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ARAŞTIRMA / RESEARCH

Effects of bedside adequacy assessment in thyroid cytology on cytological sufficiency and the final histopathological diagnosis

Tiroid sitolojisinde hasta başı yeterlilik çalışmasının sitolojik yeterlilik ve kalıcı histopatolojik tanıya etkisi

Tuğba Toyran[1], Gülname Fındık Güvendi[2], Yasemen Adalı[3], Hüseyin Üstün[4]

[1]Adana State Hospital, Department of Pathology, Adana, Turkey
[2]Rize Recep Tayyip Erdoğan University Faculty of Medicine, Department of Pathology, Rize, Turkey
[3]Çanakkale Onsekiz Mart University Faculty of Medicine, Department of Pathology, Çanakkale, Turkey
[4]Synlab Pathology, Ankara/ Turkey

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Abstract

Purpose: The thyroid fine needle aspiration cytology (FNAC) is a fast, reliable, and economical method for the interpretation of thyroid nodules. This method contributes to the later management of patients and reduces unnecessary surgical interventions. This study aimed to demonstrate the contribution of bedside adequacy assessment during FNAC to the accuracy rates of cytological competence and final histological diagnosis.

Materials and Methods: The study included 443 patients who underwent FNAC in a university hospital between 2012 and 2015. Correlations between the histological diagnosis categories of patients who had and who did not have bedside adequacy assessment were compared per sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy.

Results: As a result of comparison of cytological and histopathological diagnoses, 30.7% sensitivity, 75% specificity, 50% positive predictive value, 57.1% negative predictive value and 55.1% diagnostic accuracy were found in the group with bedside adequacy assesment. Whereas in the group without bedside adequacy assessment, 50% sensitivity, 69.2% specificity, 42.8% positive predictive value, 75% negative predictive value, and 63.1% diagnostic accuracy were found

Conclusion: Bedside adequacy assessment increases the cytological adequacy proportion, but does not contribute to the diagnostic accuracy rate.

Keywords: Bedside adequacy assessment, thyroid, fine-needle aspiration cytology

Öz

Amaç: Tiroid ince iğne aspirasyon sitolojisi (İİAS), tiroid nodüllerinin değerlendirilmesi için; hızlı, güvenilir, ekonomik bir yöntemdir. Bu yöntem hastaların ileri dönemde yönetimine katkı sağlamakta ve gereksiz cerrahi uygulamaları azaltmaktadır. Bu çalışmada İİAS sırasında, hasta başında yeterlilik değerlendirilmesinin, sitolojik yeterlilik ve histolojik kesin tanıda doğruluk oranlarına ne kadar katkısı olduğunu göstermek amaçlandı.

Gereç ve Yöntem: Çalışmaya, 2012-2015 yılları arasında, bir üniversite hastanesinde İİAS uygulanmış 443 hasta dâhil edilmiştir. Hasta başında yeterlilik değerlendirilen ve değerlendirilmeyen olguların histolojik tanı kategorileriyle korelasyonu; duyarlılık, özgüllük, pozitif öngörü değeri, negatif öngörü değeri, tanısal doğruluk oranlarına göre karşılaştırılmıştır.

Bulgular: Sitolojik ve histopatolojik tanıların karşılaştırılması sonucunda, hasta başı yeterlilik değerlendirilen grupta, duyarlılık %30,7, özgüllük %75, pozitif öngörü değeri %50, negatif öngörü değeri %57,1, tanısal doğruluk %55,1 olarak bulunmuştur. Hasta başı yeterlilik değerlendirilmeyen grupta ise duyarlılık %50, özgüllük %69,2, pozitif öngörü değeri %42,8 negatif öngörü değeri %75, tanısal doğruluk %63,1 olarak bulunmuştur.

Sonuç: Hasta başı yeterlilik değerlendirilmesi, sitolojik yeterlilik oranını arttırır, ancak tanısal doğruluk oranına katkıda bulunmaz.

