distribution width (%)#	13.7 (12-27.6)	14.4 (11.6-30.7)	0.02
Neutrophil count (10^3/ml)#	5.2 (1.6-15.4)	5.4 (2-24)	0.98
Lymphocyte count (10^3/ml)#	2 (0.4-8)	1.9 (0.3-4.1)	0.14
Neutrophil percentage (%)*	65.4 (10.6)	68.3 (11.9)	0.09
Lymphocyte percentage (%)#	26.7 (4.3-67.6)	23.7 (2.4-45.7)	0.03
White blood cell (mcl)#	8.290 (3.400-18.600)	8.770 (4.300-19.900)	0.29
Platelets (mcl)#	280.000 (136.000-553.000)	299.000 (13.5000-728.000)	0.47
Creatinine (mg/dl)#	0.79 (0.3-9)	0.82 (0.6-4.8)	0.13
Alanine Transaminase (ALT) (u/l)#	17 (6-62)	16 (1-114)	0.09
Aspartate Transaminase (AST) (u/l)#	20 (9-99)	21 (4-375)	0.97
Plasma glucose level (mg/dl)#	122 (76-286)	112 (67-258)	0.19
Fibrinogen#	344 (186-644)	350 (167-712)	0.05
Neutrophil/Lymphocyte Ratio#	2.4 (0.7-24.2)	2.8 (1-45.3)	0.03
Platelet/Lymphocyte Ratio#	136.9 (36.8-610)	153.4 (40.9-703.3)	0.05

Descriptive analyses were performed using mean and standard deviation, marked as * for normally distributed data, and median and minimum-maximum values (median (min-max)) for non-normally distributed data. *P*-value <0.05 was considered significant. (*: t-test, #: Mann Whitney U)

Analysis according to the type of endometrial cancer is examined in Table 4. Patients with type 1 endometrial cancer constitute a significantly younger population than those with type 2 (P=0.048). While hemoglobin and lymphocyte percentage parameters measured before surgery are lower in patients with type 2 endometrial cancer, RDW, platelet/lymphocyte ratio, and neutrophil/lymphocyte ratios are higher (P<0.05 for all).

Table 4: Comparison of parameters in terms of endometrial cancer typing

	Type 1 Endometrial Cancer (n=142) Mean (SD) Median (min-max)	Type 2 Endometrial Cancer (n=33) Mean (SD) Median (min-max)	*P*-value
Age*	60.6 (9)	64.1 (10.2)	0.048
Duration of hospitalization (day)#	7 (3-45)	8 (4-22)	0.36
Hemoglobin (g/dl)#	12.7 (6.3-17.3)	11.8 (6.5-14.4)	0.05
Mean corpuscular volume (fl)#	84.4 (58.6-97.5)	83.6 (68.2-93.7)	0.46
Mean platelet volume (fl)*	9.1 (1.2)	9.1 (1.3)	0.82
Red cell distribution width (%)#	13.9 (11.6-30.7)	14.6 (12.6-28.1)	0.01
Neutrophil count (10^3/ml)#	5.2 (1.6-23.9)	5.4 (2-20)	0.36
Lymphocyte count (10^3/ml)#	2 (0.4-8)	2.1 (0.3-3.9)	0.44
Neutrophil percentage (%)*	66.8 (11.2)	66.7 (11.6)	0.96
Lymphocyte percentage (%)#	26.7 (4.3-67.6)	23.7 (2.4-45.7)	0.03
White blood cell (mcl)#	8.290 (3.400-18.600)	8.770 (4.300-19.900)	0.29
Platelets (mcl)#	280.000 (136.000-553.000)	299.000 (135.000-728.000)	0.47
Creatinine (mg/dl)#	0.79 (0.3-9)	0.82 (0.6-4.8)	0.13
Alanine Transaminase (ALT) (u/l)#	17 (6-62)	16 (1-114)	0.09
Aspartate Transaminase (AST) (u/l)#	20 (9-99)	21 (4-375)	0.97
Plasma glucose level (mg/dl)#	122 (76-286)	112 (67-258)	0.19
Fibrinogen#	344 (186-644)	350 (167-712)	0.77
Neutrophil/Lymphocyte Ratio#	2.4 (0.7-24.2)	2.8 (1-45.3)	0.03
Platelet/Lymphocyte Ratio#	136.9 (36.8-610)	153.4 (40.9-703.3)	0.05

Descriptive analyses were performed using mean and standard deviation, marked as * for normally distributed data, and median and minimum-maximum values (median (min-max)) for non-normally distributed data. *P*-value <0.05 was considered significant. (*: t-test, #: Mann Whitney U)

We divided the patients into three groups according to differentiation: Grade 1 indicated high differentiation, Grade 2, moderate differentiation and Grade 3, poor differentiation. As shown in Table 5, Hb, MPV, RDW, ALT, Fasting blood glucose,

Lymphocyte percentage, NLR, and PLR significantly differed between the groups (P<0.05 for each). Post-hoc evaluation of the groups in pairs showed that MPV, Hb, lymphocyte percentage, fasting blood glucose, and PLR significantly differed between grade 1 and 2 tumor groups (P<0.05 for each), while only hemoglobin value significantly differed between Grade 1 and Grade 3 groups (P=0.01).

