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Comparison of Preoperative Imaging and FNAB Results with Postoperative Pathology Results in Patients Undergoing AUS/FLUS

AUS/FLUS Nedeniyle Opere Edilen Hastalarda Preoperatif Görüntüleme ve İİAB Sonuçlarının Postoperatif Patoloji Sonuçlarıyla Kıyaslanması

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ABSTRACT

Objective: Thyroid nodules are observed in 3-7% of the general population, of which 4-8% are detected by palpation and 10-41% by thyroid ultrasonography (USG). In this study, we aimed to make early surgical or follow-up decisions in patients with thyroid atypia of undetermined significance (AUS)/follicular lesion of undetermined significance based on demographic and clinical characteristics, sonographic findings, and laboratory tests.

Methods: Patients over the age of 18 years who were diagnosed with AUS and operated between August 2016 and August 2022 were included in the study. Patients under 18 years of age, those with missing data in the hospital automation system, and those with repeat fine-needle aspiration biopsy were excluded from the study.

Results: Sonographic features of malignant and benign cases were compared. In malignant cases, the diameter of the dominant nodule was smaller, which was significant in terms of malignancy. Multicentricity, edge irregularity, and presence of cervical lymph nodes on USG and American Thyroid Association high-risk cases were found to be significant regarding malignancy. "Taller than wide (TTW)" appearance on sonographic images of nodules was observed more frequently in malignant cases.

Conclusion: In regression analysis with age, gender, dominant nodule diameter, multicentricity, TTW shape, presence of calcification, presence of sonographic cervical lymph node, presence of lymphocytic thyroiditis in the parenchyma in the final pathology, and edge irregularity, the parameters TTW shape, presence of cervical lymph node, and presence of lymphocytic thyroiditis in the parenchyma were significant in favor of malignancy.

Keywords: Cancer of thyroid, AUS, thyroid nodule, thyroid neoplasms, ultrasound, biopsy

ÖZ

Amaç: Tiroid nodülleri genel popülasyonda %3-7 sıklıkla görülmekte olup; bunun %4-8'i palpasyon ile, %10-41'i ise tiroid ultrasonografi (USG) ile saptanmaktadır. Bu çalışmada tiroid önemi belirsiz atipi (AUS)/önemi belirsiz foliküler lezyon tanısı almış hastalarda demografik ve klinik özellikler, sonografik bulgular ve laboratuvar tetkikleri ile erken cerrahi kararı veya takip kararı vermeyi hedefledik.

Yöntemler: Çalışmaya; Ağustos 2016-2022 tarihleri arasında ince iğne aspirasyon biyopsisi (İİAB) sonucu AUS tanısı almış ve opere edilmiş 18 yaş üstü hastalar dahil edildi. On sekiz yaş altı hastalar, hastane otomasyon sisteminde verileri eksik olan hastalar ve İİAB tekrarı yapılmış hastalar çalışma dışı bırakıldı.

Bulgular: Malign ve benign olguların sonografik özellikleri karşılaştırıldı. Malign olgularda dominant nodül çapı daha küçük olduğu ve bunun malignite açısından anlamlı olduğu görüldü. Multisentrisite, kenar düzensizliği, USG'de servikal lenf nodu varlığı ve Amerikan Tiroid Derneği yüksek riskli olguların malignite açısından anlamlı olduğu görüldü. Nodüllerin sonografik görüntülerinde "Taller than wide (TTW)" görünümü malign olgularda daha sık izlendi.

Sonuç: Yaş, cinsiyet, dominant nodül çapı, multisentrisite, TTW şekil özelliği, kalsifikasyon varlığı sonografik servikal lenf nodu varlığı, nihai patolojide parankimde lenfositik tiroidit olması, kenar düzensizliği eklenerek regresyon analizi yapıldığında TTW şekil özelliği, servikal lenf nodu varlığı, lenfositik tiroidit parankim bulunması parametreleri malignite lehine anlamlı idi.

Anahtar Sözcükler: Tiroid kanseri, AUS, Tiroid nodülü, tiroid tümörleri, ultrason, biyopsi

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INTRODUCTION

Thyroid nodules are observed in 3-7% of the general population, of which 4-8% are detected by palpation and 10-41% by thyroid ultrasonography (USG) (1). 3-5% of these nodules are malignant (2).