Anahtar kelimeler: Hasta başı yeterlilik değerlendirilmesi, tiroid, ince iğne aspirasyon sitolojisi

Yazışma Adresi/Address for Correspondence: Dr. Tuğba Toyran, Adana State Hospital, Department of Pathology, Adana, Turkey E-mail: tugbaolcan@hotmail.com
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INTRODUCTION

Thyroid nodules are increasingly common lesions in all populations; they are seen four times more in women than men. Old age and low iodine intake are contributors to this condition. Especially ionizing radiation exposure during childhood increases the chance of developing thyroid nodules at a rate of 2% per year. According to the data obtained from different studies, the proportion of detecting thyroid nodules by palpation is between 4-7%. However, it increases to 20-76% with ultrasonography (US), and 50-65% in autopsy series[1,2].

The assessment of thyroid nodules begins with a good history and physical examination. Thyroid stimulating hormone (TSH) level is checked, ultrasonography is applied, and FNAC comes as the next step in cases where the possibility of malignancy cannot be ruled out[3]. The application of US-guided FNAC is more effective, especially in patients with multiple thyroid nodules[4].

FNAC is a practical, reliable, efficient, and economical method for the assessment of thyroid nodules[5]. Although the final diagnosis is not always possible, it contributes to the advanced management of patients and reduces unnecessary surgical procedures[6]. When all thyroid nodules are evaluated, only 5-15% are malignant[4].

To make a correct diagnosis in FNAC, a sufficient number of follicle cells should be seen in a single preparation and at least 10-15 follicle cells per six groups[7,8]. 10-15% of thyroid aspirations cannot be diagnosed even in experienced centers[5]. Reasons for this may be the inability to perform the sampling; the inaccuracy of the technique; laboratory errors during fixation, slide preparation, and staining; excess cystic, fibrotic or necrotic thyroid nodules; and the inability to differentiate the cells as a result of bleeding[9].

Bedside adequacy assessment is done under US guidance to distinguish between benign and malignant thyroid nodules and to reduce the diagnosis of Nondiagnostic or Unsatisfactory (ND/U)[10].

Bedside adequacy assessment in FNAC can be considered similar to frozen sampling regarding the provision of a fast, reliable, and morphologically correct diagnosis in cooperation with clinicians such as endocrinologists and radiologists. Bedside assessment can provide immediate feedback for the clinicians by enabling a preliminary decision, deliver information about whether the aspiration material is sufficient or inadequate, and may prompt the clinician for additional diagnoses and tests by alerting about the nature of the aspirate. At the same time, bedside assessment contributes to cost and time savings by reducing the number of slides prepared.

This study aimed to show whether adequacy assessment during FNAC reduces the incidence of ND/U in the cytopathological diagnosis, and how much it contributes to the accuracy of the histopathological diagnosis.

MATERIALS AND METHODS

Four hundred fortythree patients admitted to the Internal Medicine or General Surgery Departments at the Kafkas University Medical Faculty between 2012 and 2015, who were diagnosed with nodular thyroid disease and underwent FNAC, were included in the study. While in 247 of these patients' bedside assessment was done during FNAC, no evaluation was performed in 196 patients. Ethical approval was obtained from the local Ethics Committee of the Kafkas University Faculty of Medicine (Date: 2 February 2017; meeting number: 2, decision number: 24).

Procedure

The FNAC procedure was performed with direct palpation under ultrasound guidance either by a radiologist or an experienced endocrinologist. The assessment of the bedside adequacy was conducted in collaboration with the clinician and pathologist in the pathology laboratory. For each patient, materials were obtained using a 21-G needle after approximately three aspirations. The first of these samples was prepared as a wet preparation to determine whether the smears had sufficient cellularity. Toluidine blue was preferred during this preparation process due to its low cost and availability. Samples taken during the procedure were sprayed from the tip of the needle onto the slides, added one drop Toluidine blue, covered with a lamella, and evaluated quickly with light microscopy by three different pathologists.

The decision of adequacy and preliminary diagnoses were reported verbally and noted in the pathology request forms. The sampling procedures were continued until the number of cells required for

optimal diagnosis (minimum six follicle cell groups each containing at least ten cells in a single slide) was obtained. Sometimes, the clinician terminated the procedure depending on the tolerance condition of the patient or when he/she felt that the sample was sufficient. At the end of the process, two wet slides were prepared for each patient, fixated in 95% alcohol, and stained with PAP and/or H&E; other smears were air-dried and stained with MGG. The number of slides prepared and the lobe from which the aspiration was performed was noted in the pathology request form.

