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Prognostic Significance of Preoperative Inflammatory Markers in Thyroid Follicular Neoplasms: Focus on Neutrophil-to-Lymphocyte and Platelet-to-Lymphocyte Ratios

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ABSTRACT

Objective: Thyroid nodules are common, and assessing their malignancy risk is important for effective management. This study examined the diagnostic significance of preoperative inflammatory markers, particularly the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), in predicting malignancy in thyroid follicular neoplasms.

Materials and Methods: We conducted a retrospective review of 150 patients with thyroid nodules who underwent total thyroidectomy. Nodules were classified as benign or malignant based on postoperative pathology. Demographic data, radiological findings, tumor size, and preoperative blood samples were analyzed, with a focus on NLR, PLR, and other inflammatory markers, to evaluate their potential in predicting malignancy.

Results: Of the 150 patients, 89 met the inclusion criteria: 51 benign and 38 malignant cases. Platelet counts were significantly higher in malignant cases (p=0.015). NLR values were greater in patients with solitary nodules compared to those with multifocal nodules (p=0.027). No significant association was found between nodule size and malignancy (p=0.797). Thyroid-stimulating hormone (TSH) levels were higher in nodules smaller than 4 cm (p=0.002). Microcalcifications were significantly associated with malignancy (p=0.014).

Conclusion: This study indicates that while NLR and PLR have limited predictive value for malignancy in thyroid follicular neoplasms, platelet counts and microcalcifications are significant indicators. These findings may assist in guiding clinical decisions regarding the management of thyroid nodules.

Keywords: Follicular neoplasm, follicular thyroid carcinoma, NLR, PLR, thyroid nodule.

INTRODUCTION

Thyroid nodules are among the most prevalent endocrine disorders, involving the abnormal growth of thyroid cells that form a lump in the thyroid gland. These typically asymptomatic lumps are often detected during physical examinations or incidentally on imaging studies.

Fine-needle aspiration (FNA) is the primary diagnostic method for thyroid nodules; however, it has limitations in detecting thyroid follicular neoplasms, which account for 10–12% of thyroid malignancies.[1,2] Ultrasonography and pathological features, such as vascular invasion, can help predict the likelihood of malignancy in thyroid nodules and their subsequent clinical outcomes.[3–7] Various inflammatory markers may also have potential diagnostic value in indicating malignancy in neoplasms.[8,9] The presence of tumor-infiltrating lymphocytes and neutrophils is associated with the enhancement of immune responses and cytokine production.[10,11] In addition, malignant cells stimulate platelet production, which promotes tumor growth, tissue invasion, and cancer cell dissemination.[12]

This study investigated blood inflammatory markers associated with thyroid follicular neoplasms. Specifically, it evaluated the levels of inflammatory markers, including the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), in follicular thyroid nodules and assessed their role in predicting the final pathological diagnosis of follicular thyroid neoplasms.

KEY MESSAGES

- Platelet count and microcalcifications were significantly associated with malignancy in thyroid follicular neoplasms.
- Neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) did not reliably predict malignancy.
- Platelet count and microcalcifications may serve as useful markers to improve diagnostic accuracy in thyroid neoplasms.

MATERIALS AND METHODS

Study Design and Participant Selection

This cross-sectional descriptive study involved 150 patients aged 18 to 65 years with thyroid nodules who underwent thyroid surgery at Imam Reza Hospital, Tabriz University of Medical Sciences, Iran, between April 2019 and September 2022. After surgery, patients were classified as having benign (follicular adenoma) or malignant thyroid follicular neoplasms based on postoperative pathology results, which considered the presence of capsular and/or vascular invasion.

Ethical Approval

The study was approved by the local ethics committee of Tabriz University of Medical Sciences, Iran (Code: IR.TBZMED.REC.1402.054, Approval Date: April 17, 2023).

Data Collection

Demographic data, including sex, age, weight, and medical history, were extracted from patients' medical records. Patients were excluded if they did not have a final diagnosis of follicular adenoma or carcinoma, or if they had underlying infectious or hematological conditions, other associated malignancies, a history of head and neck radiation, coronary artery disease, autoimmune disorders, liver or kidney dysfunction, or long-term use of medications such as steroids.