Binary logistic regression was used to determine the independent predictors of more than ½ thickness myometrial invasion. Accordingly, as NLR increased, so did the chances of more than ½ thickness myometrial tumor invasion (P=0.05) (Table 6).

Table 5: Comparison of laboratory parameters in terms of tumor differentiation

	Grade 1 (n=92) Mean (SD) Median (min-max)	Grade 2 (n=58) Mean (SD) Median (min-max)	Grade 3 (n=25) Mean (SD) Median (min-max)	*P*-value	*P*-value Grade1 & Grade2	*P*-value Grade1 & Grade3
Age*	60.4 (8.2)	61.8 (10.4)	63.4 (10.9)	0.30		
Duration of hospitalization (day)#	7 (3-45)	8 (4-33)	7 (4-22)	0.12		
Hemoglobin (g/dl)#	13 (6.3-17.3)	12.1 (6.5-15.1)	11.7 (8.1-14)	0.001	0.02	0.01
Mean corpuscular volume (fl)#	84.7 (60.7-97.5)	83.8 (58.6-94.3)	83 (68.2-98)	0.45		
Mean platelet volume (fl)*	9.3 (1.2)	8.8 (1.18)	9.2 (1.28)	0.02	0.02	0.959
Red cell distribution width (%)#	13.6 (11.6-31.7)	14.3 (12.6-27.1)	14.8 (12.6-28.1)	0.002	0.23	0.11
Neutrophil count (10^3/ml)#	5 (2.5-15.4)	5.4 (1.6-23.9)	6.3 (2-20)	0.31		
Lymphocyte count (10^3/ml)#	2 (0.5-8)	1.9 (0.4-5.5)	2.1 (0.3-3.9)	0.07		
Neutrophil percentage (%)*	65.6 (10.8)	68.3 (11.7)	67.9 (11.9)	0.29		
Lymphocyte percentage (%)#	27.9 (4.2-67.6)	23.4 (3.6-47.2)	21.9 (2.4-39.9)	0.03	0.04	0.36
White blood cell (mcl)#	8.1 (5-18.6)	8.3 (3.4-19.9)	9.6 (4.3-24.2)	0.41		
Platelets (mcl)#	285 (135-553)	282 (181-685)	300 (162-725)	0.59		
Creatinine (mg/dl)#	0.81 (0.3-9)	0.78 (0.5-1.6)	0.8 (0.6-3.2)	0.98		
Alanine Transaminase (ALT) (u/l)#	19 (1-64)	15 (5-44)	13 (5-114)	0.02	0.07	0.98
Aspartate Transaminase (AST) (u/l)#	21 (4-85)	21 (8-375)	19 (11-135)	0.43		
Plasma glucose level (mg/dl)#	125 (76-282)	109 (78-286)	101 (67-264)	0.01	0.03	0.07
Fibrinogen#	346 (176-654)	344 (189-712)	355 (167-491)	0.82		
Neutrophil/Lymphocyte Ratio#	2.2 (0.7-24.2)	2.8 (0.9-25.6)	2.7 (1.1-45.3)	0.05	0.17	0.62
Platelet/Lymphocyte Ratio#	127.8 (36.8-494)	156.9 (51.8-620)	142.3 (67.1-703.3)	0.01	0.04	0.52

Descriptive analyses were performed using mean and standard deviation, marked as * for normally distributed data, and median and minimum-maximum values (median (min-max)) for non-normally distributed data. *P*-value <0.05 was considered significant. (*: One Way ANOVA, #: Kruskal Wallis) Tukey tests were used in cases where variances were homogeneously distributed from post hoc tests and Games-Howell tests were used in cases where they were not homogeneously distributed for the double group analysis of the results that were significant in multiple analysis. Homogeneity of variances was evaluated by Levene test.