Cytological assessments of FNAC were made according to the Bethesda Classification, which has six diagnostic categories: I-Nondiagnostic or Unsatisfactory (ND/U), II-Benign, III-Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance (AUS), IV-Follicular Neoplasm or Suspicious for a Follicular Neoplasm (FN/SFN), V-Suspicious for Malignancy (SM), and VI-Malignant (11). The histopathological diagnoses, on the other hand, were divided into seven categories as seen in Table 1. Also, histopathologically, benign vs. malignant categorization was made. While NG, thyroiditis, FA, and HHA were grouped as "benign," PC, HCT, FC, and MC were classified as "malignant."

Statistical analysis

Statistical data were analyzed by the SPSS v.20 (Statistical Package for Social Sciences, SPSS Inc., Chicago, IL, USA) software. Categorical data were analyzed using the Chi-Square test. P-values below 0.05 were considered as statistically significant. Additionally, the correlation of the histopathologic results of the 247 patients who had bedside assessment was compared with the cytological diagnoses of the 196 patients who did not have bedside assessment, concerning sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy.

Table 1. Histopathological diagnosis categories.

1.	Multinodular goiter (MNG), Nodular hyperplasia (NG), thyroiditis
2.	Follicular adenoma (FA)
3.	Hurthle cell adenoma (HCA)
4.	Papillary carcinoma (PC)
5.	Hurthle cell tumor (HCT)
6.	Follicular carcinoma (FC)
7.	Medullary carcinoma (MC)

RESULTS

The study included 443 patients. Of the sample, 247 (55.8%) patients underwent bedside adequacy assessment, while 196 (44.2%) patients were not evaluated for adequacy. Of the 443 patients included in the study, 369 (83.3%) were female, and 74 (16.7%) were male.

Distribution of the diagnoses in the groups with and without adequacy assessment is given in Table 2. Forty nine (19.8%) of the 247 patients who had bedside assessment and 29 (14.8%) of the 196 patients who did not have bedside adequacy assessment underwent surgical interventions. Histopathologically, of the 78 operated patients, 50 (64.1%) were diagnosed as benign, and 28 (35.9%) were diagnosed as malignant.

Correlation of the histopathological diagnoses of the resection materials according to benign vs. malignant categorization are given in Table 3, while the distribution according to the histopathological diagnosis groups is given in Table 4.

Table 2. Distribution of fine needle aspiration cytology according to the groups with and without adequacy assessment

Cytological diagnosis	Bedside adequacy assessed		Bedside adequacy not assessed		Total	p
	Number (n)	Percentage (%)	Number (n)	Percentage (%)		
ND/U	38	15.4	79	40.3	117 (26.4)	
Benign	146	59.1	86	43.9	232 (52.4)	<0.0001
AUS	46	18.6	15	7.7	61 (13.8)	
FN/SFN	7	2.8	2	1.0	9 (2.0)	
SM	9	3.6	13	6.6	22 (5.0)	
Malignant	1	0.4	1	0.5	2 (0.5)	
Total	247	100.0	196	100.0	443(100.0	

Table 3. Distribution of the two groups with and without bedside assessment according to the Bethesda Classification categories and histopathological examinations categorized as benign or malignant

Cytological diagnoses	Histopathological Diagnosis				
	Adequacy assessed		Adequacy not assessed		
	Benign	Malignant	Benign	Malignant	
	n (%)	n (%)	n (%)	n (%)	Total
ND/U	6 (100.0)	0 (0.0)	4 (80.0)	1 (20.0)	11
Benign	12 (57.1)	9 (42.9)	9 (75.0)	3 (25.0)	33
AUS	4 (40.0)	6 (60.0)	4 (100)	0 (0.0)	14
FN/SFN	2 (50.0)	2 (50.0)	1(100.0)	0 (0.0)	5
SM	4 (57.1)	3 (42.9)	4 (66.7)	2 (33.3)	13
Malignant	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)	2
Total	28 (57.1)	21 (42.9)	22 (75.9)	7 (24.1)	78

Table 4. Comparison of the groups with and without bedside adequacy assessment.