Radiological data were collected, including nodule echogenicity, ultrasound appearance (solid, cystic, or mixed solid-cystic), number of nodules (single or multiple), presence of microcalcifications, and nodule dimensions and location. These parameters were analyzed to assess features potentially associated with malignancy.

Laboratory Parameters

Preoperative blood samples were obtained from all patients to perform a complete blood count (CBC), which included measurements of white blood cells, monocytes, lymphocytes, neutrophils, and platelets, along with hemoglobin concentration. Additional tests included C-reactive protein (CRP) and thyroid profiles (free triiodothyronine [FT3], free thyroxine [FT4], and thyroid-stimulating hormone [TSH]) with reference ranges of FT3: 2.3–4.2 pg/mL, FT4: 0.8–1.8 ng/dL, and TSH: 0.4–4 mIU/L. Inflammatory markers, such as NLR and PLR, were determined by calculating the ratio of the total neutrophil count to the lymphocyte count and the total platelet count to the lymphocyte count, respectively. These ratios were compared with pathology results to assess their prognostic value in predicting malignancy in thyroid follicular neoplasms.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics, version 26. The Kolmogorov-Smirnov test was applied to assess the normality of quantitative variables. Qualitative data were presented as frequencies and percentages. Quantitative variables with a normal distribution were summarized using the mean and standard deviation, whereas non-normally distributed variables were summarized using the median (25^{th} and 75^{th} percentiles). For qualitative data analysis, the chi-square test was applied; when not applicable, Fisher's exact test was used. For comparing quantitative data between two groups, the independent t-test was employed for normally distributed variables, and the Mann-Whitney test was used for non-normally distributed variables. To compare quantitative data across multiple groups, one-way analysis of variance (ANOVA) with Tukey's post-hoc test was applied for normally distributed data, while the Kruskal-Wallis test was used for non-normally distributed data. A p-value of <0.05 was considered statistically significant.

RESULTS

From the initial 150 participants, 89 patients met the study criteria: 51 had benign masses and 38 had malignant masses. A total of 61 patients were excluded due to incomplete data or the absence of a pathological diagnosis of thyroid follicular neoplasms. The mean age of patients in this study was 41.59±10.9 years, and 71 patients (79.8%) were female.

Imaging and Nodule Characteristics

The imaging results, nodule size, blood inflammatory markers, thyroid profile, type of surgery, and pathology findings for the patients are presented in Table 1.

Blood Inflammatory Markers and Malignancy

Analysis of blood inflammatory markers as potential indicators of malignancy in thyroid follicular tumors revealed that only the platelet count was higher in patients with malignant tumors compared to those with benign tumors (p=0.015) (Table 2).

Nodule Size and Malignancy

The association between nodule size (<4 cm and ≥4 cm) and malignancy was not significant when comparing patients with malignant tumors to those with benign tumors (p=0.797). None of the blood inflammatory markers or thyroid profile results showed a statistically significant correlation with nodule echogenicity or ultrasound appearance (p>0.05) (Table 3).

Nodules and Blood Inflammatory Markers

Analysis of the relationship between blood inflammatory markers and multifocal nodules revealed that the NLR was significantly higher in patients with solitary nodules compared to those with multifocal nodules (p=0.027) (Table 4). The presence of microcalcifications within the thyroid demonstrated a statistically significant association with malignancy in thyroid follicular neoplasms (p=0.014).

TSH Levels

Evaluation of laboratory parameters showed that TSH levels were significantly higher in individuals with nodules <4 cm compared to those with nodules ≥4 cm (p=0.002) (Table 5).

DISCUSSION

Previous studies have supported the role of inflammatory processes in predicting malignancy in thyroid nodules.[8,9] Systemic inflammatory markers such as NLR and the PLR have also been linked to cancer progression.[13,14] Currently, no universally accepted algorithm exists for the preoperative diagnosis of thyroid follicular neoplasms that incorporates blood inflammatory markers in patients with thyroid

Table 1. Evaluation of imaging findings, blood parameters and outcome in the studied subjects