Table 6: Binary logistic regression analysis results in terms of prediction of myometrial Invasion

Myometrial Invasion	Wald	OR	95% CI	*P*-value
Hemoglobin (g/dl)	3.65	0.869	0.714-0.924	0.05
Neutrophil/Lymphocyte Ratio	2.49	1.069	0.886-0.940	0.05

GA (95%); confidence interval; OR: odds ratio. Wald: test statistic value. Binominal logistic regression was used because the dependent variable consists of 2 groups. The reference group was the one with less than ½ myometrial invasion. Variables with P<0.25 in univariate analysis were included in the multivariate analysis. The Backward LR method was used in binary analysis. In the Hosmer-Lemeshow test, P is >0.05 and the models fit well with the data.

Discussion

The impact of inflammation in various cancers, including cancer initiation, development, progression, and metastasis, has recently been described [24]. Since the association between cancer and inflammation was first reported, many studies have been conducted on this subject. Today, we know that many cells we evaluate with complete blood count play a role in the chronic inflammatory pathway. However, the relationship between cancer and inflammation is frequently mentioned in the literature. Studies on this are gradually increasing and becoming remarkable [25–27].

Endometrial carcinoma is the most common malignancy among gynecological neoplasms. Studies show that proinflammatory cytokines could stimulate aromatase activity in the adipose tissue, increasing estrogen production and bioavailability. Inflammatory markers can be elevated in endometrial cancer patients [28, 29].

In studies conducted on patients with endometrial cancer, various complete blood parameters such as WBC count, PDW, MPV, platelet, and NLR are higher. There are even reports that some of these values affect tumor stage, differentiation, and lymph node invasion. In other words, complete blood parameters can be a useful diagnostic or screening tool in patients with endometrial cancer [30–33]. Kemal et al. defined the association between red blood cell distribution width and endometrial cancer [34]. Takahashi R. et al. found that thrombocytosis and neutrophilia are associated with poor prognosis in stage 3 and 4 endometrial cancer patients [35]. Njølstad et al. [36] and Luomaranta et al. [37] determined that pre-operative anemia, leukocytosis, or thrombocytosis is related to endometrial cancer and its poor prognosis with distant metastasis. Temur et al. [38] found that pre-operative NLR and PLR values are essential in endometrium cancer in predicting poor prognostic factors, including advanced-stage disease, deep myometrial invasion, cervical and nodal involvement. Zhou et al. [39] stated that pre-operative higher fibrinogen values can predict possible lymphovascular invasion in endometrial cancer.

Our study determined that some of the complete blood parameters we examined pre-operatively may be related to endometrial cancer, stage of the disease, and prognostic factors. The tumor stage may be increased with decreased hemoglobin value and lymphocyte percentage, and increased red cell distribution width. It may also indicate an increased risk of more than ½ thickness myometrial invasion and poor differentiation. Tumor myometrium invasion may increase with higher NLR and PLR. Fittingly, these two parameters were lower in well-differentiated tumors. We also found that more than ½ thickness myometrial invasion is more likely with increased plasma fibrinogen levels. Mean platelet volume levels significantly differed in terms of tumor differentiation among the three groups. There were few significant studies in which MPV values were associated with endometrial cancer and advanced stage. However, this is perhaps the first study to demonstrate the relationship between MPV and the degree of tumor differentiation.

In our study, lower hemoglobin values and higher NLR were highly predictive of more than ½ thickness myometrial invasion, which is one of the poor prognostic factors in endometrial carcinoma. Studies in the literature show the relationship of endometrial cancer with inflammatory markers and its poor prognostic status in the presence of anemia, both of which were supported by our results. We think that our study will contribute to the literature in terms of the multifaceted effects of inflammation on endometrial cancer.

Evaluation of the patients according to Bokhman's histomorphological classification showed that RDW, NLR, and PLR values were higher in patients with type 2 endometrial cancer, while hemoglobin and lymphocyte percentages were lower. This may give the surgeon an idea, especially in patients who are scheduled for frozen examination or lymph node dissection during surgery. Analyses with more patients are needed.

The most important limitations of this study include its retrospective single-center design and relatively small patient size. However, the present study is the first to report the usability of the hemoglobin, neutrophil, and lymphocyte count for detecting myometrial invasion of endometrial cancer and type of disease.

Conclusion

Our study showed the potential predictive and prognostic roles of complete blood count parameters in endometrium cancer. Hemoglobin, RDW, NLR, lymphocyte percentage, and MPV were significant prognostic parameters of endometrial cancer. As complete blood count levels can be routinely determined pre-operatively, these low-cost and readily available parameters may be novel and promising markers to predict poor prognosis. However, comprehensive studies on different histological subtypes or gynecological cancers are necessary to further determine these tests' use for malignancies.

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