According to the American Thyroid Association (ATA) guidelines, the clinical and diagnostic approach to nodules should include detailed anamnesis and physical examination, thyroid function tests should be performed, and thyroid fine-needle aspiration biopsy (FNAB) should be planned if necessary regarding the results. FNAB is an easy-to-access, fast, simple, cost-effective, and reliable method that is frequently used in the differentiation of benign and malignant nodules. FNAB and cytologic examination is the gold standard method for the differentiation of benign malignant nodules with 89-98% sensitivity and 92% specificity (3,4).

Although FNAB being the gold standard method, a comprehensive classification system has emerged as a necessity to avoid controversies on this issue. Therefore, the BETHESDA classification system was defined in 2007, and six categories were distinguished. Accordingly, it was categorized as 1) non-diagnostic, 2) benign, 3) atypia of undetermined significance/follicular lesion of undetermined significance (AUS/FLUS), 4) follicular neoplasia/suspected follicular neoplasia, 5) suspected malignancy, and 6) malignant (5).

BETHESDA 3 AUS/FLUS is reported in up to 7% of all thyroid FNABs, and studies have shown that 6-76% of malignancies can be found in these lesions following surgery, which is much higher than expected. This wide range in malignant lesion rates calls into question the accuracy of the National Cancer Institute's (NCI) BETHESDA classification. Thus, the approach to these lesions remains controversial (6,7).

In this study, we aimed to make early surgical or follow-up decisions in patients diagnosed with AUS/FLUS on the basis of demographic and clinical characteristics, sonographic findings, and laboratory tests. We also revealed the risks associated with histopathological aggressiveness findings in patients who underwent surgery.

MATERIALS AND METHODS

Ethics committee approval was obtained with the decision of the University of Health Sciences Türkiye, Gülhane Training and Research Hospital Clinical Research Ethics Committee (approval number: 2021/81, date: 15.12.2021). This study complies with the Declaration of Helsinki and the principles of Good Clinical Practice and does not contradict the ethical rules of subject research.

Patients over the age of 18 years who were diagnosed with AUS because of FNAB and operated between August 2016 and August 2022 were included in the study. Patients under 18 years of age, patients with AUS diagnosed by FNAB who were not operated on in our clinic, patients with missing data in the hospital automation system, patients who could not be reached by one-to-one interview technique, and patients with repeat FNAB were excluded from the study.

All patients admitted to University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Department of General Surgery and who underwent thyroid FNAB were evaluated retrospectively. The information of 616 patients with a pathologic diagnosis of AUS was scanned through the hospital information system, and 321 patients were found to have undergone surgery in the general surgery clinic, and were included in the study.

Demographic characteristics (age, gender), body weight, height, and body mass index (BMI) of patients were recorded. We assessed comorbidity burden using the Charlson Comorbidity Index (CCI), which assigns a weighted score to each of the 17 comorbid conditions based on the relative risk of 1-year mortality. Preoperative TSH, fT3, fT4, thyroglobulin, and anti-TPO levels were recorded. The number of nodules, dominant nodule diameter, localization, multicentricity, multifocality, heterogeneity, presence of edge irregularity, echogenicity features, Taller than wide (TTW) shape, solid, cystic, mixed type, presence and nature of calcification (microcalcification, macrocalcification, presence of peripheral halo), and presence of cervical lymph nodes were obtained from hospital records as patients' preoperative ultrasonographic findings and classified as benign, low risk, intermediate risk, and high risk by ATA risk scoring based on these sonographic parameters. New TIRADS category information was collected from patients who underwent repeat FNAB. Information regarding the surgical procedure performed on the patients was obtained from the operating room records.

The final pathologic diagnosis of the postoperative thyroid material was recorded by dividing it into benign and malignant groups. The benign group included multinodular goiter, lymphocytic thyroiditis, NIFTP, and follicular adenoma, whereas papillary cancer, follicular cancer, and Hurthle cell cancer were included in the malignant group. Histopathologically, the presence of lymphovascular, capsular, and perineural invasion in the malignant group was examined, and reactive, malignant, and total lymph node counts were also analyzed. TNM staging of malignant cases was recorded.

Statistical Analysis

Statistical analyses were performed using SPSS version 22.0 package program. The conformity of the variables to the normal distribution was examined using visual (histograms and probability graphs) and analytical methods ("Kolmogorov-Smirnov test" and "Shapiro-Wilk tests"). Numerical variables determined according to normal distribution were analyzed by the "Independent groups t-test" between the two groups, and variables that were not normally distributed were analyzed by the "Mann-Whitney U test". Chi-square analysis and Fisher's exact test were used to compare categorical data. Multivariate analyses were performed using "Binary Logistic Regression analysis". Comparisons with p-values below 0.05 were considered statistically significant.