Variant	n (%): 89 (100%)
Echogenicity	n=88/89
Hypoechoic	36 (40.4)
Hyperechoic	11 (12.4)
Isoechoic	29 (32.6)
Mixed-echoic	12 (13.5)
Sonographic view	n=88/89
Solid	65 (73.0)
Cystic	6 (6.7)
Solid-cystic	17 (19.1)
Nodule	n=87/89
Solitary	51 (57.3)
Multinodular	36 (40.4)
Microcalcification	n: 87/89
Negative	68 (76.4)
Positive	19 (21.3)
Nodule size (cm)	n=86/89
<4 cm	61 (68.5)
≥4 cm	25 (28.1)
CBC, and inflammatory markers	
WBC	7.70 (±1.6)
Neutrophil	4.58 (±1.5)
Lymphocyte	2.43 (±0.5)
Monocyte	0.42 (±0.2)
Platelet	255.76 (±51.8)
Hemoglobin	13.59 (±1.4)
NLR	1.9 (1.3–2.3)
PLR	103.7 (84.9–125.6)
CRP	2.6 (0.6–3.7)
Thyroid profile	
TSH	1.8 (1.1–3.1)
Free T4	7.2 (2.3–9.0)
Free T3	2.7 (1.5–4.0)
Pathology report	n=89
Benign mass	51(57.3)
Malignant mass	38 (42.7)
Side of involvement	
Right lobe involvement	52 (58.4)
Left lobe involvement	37 (41.6)
Type of surgery	n=89
Total thyroidectomy	58 (65.2)
Subtotal thyroidectomy	29 (32.6)
Right lobectomy	2 (2.2)
Left lobectomy	0

CBC: Complete blood count; WBC: White blood cell; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio; CRP: C-reactive protein; TSH: Thyroid-stimulating hormone.

Table 2. Evaluation of the relation between blood parameters and imaging findings with the possibility of malignancy in thyroid follicular neoplasm in the studied subjects

Variant	Malignant mass	Benign mass	p
WBC	7.77 (±1.6)	7.64 (±1.7)	0.723*
Neutrophil	4.61 (±1.5)	4.55 (±1.4)	0.864*
Lymphocyte	2.50 (±0.6)	2.36 (±0.4)	0.206*
Monocyte	0.43 (±0.3)	0.41 (±0.1)	0.728*
Platelet	271.74 (±51.8)	243.85 (±49.0)	0.015*
Hemoglobin	13.67 (±1.5)	13.53 (±1.3)	0.645*
CRP	3.0 (0.8–4.4)	2.1 (0.3–3.3)	0.376**
TSH	1.8 (1.1–4.2)	1.8 (1.1–2.7)	0.464**
Free T4	7.2 (2.3–9.8)	7.3 (2.1–8.6)	0.991**
Free T3	1.8 (1.4–2.9)	3.3 (1.5–100.2)	0.195**
NLR	1.6 (1.3–2.1)	2.0 (1.3–2.5)	0.291**
PLR	105.1 (86.1–135.2)	101.9 (84.8–123.1)	0.491**
Echogenicity, n (%)			0.681***
Hypoechoic	18 (20.5)	18 (20.5)	
Hyperechoic	5 (5.7)	6 (6.8)	
Isoechoic	11 (12.5)	18 (20.5)	
Mixed echoic	4 (4.5)	8 (9.1)	
Sonographic view, n (%)			0.462****
Solid	26 (29.5)	39 (44.3)	
Cystic	4 (4.5)	2 (2.3)	
Solid-cystic	8 (9.1)	9 (10.1)	
Nodule, n (%)			0.104***
Solitary	18 (20.7)	33 (37.9)	
Multinodular	19 (21.8)	17 (19.5)	
Microcalcification, n (%)			0.014***
Positive	13 (14.9)	6 (6.9)	
Negative	25 (28.7)	43 (49.4)	
Nodule size (cm), n (%)			0.797***
<4 cm	25 (29.1)	36 (41.0)	
≥4 cm	11 (12.8)	14 (16.3)	

*: P-value by Independent Samples T-test; **: P-value by Mann-Whitney test; ***: P-value by Chi-square test; ****: P-value by Fisher's Exact test; WBC: White blood cell; CRP: C-reactive protein; TSH: Thyroid-stimulating hormone; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio.

nodules. This study was designed to assess the potential of NLR and PLR in predicting malignancy in nodules diagnosed as follicular neoplasms.