	Adequacy assessed	Adequacy not assessed
Sensitivity	30.7%	50%
Specificity	75.0%	69.2%
Positive predictive value	50.0%	42.8%
Negative predictive value	57.1%	75.0%
Diagnostic accuracy	55.1%	63.1%

Histological examination of the 6 cases diagnosed as ND/U in the group with bedside adequacy assessment, revealed 4 (66.7%) patients with MNG/NG/Thyroiditis, 1 (16.7%) patient with FA, and 1 (16.7%) patient with HCA. Of these six cases, which remained non-diagnostic despite the adequacy assessment, 3 had a widespread cystic degenerated nature. The other 3 were categorized as ND/U due to technical reasons such as tissue fixation and staining defects. From the five cases diagnosed as ND/U in the group without adequacy assessment, 3 (60.0%) had MNG/NG/Thyroiditis, 1 (20.0%) had HCA, and 1 (20.0%) had PC. While 3 of these cases were cystic, hemorrhagic, and adenomatoid nodules, 1 case with PC was in the form of microcarcinoma.

In the group with bedside assessment, of the 21 cases diagnosed as cytologically benign, 10 (47.6%) had MNG/NG/Thyroiditis, 2 (9.5%) had FA, 8 (38.1%) had PC, and 1 (4.8%) had FC. Of the 8 cases diagnosed as PC, 5 were papillary microcarcinoma, 1 was a classical variant, and 2 were follicular variant of papillary thyroid carcinoma. Of the cytologically benign 21 cases, 9 (42.9%) had false negativity. In the group without bedside assessment, of the 12 cases diagnosed as benign, 8 (66.7%) were MNG/NG/Thyroiditis, 1 (8.3%) was HCA, 2 (16.7%) were PC, and 1 (% 8.3) was MC. Three of the 12 (25.0%) patients with a cytologically benign diagnosis had false negative results. While two of the 3 cases evaluated as histopathologically malignant were papillary microcarcinomas, 1 case of MC was taken from a different thyroid lobe.

On the histological examination of the 10 cases with the diagnosis of AUS, 2 patients (20.0%) had MNG/NG/Thyroiditis, 1 (10.0%) had FA, 1 (10.0%) had HCA, 4 (40.0%) had PC, 1 (10.0%) had HCT, and 1 (10.0%) had MC. Of the four cases diagnosed as PC, 3 had papillary microcarcinoma, and 1 had FVPTC. The frequency of malignant thyroid nodules in the histological diagnosis was 60.0% in patients with AUS. In the group without bedside assessment, all (100%) of the 4 patients were diagnosed as MNG/NG/Thyroiditis. Of these histologically benign four cases, two had lymphocytic thyroiditis, while the other two had nodular hyperplasia showing degenerative regressive changes. No malignity was encountered in the patients with bedside adequacy assessment.

In the group with bedside assessment, of the four cases diagnosed as FN/SFN, 1 (25.0%) had FA, 1 (25.0%) had HCA, and 1 (25.0%) had PC. One case with PC had HCA additionally. Thus, the diagnostic accuracy rate in the group with a bedside assessment can be expressed as 100%. In the group without bedside assessment, on the other hand, one case evaluated cytologically as FN/SFN was reported histologically as a hyperplastic nodule.

In the group with bedside assessment, of the 7 cases who were diagnosed cytologically as SM, 4 (57.1%) had MNG/NG/Thyroiditis, and 3 (42.9%) had PC in the histological evaluation. All three PC's were papillary microcarcinoma. In the group without bedside assessment, of the six cases diagnosed cytologically as SM, 3 (50.0%) had MNG/NG/Thyroiditis, 1 (16.7%) had FA, and 2 (33.3%) had PC in the histological assessment. Both PC diagnoses were reported as FVPTC.