RESULTS

The mean age of the 321 patients included in the study was 46.7±12.3 years (18-88 years). Of these, 24.3% were over 55 years of age. Of the patients included in the study, 26.8% (n=86) were male and 73.2% (n=235) were female, with a female-to-male ratio of 2.7/1.

On ultrasonographic evaluation, multiple nodules were observed in 62.6% of the cases and single nodules in 37.4%. The median diameter of the dominant nodule was 19 mm. The most common nodule localization was in the right lobe (58.6%) and lower pole (51.7%). Heterogeneous appearance was observed in 49.8% of nodules. Moreover, multifocality was observed in 50.8%, multicentricity in 7.8%, margin irregularity in 23.4%, calcification in 29.3%, and cervical lymph node in 12.8%. In total, 74.8% of nodules had a solid appearance. Regarding the sonographic

features grouped in accordance with the criteria mentioned in the ATA guidelines, 17.4% of the cases had a high risk for malignancy (n=56), 9.3% (n=30) had an intermediate risk, 29.6% (n=95) had a low risk, 33.6% (n=108) had a very low risk, and 10% (n=32) had a benign risk category. All patients included in the study had AUS as the preoperative FNAB result. FNAB was repeated in 40.5% of these cases. According to the Bethesda classification, 6.2% were stage II, 65.4% were stage III, 27.7% were stage IV, and 0.8% were stage VI. Total bilateral thyroidectomy was performed in 77.6% of the patients, and lobectomy was performed in the remaining 22.4%. Postoperative histopathological results were evaluated. 37.1% were malignant (papillary carcinoma=112, Hürthle cell carcinoma=5, follicular carcinoma=2) and 62.9% were benign (multinodular goiter=93, follicular adenoma=82, NIFTP=14, thyroiditis=13). Lymphovascular invasion was observed in 13.4% of malignant cases, capsular invasion in 10.9%, and perineural invasion in 1.7%. Based on T staging, 78.2% of malignant cases were T1, 21% were T2, and 0.8% were T3.

The descriptive characteristics of the patients with malignant histopathology were compared with those with benign histopathology. Nonetheless, no difference was observed in terms of age, gender, BMI, or CCI (Table 1).

Sonographic features of malignant and benign patients were compared. In malignant cases, the diameter of the dominant nodule was smaller, which was significant in terms of malignancy (p<0.001). Multicentricity (p=0.014), edge irregularity (p<0.001), presence of cervical lymph nodes on USG (p=0.007), and ATA high-risk cases (p<0.001) were significant for malignancy. TTW appearance on sonographic images of nodules was observed more frequently in malignant cases (p<0.001). Table 2 shows the sonographic features of the malignant and benign cases.

There were 121 patients who had AUS as the first FNAB result, underwent repeat procedure, and underwent surgery. There was no difference between benign and malignant final pathology in these patients. Among these patients, the malignancy rate decreased in those whose BETHESDA stage remained the same, whereas malignancy was observed more frequently in those whose Bethesda stage changed (increased or decreased) (Table 3).

Sonographic features of patients with and without lymphovascular invasion were compared. Hypoechoic echogenicity (p<0.001), presence of calcifications (p<0.001), macrocalcifications (p=0.006),

Table 1. Comparison of the descriptive characteristics of benign and malignant cases

Characteristics	Benign, (n=202)	Malign, (n=119)	p-value
	n (%)	n (%)	
Age*	47.3±11.9	45.7±12.9	0.247†
<55 years old	150 (74.3)	93 (78.2)	0.432††
>55 years old	26 (21.8)	52 (25.7)	-
Gender			0.818††
Female	147 (72.8)	88 (73.9)	-
Male	55 (27.2)	31 (26.1)	-
BMI (kg/m²)*	27.1±4.2	27.2±5.3	0.871†
Charlson Comorbidity Index			0.154††
Mild (1-2)	175 (86.6)	110 (92.4)	-
Moderate (3-4)	23 (11.4)	9 (7.6)	-
Severe (5+)	4 (2.0)	0	-

†Student's t-test, ††Chi-square test, *Mean ± standard deviation, BMI: Body mass index.