A study by Deng et al.[15] on thyroid nodules revealed that platelet count, NLR, and PLR were elevated in patients with malignant nodules compared to those with benign nodules. They also reported that PLR was an independent risk factor for malignancy. In the study by Atak et al.[16] on thyroid nodules, patients were classified into benign or malignant groups based on FNA cytology reports. Their findings indicated that elevated PLR played a significant role in predicting malignancy in thyroid nodules. Ari et al.[17] observed that patients with thyroiditis and those with papillary thyroid cancer (PTC) had elevated NLR and PLR. However, their results showed that PLR could not be used to differentiate between benign and malignant conditions. Offi et al.[18] found that neither NLR nor PLR effectively predicted malignancy in patients with

Table 3. Evaluating the relation between blood parameters with echogenicity and ultrasound findings in the studied subjects

Variant	Mixed echoic	Isoechoic	Hyperechoic	Hypoechoic	p	Solid-cystic	Cystic	Solid	p
WBC	7.96 (±1.5)	8.02 (±1.6)	7.04 (±1.7)	7.51 (±1.6)	0.337*	7.54 (±1.6)	7.82 (±1.6)	7.68 (±1.6)	0.930*
Neutrophil	4.67 (±1.4)	4.83 (±1.5)	3.98 (±1.3)	4.51 (±1.6)	0.503*	4.52 (±1.7)	4.44 (±1.2)	4.56 (±1.4)	0.981*
Lymphocyte	2.55 (±0.3)	2.42 (±0.5)	2.43 (±0.5)	2.37 (±0.6)	0.776*	2.43 (±0.4)	2.51 (±0.4)	2.41 (±0.5)	0.915*
Monocyte	0.42 (±0.1)	0.45 (±0.2)	0.37 (±0.2)	0.40 (±0.1)	0.546*	0.43 (±0.1)	0.34 (±0.1)	0.41 (±0.2)	0.651*
Platelet	263.09 (±62.0)	260.79 (±48.8)	244.33 (±30.7)	252.41 (±57.2)	0.795*	250.13 (±52.0)	254.20 (±77.9)	257.32 (±50.7)	0.887*
Hemoglobin	13.87 (±1.4)	13.78 (±1.5)	13.40 (±1.1)	13.33 (±1.3)	0.508*	14.49 (±1.3)	13.88 (±2.1)	13.59 (±1.4)	0.867*
CRP	0.1 (0.1–4.6)	3.0 (2.0–5.2)	3.0 (0.7–3.6)	2.2 (1.3–3.8)	0.478**	2.9 (1.0–3.0)	2.3 (2.1)	2.4 (0.1–3.9)	0.720**
TSH	1.9 (0.8–3.3)	1.5 (0.9–2.3)	1.8 (1.6–12.9)	2.1 (1.3–4.4)	0.064**	1.4 (0.9–2.2)	2.3 (0.9–3.7)	1.9 (1.3–3.5)	0.409**
Free T4	7.5 (1.1–8.4)	6.7(1.9–10.7)	5.8 (1.1–10.4)	7.5 (3.2–9.5)	0.951**	3.8 (1.1–8.0)	6.0 (2.1–8.5)	7.5 (3.3–9.0)	0.240**
Free T3	3.4 (1.6–71.6)	1.9 (1.2–106.0)	–	2.4 (1.7–3.7)	0.915**	2.3 (1.6–3.1)	1.1 (1.1)	3.8 (2.0–103.1)	0.064**
NLR	1.9 (1.4–1.9)	2.0 (1.5–2.6)	1.6 (1.3–2.2)	1.6 (1.3–2.5)	0.629**	1.6 (1.2–2.3)	1.6 (1.3–2.5)	1.9 (1.4–2.3)	0.816**
PLR	107.1 (77.1–124.1)	104.8 (87.7–140.8)	97.3 (89.3–114.9)	103.7 (86.3–130.2)	0.893**	104.7 (95.8–119.3)	91.9 (74.8–142.7)	106.1 (83.8–130.2)	0.739**

*: P-value by One-way ANOVA test; **: P-value by Kruskal-Wallis test; WBC: White blood cell; CRP: C-reactive protein; TSH: Thyroid-stimulating hormone; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio.

indeterminate thyroid nodules. The findings of Offi et al.[18] were consistent with our results, as we also found no correlation between PLR and malignancy in thyroid follicular neoplasms.