In the group with bedside assessment, the only case categorized cytologically as malignant was confirmed to have FVPTC in the histological examination. On the other hand, in the group without bedside assessment, the only case diagnosed cytologically as malignant was found to have papillary microcarcinoma in the histological examination. There were no false positives in both groups diagnosed to have malignant cytology.

Table 4 shows the sensitivity, specificity, diagnostic accuracy, as well as, positive and negative predictive values of both groups according to the final histopathological diagnoses.

DISCUSSION

FNAC is a valuable fast, reliable, and easily applicable method in the first step of differentiating between benign and malignant thyroid nodules[12,13]. First and foremost, a sufficient aspiration material is required to make a correct diagnosis in FNAC. This situation is affected by many factors, ranging from the doctor's experience in aspiration and the lesion characteristics to the laboratory conditions. It was suggested that bedside assessment is an efficient method to prevent the limiting effects of these factors[12,14,15].

Bedside evaluation ensures a sufficient number of follicle cells for a correct diagnosis, decreases the number of interventions, increases patient comfort, and reduces complications[15]. Additionally, it promotes further studies by giving a clue whether the lesion is benign or malignant[14,15]. Another advantage is that it reduces ND/U. To prevent false positive evaluations due to reactive/regenerative changes, patients diagnosed with ND/U should undergo FNAC at the earliest three months later[16,17]. This situation is time-consuming, and the repetition of all the procedures is costly. Thus, bedside assessment also saves time and money[12,18]. The desired ND/U proportion in FNAC is below 10-15%[19,20]. Variable findings are reported in the literature about FNAC performed by bedside adequacy evaluation.

Our attempts performed with direct palpation or US guidance had an ND/U rate of 15.4% in the group with bedside adequacy assessment (247 out of 443 patients) and 40.3% in the group without bedside assessment. Undiagnosed specimens were due to the inability to aspirate a sufficient number of cells because of cystic or deeply located, non-palpable nodules.

Baloch et al.[21,22] reported the rate of ND/U as 11% in the group without bedside assessment and 5% in the group with bedside assessment. When they excluded cystic nodules from the analysis, this rate decreased even to 2%.

Eedes and Wang[15] collected aspiration materials from 311 patients. Adequacy was assessed in 116 aspiration materials, while 215 aspirations were done without adequacy assessment. The proportion of ND/U was 9.5% in the group with and 14.9% in the group without adequacy evaluation. It was emphasized that although the adequacy assessment decreased the rate of ND/U by around 20%, it was time-consuming for the clinician, radiologist, and pathologist, and thus, considered unpractical.

Schmidt et al.[23] reviewed 25 studies from 9 different anatomical regions, which were evaluated for adequacy during FNAC. The adequacy rate at the bedside was found to be 12% higher. The most emphasized point in this study was that although the competence was not assessed during FNAC, the benefit of bedside adequacy assessment was lower in laboratories with high success rates. We observed that we benefited more from the sufficiency assessment because in our circumstances the ND/U ratio is quite high when the adequacy is not evaluated. In our study, the proportion of correct diagnosis was 24.9% higher in the group with a bedside assessment.

In this study, 19.8% of the patients who were assessed for bedside adequacy and 14.8% of the patients who were not assessed were operated. In the histopathological examination, 64.1% of the 78 patients were diagnosed with benign, while 35.9% were diagnosed with malignant conditions. Önver et al.[24] performed surgical treatment in 10.5% of 1420 patients who underwent FNAC. Their histopathological results returned 76.9% benign and 33.1% malignant. In the study of Inan et al. (12), all patients underwent FNAC were operated, and 85.5% of the patients had benign, and 14.5% had malignant

diagnoses. Yang et al.[25] performed surgical treatment in 26.6% of the 3949 patients who underwent FNAC; the diagnosis was 54.5% benign and 45.4% malignant. In all the mentioned studies, the likelihood of benign histopathological diagnoses is higher. Similar to our study, Yang et al.[25] reported the rate of malignancy higher compared to other studies. This may be due to an increase in the incidence of papillary microcarcinoma, particularly as a result of the increased frequency of computed tomography (CT) investigations and the accident in the Chernobyl nuclear power plant[9].