Table 2. Comparison of the sonographic characteristics of benign and malignant cases

Characteristics	Benign, (n=202)	Malign, (n=119)	p-value
	n (%)	n (%)	
Number of nodules			0.401†
Single	72 (35.6)	48 (40.3)	-
Multiple	130 (64.4)	71 (59.7)	-
Dominant nodule diameter (mm)*	21 (4-90)	17 (2-70)	<0.001††
Localization			0.602†
Right lobe	116 (57.4)	72 (60.5)	-
Isthmus	7 (3.5)	6 (5.0)	-
Left lobe	79 (39.1)	41 (34.5)	-
Presence of multifocality	100 (49.5)	63 (52.9)	0.552†
Presence of multicentricity	10 (5.0)	15 (12.6)	0.014†
Nodule localization within the lobe			0.339†
Lower pole	110 (54.5)	56 (47.1)	-
Middle	69 (34.2)	44 (37.0)	-
Superior pole	23 (11.4)	19 (16.0)	-
Presence of heterogeneity	95 (47.0)	65 (54.6)	0.189†
Echogenicity			0.325†
Hyperechoic	49 (24.3)	21 (17.6)	-
Isoechoic	79 (39.1)	47 (39.5)	-
Hypoechoic	74 (36.6)	51 (42.9)	-
Presence of edge irregularity	30 (14.9)	45 (37.8)	<0.001†
Shape characteristics			<0.001†
Taller than wide (-)	180 (89.1)	13 (10.9)	-
Taller than wide (+)	22 (10.9)	106 (89.1)	-
Qualification			0.389†
Solid	146 (72.3)	94 (79.0)	-
Semisolid	20 (9.9)	8 (6.7)	-
Cystic	36 (17.8)	17 (14.3)	-
Presence of calcification	52 (25.7)	42 (35.3)	0.069†
Macrocalcification	10 (5.0)	7 (5.9)	0.719†
Peripheral halo	25 (12.4)	19 (16.0)	0.366†
Punctate microcalcification	17 (8.4)	16 (13.4)	0.152†
Presence of cervical lymph nodes	18 (8.9)	23 (19.3)	0.007†
Presence of ATA high risk	19 (9.4)	37 (31.1)	<0.001†

†Chi-square test, ††Mann-Whitney U test, *Median (minimum-maximum), ATA: American Thyroid Association.

and punctate microcalcifications (p=0.008) were significantly more frequent in cases with lymphovascular invasion. In total, 68.8% of patients with lymphovascular invasion and 25.2% of cases without lymphovascular invasion were in the ATA high-risk category. Lymphovascular invasion was observed more frequently in patients in the ATA high-risk category (p=0.001) (Table 4).

Predictors of malignancy were evaluated using multivariate analyses. The model was created with the variables that were found to be statistically significant in univariate analyses and considered clinically crucial based on the literature. The model included age, gender, dominant nodule diameter, presence of multicentricity, margin irregularity, shape (TTW), presence of calcification, presence of cervical lymph node, and lymphocytic surrounding tissue from thyroid parenchyma features other than the nodule examined in the specimen. The model was found to be significant (Nagelkerke R^2=0.696, X^2=228,475, p<0.001). Regression analysis showed that the TTW shape feature [p<0.001, odds ratio (OR): 70.52, 95% confidence interval (CI): 31.32-158.77] and presence of cervical lymph nodes (p=0.018, OR: 3.94, 95% CI: 1.26-12.31) were predictive of malignancy (Table 5).

DISCUSSION

To create a common language between cytopathologists and clinicians, the NCI defined the BETHESDA classification and categorized the FNAB result into four groups: non-diagnostic material, benign, AUS, FLUS, and malignant. The TIRADS 3 category of AUS/FLUS is a group that does not fit into any other category but contains nuclear abnormalities (8). This group accounts for approximately 4-15% of all FNABs. According to the literature, this group is operated with a rate of 6-48% and has a 5-15% risk of malignancy (9,10). It is assumed that radiological findings and cytopathological examination may be diagnostically helpful in making the malignant-benign distinction in thyroid nodules in intermediate cases (11).

In a 2015 meta-analysis by Straccia et al. (12), 145,920 FNAB cytology samples from 51 publications between 2009 and 2014 were examined, and the malignancy rate was found to be 23-31% in the postoperative pathology results of patients reported as having AUS. It was stated that this range showed a very heterogeneous distribution because the evaluation was performed in more than one center (12). According to the BETHESDA thyroid cytopathology reporting system, the expected malignancy rate for category 3 AUS/

Table 3. Analysis of cases with repeated FNAB

Characteristics	Benign, (n=202)	Malign, (n=119)	p-value
	n (%)	n (%)	
Repeat FNAB	74 (36.6)	47 (39.5)	0.609†
Bethesda (n=130)			0.039†
Stage II	3 (3.9)	5 (9.3)	
Stage III	57 (75.0)	28 (51.9)	
Stage IV	16 (21.1)	20 (37.0)	
Stage VI	0	1 (1.9)	

†Student t test, ††Chi-square test, FNAB: Fine-needle aspiration biopsy.