Kocer et al.[19] examined neutrophil and lymphocyte counts and calculated NLR for patients with multinodular goiter (MNG), lymphocytic thyroiditis (LT), LT with PTC (LT-PTC), and PTC. They observed that patients with LT-PTC and PTC had significantly higher NLR levels compared to those with MNG and LT. The researchers proposed that NLR could be considered a potential marker for differentiating between benign and malignant thyroid disorders. In contrast, Liu et al.[20] found no significant association between NLR and benign or malignant nodules in their study of patients with differentiated thyroid cancer and those undergoing thyroidectomy. Similarly, Haider et al.'s[21] cross-sectional clinical study concluded that preoperative NLR did not provide substantial evidence for distinguishing between benign and malignant thyroid carcinomas. Kuzu et al.[9] conducted a study on patients with thyroid cell changes that are not clearly defined (primary atypia of undetermined significance/follicular lesion of undetermined significance) and found a significant association between elevated NLR and malignant nodules. These findings suggest that NLR may be useful in assessing the risk of malignancy. Furthermore, Seretis et al.[22] showed that elevated preoperative NLR was associated with a higher risk of incidental papillary thyroid microcarcinoma (PTMC), finding patients with PTMC and thyroid cancer had a significantly increased mean preoperative NLR.

The findings of Liu et al.[20] and Haider et al.[21] are consistent with our study, which also found no significant correlation between NLR and malignant thyroid follicular neoplasms. In contrast, Kocer et al.,[19] Kuzu et al.,[9] and Seretis et al.[22] reported a substantial difference in NLR between malignant and benign thyroid nodules. Thus, studies have reported divergent findings regarding the effectiveness of NLR in distinguishing malignant from benign thyroid conditions.

Zhang et al.[23] studied 487 patients with thyroid tumors, assessing serum inflammatory factor levels in individuals with thyroid adenoma and differentiated thyroid carcinoma, including PTC and follicular thyroid carcinoma. Their study found no significant association between NLR and PLR in patients with follicular neoplasms; however, a significant association was observed in patients with PTC. These findings on the relationship between NLR and PLR in thyroid follicular neoplasms are consistent with the results of our study.

Tazeoglu et al.[24] investigated the diagnostic significance of preoperative NLR and PLR in non-invasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP). They analyzed 209 patients diagnosed with the follicular variant

Table 4. Evaluation of the relation between blood parameters with nodule and microcalcification findings in the studied subjects

Variant	Multinodular	Solitary	p	Microcalcification (negative)	Microcalcification (positive)	p
WBC	7.35 (±1.5)	7.90 (±1.6)	0.129*	7.62 (±1.5)	7.75 (±1.8)	0.764*
Neutrophil	4.19 (±1.4)	4.82 (±1.5)	0.061*	4.54 (±1.4)	4.48 (±1.6)	0.878*
Lymphocyte	2.48 (±0.4)	2.37 (±0.5)	0.365*	2.39 (±0.5)	2.56 (±0.4)	0.225*
Monocyte	0.43 (±0.2)	0.40 (±0.1)	0.537*	0.41 (±0.2)	0.41 (±0.1)	0.856*
Platelet	257.97 (±60.7)	254.56 (±46.7)	0.778*	255.32 (±50.0)	258.82 (±61.8)	0.808*
Hemoglobin	13.42 (±1.4)	13.69 (±1.4)	0.407*	13.57 (±1.4)	13.45 (±1.3)	0.737*
CRP	2.5 (0.1–3.2)	2.3 (1.2–3.8)	0.515**	2.2 (0.8–3.3)	3.0 (0.1–5.2)	0.616**
TSH	1.7 (1.0–3.9)	1.9 (1.2–3.1)	0.690**	1.8 (1.3–3.3)	1.7 (1.1–3.7)	0.844**
Free T4	6.1 (1.3–8.8)	7.2 (3.1–9.7)	0.364**	7.2 (2.7–8.8)	7.4 (1.2–9.5)	0.826**
Free T3	4.0 (1.7–110.9)	4.0 (1.7–110.9)	0.162**	1.9 (1.3–3.7)	3.0 (1.6–26.3)	0.606**
NLR	2.7 (1.9–3.4)	2.0 (1.5–2.5)	0.027**	1.9 (1.4–2.3)	1.6 (1.3–2.1)	0.372**
PLR	101.5 (82.5–124.7)	107.1 (91.7–128.1)	0.511**	102.7 (86.1–130.8)	104.8 (81.4–118.2)	0.441**

*: P-value by One-way ANOVA test; **: P-value by Kruskal-Wallis test; WBC: White blood cell; CRP: C-reactive protein; TSH: Thyroid-stimulating hormone; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio.