In the literature, 37-90% of the cytological investigations are reported as benign, 1-16% malignant, 1–23% SM, 5–28% AUS, 5-25% FN/SFN, and 2-32% as inadequate aspirates[14,24-31]. In our study, while 15.4% of the patients assessed at bedside were diagnosed with ND/AU, this rate was 40.3% in the group without bedside assessment. While our rate of ND/U diagnosis in the group with bedside assessment was consistent with the literature, this proportion was quite high in the group that did not have a bedside assessment. However, in the group evaluated at the bedside, 59.1% returned as benign, 18.6% were AUS, 2.8% FN/SFN, 3.6% SM, and 0.4% were malignant. On the other hand, in the group without bedside assessment, 43.9% of the samples were benign, 7.7% were AUS, 1.0% FN/SFN, 6.6% SM, and 0.5% malignant. In both groups, compatible with other studies in the literature, the proportion of non-malignant findings was high, whereas the diagnosis of malignant results was low. The diagnoses of AUS and FN/SFN were higher in the group with bedside assessment.

FNAC, as the first step in the differential diagnosis of benign vs. malignant thyroid nodules, was reported with sensitivity rates of 65-99%, specificity rates of 65-100%, and diagnostic accuracy rates of 53-98% as compared to the final histopathological diagnosis[29,32,33]. In our study, when the cases with ND/U, AUS, and FN/SFN cytology diagnostic categories were excluded from the evaluation, in the group without bedside competence assessment, the sensitivity rate was 30.7%, specificity 75%, positive predictive value 50%, negative predictive value 57.1%, and diagnostic accuracy was 55.1%. In the group without bedside assessment, sensitivity was 50%, specificity was 69.2%, positive predictive value was 42.8%, negative predictive value was 75%, and diagnostic accuracy was 63.1%.

In the study conducted by Şimşek et al.[9] in the bedside assessed group, 54 samples in the cytologically evaluated benign category were diagnosed as histologically benign; no false negativity was detected in this group. In the group without adequacy assessment, 57.1% of the cytologically benign and 42.9% of the histologically benign patients were reported as malignant. In this group, the rate of false negativity was 42.9%. The difference between the two groups was statistically significant. In our study, in the group whose adequacy was evaluated, 42.8% of the cases with benign cytology were found to have false negatives. Five of these cases were papillary microcarcinoma, and the negativity rate was 19% when these cases were excluded. In the group without adequacy assessment, a 25% false-negativity was observed in the cases diagnosed with benign cytology.

Sensitivity is the percentage of malignancy reported in the cytological diagnosis and confirmed by the final histopathological diagnosis. Incorrect negativity is inversely proportional to the sensitivity ratio. In the study conducted by Şimşek et al. (9), the sensitivity of the adequacy-assessed group was 100% when calculated by including the SM category, while it was 40% in the group without adequacy assessment. In our study, the sensitivity in the bedside-assessed and not assessed groups was 30.7% and 50%, respectively. The primary reason for the low sensitivity in our study compared to the literature was considered as the insufficient sampling of papillary microcarcinoma foci due to FNAC done mostly by palpation.

The literature on the comparison of the cytological and histological final diagnoses of the groups with or without bedside assessment is limited. When we look at the studies on the correlations between cytological and histological diagnoses of the thyroid gland; in 54.2% of the FNAC samples with benign diagnoses obtained from 83 patients, Inan et al.[13] reported 88.9% benign and 11.1% malignant final diagnoses. In this study, the false negatives and sensitivity rates were reported as 11.1% and 37.5%, respectively. In the study of Önver et al.[24], histopathologically final results of 152 patients who underwent thyroidectomy were compared with the FNAC results. Histopathological final reports of the 61 patients with a preliminary benign cytological diagnosis were finally evaluated as 90.1% benign vs. 9.9% malignant. The false negativity rate of this study was 9.9% with a sensitivity of 73.9%.