Table 4. Comparison of the sonographic characteristics of malignant cases with and without lymphovascular invasion

Characteristics	Lymphovascular invasion (-), (n=103)	Lymphovascular invasion (+), (n=16)	p-value
	n (%)	n (%)	
Number of nodules			0.765†
Single	41 (39.8)	7 (43.8)	
Multiple	62 (60.2)	9 (56.2)	
Dominant nodule diameter (mm)*	16 (2-65)	19 (5-70)	0.515††
Localization			0.652†
Right lobe	64 (62.1)	8 (50.0)	
Isthmus	5 (4.9)	1 (6.2)	
Left lobe	34 (33.0)	7 (43.8)	
Presence of multifocality	55 (53.4)	8 (50.0)	0.800†
Presence of multicentricity	15 (14.6)	0	0.217†††
Nodule localization within the lobe			0.191†
Lower pole	50 (48.5)	6 (37.5)	
Middle	35 (34.0)	9 (56.2)	
Superior pole	18 (17.5)	1 (6.2)	
Presence of heterogeneity	56 (54.4)	9 (56.2)	0.888†
Echogenicity			0.012†
Hyperechoic	16 (15.5)	5 (31.2)	
Isoechoic	46 (44.7)	1 (6.2)	
Hypoechoic	41 (39.8)	10 (62.5)	
Presence of edge irregularity	31 (30.1)	14 (87.5)	<0.001†
Shape characteristics			0.380†††
Taller than wide (-)	10 (9.7)	3 (18.8)	
Taller than wide (+)	93 (90.3)	13 (81.2)	
Qualification			0.469†
Solid	81 (78.6)	13 (81.2)	
Semisolid	8 (7.8)	0	
Cystic	14 (13.6)	3 (18.8)	
Presence of calcification	29 (28.2)	13 (81.2)	<0.001†
Macrocalcification	3 (2.9)	4 (25.0)	0.006†††
Peripheral halo	16 (15.5)	3 (18.8)	0.719†††
Punctate microcalcification	10 (9.7)	6 (37.5)	0.008†††
Cervical lymph node			0.176†
No	84 (81.6)	12 (75.0)	
Yes	19 (18.4)	4(25.0)	
ATA high-risk category	26 (25.2)	11 (68.8)	0.001†

†Chi-square test, ††Mann-Whitney U test, †††Fisher's exact test, *Median (minimum-maximum).

Table 5. Evaluation of the determinants of malignancy by regression analysis

Variable	B	p-value	OR	95% CI
Gender (female)	0.722	0.113	2.058	0.844-5.023
Age	-0.004	0.790	0.996	0.965-1.027
Dominant nodule diameter	-0.018	0.241	0.982	0.954-1.012
Multicentricity	1.254	0.086	3.503	0.839-14.621
Shape characteristics (taller than wide)	4.256	<0.001	70.523	31.324-158.77
Presence of calcification	0.045	0.915	1.046	0.458-2.389
Presence of cervical lymph nodes	1.373	0.018	3.949	1.266-12.317
Presence of lymphocytic thyroiditis	0.759	0.062	2.136	0.963-4.738
Edge irregularity	0.681	0.136	1.975	0.808-4.829

OR: Odds ratio, CI: Confidence interval.

FLUS is 5-15%. In other studies in the literature, however, Theoharis et al. (13) found the malignancy rate to be 48%, Layfield et al. (14) found 28%, and Broome and Solorzano (15) found 20%. In other studies, the malignancy rate for surgically confirmed cases was reported to range between 6% and 76% (16-18). It was reported as 37.1% in our study, which is compatible with the literature but higher than the updated BETHESDA thyroid cytopathology reporting system. The fact that there is a very wide range and high malignancy rate in the literature and in our study suggests that the malignancy rate predicted by BETHESDA should be re-evaluated.