Table 5. Evaluation of the relation between blood factors with nodule size findings in the studied subjects

Variant	Nodule size ≥4 cm	Nodule size <4 cm	p
WBC	7.81 (±1.7)	7.68 (±1.6)	0.746*
Neutrophil	4.79 (±1.6)	4.52 (±1.5)	0.470*
Lymphocyte	2.31 (±0.6)	2.47 (±0.5)	0.192*
Monocyte	0.46 (±0.2)	0.40 (±0.1)	0.199*
Platelet	257.25 (±55.6)	256.16 (±51.6)	0.933*
Hemoglobin	13.54 (±1.6)	13.61 (±1.3)	0.836*
CRP	3.3 (2.3–4.5)	2.3 (0.8–3.7)	0.176**
TSH	1.4 (0.5–2.0)	2.3 (1.5–3.8)	0.002**
Free T4	7.3 (3.3–9.2)	7.3 (2.1–9.1)	0.879**
Free T3	1.8 (1.2–59.3)	2.9 (1.6–49.2)	0.549**
NLR	1.9 (1.3–2.6)	1.9 (1.4–2.2)	0.367**
PLR	107.3 (97.7–142.7)	99.1 (84.9–123.2)	0.250**

*: P-value by Independent Samples T-test; **: P-value by Mann-Whitney test; WBC: White blood cell; CRP: C-reactive protein; TSH: Thyroid-stimulating hormone; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio.

of PTC who underwent thyroid surgery, comparing those with NIFTP to patients with encapsulated follicular variant PTC (EFVPTC). The study found that patients with NIFTP were 1.96 times more likely to have an NLR >2, suggesting that NLR may help differentiate NIFTP from EFVPTC preoperatively. However, no significant difference in PLR was observed between the two groups.

Our study investigated preoperative blood samples, inflammatory markers (NLR and PLR), and imaging findings. We found that only platelet counts and the presence of microcalcifications within a thyroid follicular neoplasm were significantly associated with malignancy risk. Additionally, patients with a solitary nodule had significantly higher NLR levels compared to those with multiple nodules. The discrepancies between our findings and those of related studies could be attributed to several factors, including variations in study populations, research settings, sample sizes, and specific inclusion and exclusion criteria. Blood inflammatory markers such as NLR and PLR, which reflect systemic inflammatory responses, have been shown to play a role in cancer progression and survival across various malignancies. To improve the precision of thyroid cancer diagnosis, minimize overtreatment, and reduce unnecessary healthcare costs, accessible diagnostic methods, such as blood inflammatory marker analysis, should be integrated with ultrasonography and FNA findings.

This study represents a pioneering investigation into the role of NLR and PLR in patients with thyroid follicular neoplasms. Further research with a larger study population is recommended to validate these findings. Our work contributes to the limited body of literature examining the role of inflammatory markers, particularly NLR and PLR, in distinguishing benign from malignant thyroid follicular neoplasms. Strengths of this study include its novelty, clearly defined control groups, and access to comprehensive preoperative and postoperative data, including detailed pathology reports. However, the retrospective design is a notable limitation. Additionally, potential confounding

factors that may influence platelet indices, such as diabetes, smoking, inflammatory diseases, iron deficiency, and the use of antiplatelet medications, were not accounted for in this analysis.

CONCLUSION

This study indicates that while NLR and PLR have limited utility in predicting malignancy in thyroid follicular neoplasms, platelet count and the presence of microcalcifications are significant indicators. These findings can help guide clinical decision-making in the management of follicular thyroid nodules.

Ethics Committee Approval: The Tabriz University Research Ethics Committee granted approval for this study (date: 17.04.2023, number: IR.TBZMED.REC.1402.054).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Author Contributions: Concept – SZR; Design – SZR; Supervision – SZR; Resource – MMJ; Materials – SZR; Data Collection and/or Processing – MMJ; Analysis and/or Interpretation – EF; Literature Search – EF; Writing – EF; Critical Reviews – SZR.

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