In the histopathological examination, Yang et al.[25] reported 7.3% of the cytologically benign cases as malignant. The false negative rate of this study was 7.3% with a sensitivity of 94%. Amrikachi et al.[34] compared the FNAC results with the final histopathological results, and categorized 17.2% of the preliminary benignant cases as malignant. The false-negativity of this study was 17.2% with a sensitivity of 93%. As to our study, the false-negativity rates (42.8% in the bedside assessed group vs. 25% in the group without adequacy assessment) were slightly higher than other studies in the literature.

Specificity is defined as the proportion of cases reported as benign in the cytological diagnosis and confirmed to be benign in the final histopathological diagnosis. False positivity is inversely proportional to the specificity ratio.

In the study conducted by Şimşek et al.[9], all patients who were evaluated as cytologically malignant at the bedside assessment were also diagnosed histologically malignant; there were no false positives. When the suspicious cytology results were accepted as malignant, 3 of the 18 cases were evaluated as benign, which returned a false-positivity rate of 16.6%. In the group without bedside assessment, 75% of the cases evaluated cytologically in the malignant category were diagnosed as malignant histologically, and 25% were reported as benign. The rate of false positivity in this group was 25%. When the suspicious cytology diagnoses were categorized as malignant, 6 of the 10 cases were evaluated as benign, and the false positivity rate became 60%. Per findings from our study, one case with cytologically diagnosed malignancy in the bedside assessed group was confirmed as histologically malignant without any false-positivity. When the diagnosis of suspicious cytology was considered as malignant, 4 of the 8 cases were evaluated as benign, and the false positivity rate became 50%. There was no false positivity in the group without adequacy assessment. When the suspicious cytology diagnoses were counted as malignant, the false positive rate was 57.2%. While in Şimşek et al.'s[9] study the difference in the false-positivity rates between the groups with and without adequacy assessment was 43.4, it was 7.2 in our study. When in both studies only the malignant cytological findings were considered, the specificity in the adequacy-assessed group was 100%. In the group without adequacy assessment, Şimşek et al.[9] reported a specificity rate of 88.9%, while in our study this proportion was 100%.

In the study by Yang et al.[25], 98.5% of the cytologically malignant categories were histologically malignant as well, which meant a false positivity rate of 1.4%. When the cytological diagnoses of the SM were regarded as malignant, the specificity rate became 85.1%.

According to the literature, the rate of malignant diagnosis in histopathology ranges from 25% to 77%. From this perspective, our findings are compatible with the literature. Frozen studies during the surgery are recommended to increase the diagnostic value in patients with a histological SM diagnosis using FNAC[24].

In the study of Şimşek et al.[9], the diagnostic accuracy of 95.8% in the group with bedside accuracy assessment was fairly compatible with the final histopathological diagnoses. On the other side, in the group without adequacy assessment, the diagnostic accuracy was found at 50%. This study has demonstrated statistically significant differences between the preoperative cytopathological and postoperative histopathological diagnoses in both groups ($p<0.0001$). In our study, 32.6% of the patients who underwent thyroidectomy in the group with bedside assessment were compatible with the final histopathological diagnoses, and the diagnostic accuracy rate was 55.1%. In the group without bedside assessment, these proportions were 41.3% and 63.1%, respectively. In the study by Şimşek et al.[9], the diagnostic accuracy rates between the two groups were significantly different with an extra increase using bedside assessment. However, we observed that the difference between the two groups was not significant, and the bedside assessment did not contribute to the diagnostic accuracy. Diagnostic accuracy rates were reported as 76.5% by Önver et al.[24], 75.4% by Inan et al.[12], and 90.6% by Yang et al.[25]. In our study, the diagnostic accuracy rates were lower compared to the literature. This is because the reactive regenerative changes in follicle cells are misinterpreted in favor of malignancy and the insufficient sampling of papillary microcarcinoma foci due to FNAC done mostly by palpation.

As a conclusion, good clinician-pathologist cooperation and a common language are essential to increase the productivity of the bedside assessment. Ultrasonography provides detailed information about the location, number, size, and structure of the

nodules during FNAC, and increases the efficiency and diagnostic accuracy of FNAC. While bedside adequacy assessment increases cytological adequacy, it does not contribute to the diagnostic accuracy rates.

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