In a study by Sahin et al. (19), the final pathology result was reported as papillary thyroid cancer most frequently in patients diagnosed with AUS (42%), and papillary thyroid cancer was emphasized as the most common cancer subtype for patients diagnosed with AUS. The rate of PTK in patients with AUS who underwent surgery and were diagnosed as malignant was reported to be 38%, whereas the same rate was 45.8% in the study by Luu et al. (20) and 48% in the study by Olson et al. (21). In our study, papillary thyroid cancer was found to be the most common thyroid cancer with a rate of 34.9% in patients with AUS, supporting the literature.

Jankovic et al. (22) investigated the relationship between lymphocytic thyroiditis and malignancy and reported significant results. A significant difference was found in our study between the presence of lymphocytic thyroiditis in the non-nodule thyroid parenchyma and malignancy on postoperative histopathologic examination (p=0.009) (22). In this study, the sonographic characteristics of the patients who were diagnosed with AUS and underwent surgery were analyzed by univariate analysis for each parameter, and a significant correlation was found between dominant nodule diameter <19 mm (p<0.001), multicentricity (p=0.014), edge irregularity (p<0.001), TTW shape feature (p<0.001) and presence of cervical lymph nodes on USG (p=0.007) and malignancy, on the other hand, single or multiple nodules, nodule localization and multifocality, presence of heterogeneity, hypoechoic, isoechoic, and hyperechoic, presence of solid, cystic components, macrocalcification and microcalcification, and presence of peripheral halo were not significantly associated with malignancy. In the multivariate analysis of malignancy-related factors, a significant difference was observed between the TTW shape (p<0.001) and the presence of cervical lymph nodes (p=0.018) and malignancy.

In a study in which 305 patients were evaluated, it was reported that age and gender did not make a statistically significant difference in terms of malignancy in patients who underwent surgery for AUS (23). In another study, 667 patients with AUS were evaluated, and it was observed that gender did not significantly affect malignancy (24). In a study conducted by Seo et al. (25) to determine the factors that increase the risk of malignancy in patients diagnosed with AUS, being older than 45 years of age, female gender, nodule localization, dominant nodule diameter less than 15 mm, and two or more FNABs with AUS were examined, and it was stated that two or more repeated FNABs reported as AUS increased the possibility of malignancy. Analysis of the effects of demographic data on malignancy in this study revealed that gender, age, and BMI did not affect malignancy.

Kaliszewski et al. (26) showed in a study of 342 patients that a TSH value below 2.5 mIU/L increased the risk of malignancy in patients with AUS, whereas other laboratory parameters had no effect on malignancy. In another study examining serum TSH, fT3, fT4, anti-TPO, and thyroglobulin levels, no difference was observed between laboratory parameters and malignancy (27). In this study, no difference was observed between the benign and malignant groups in TSH, fT3, fT4, anti-TPO, and thyroglobulin levels measured preoperatively.

Study Limitations

The limitations of our study include the retrospective design of the study, the lack of a single radiologist performing radiologic imaging examinations, the lack of a single pathologist evaluating FNAB and surgical specimens, and the lack of involvement of a single surgeon in the operative and clinical processes.

CONCLUSION

The nodules considered risky using the guidelines were significant for malignancy in our study in terms of classification based on the sonographic findings described by the ATA guidelines.

In multivariate analyses, univariate analyses, and in the literature, when regression analysis was performed by adding parameters that may be significant for malignancy (age, gender, dominant nodule diameter, multicentricity, TTW shape, presence of calcification, presence of sonographic cervical lymph nodes, presence of lymphocytic thyroiditis in the parenchyma on final pathology, edge irregularity), the parameters of TTW shape, presence of cervical lymph node, presence of lymphocytic thyroiditis parenchyma were significant indicators of malignancy. In conclusion, USG and the ATA risk score determined on the basis of ultrasonographic parameters were found to be highly effective guides in the determination of malignancy in patients diagnosed with AUS.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained with the decision of the University of Health Sciences Türkiye, Gülhane Training and Research Hospital Clinical Research Ethics Committee (approval number: 2021/81, date: 15.12.2021).

Informed Consent: Retrospective study.

Authorship Contributions

Concept: F.D., O.H., Design: M.Z.B., M.Ö., Supervision: O.H., M.Z.B., M.Ö., Resources: F.D., M.Ö., Materials: F.D., B.U., Data Collection or Processing: F.D., O.H., Analysis or Interpretation: F.D., B.U., Literature Search: O.H., M.Z.B., M.Ö., Writing: F.D., B.U., M.Z.B., Critical Review: F.D., O.H., B.U., M.Z.B., M.Ö.

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