Original Article

The Relationship between 3 Dimensional Measurement Ratios of Solid Thyroid Nodules and Thyroid Papillary Carsinoma: A Retrospective Cohort Study

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ABSTRACT

Objective: We aimed to investigate whether the ratios of craniocaudal (CC), anteroposterior (AP), and mediolateral (ML) measurements to each other are useful in diagnosing thyroid papillary carcinoma by ultrasound.

Methods: The patients who have a solid thyroid nodule on ultrasonography which were diagnosed by a histopathological examination after a trucut fine needle biopsy were included in this study. Proportions of all three dimensions to one another were recorded.

Results: A total of 173 patients with a mean age of 44.49±14.54 years were included. Of the patients included in the study, 137 (79.19%) were female and 38 (20.81%) were male. AP/ML ratio (p=0.016) and CC/ML ratio showed a significant difference between thyroid papillary carcinoma group and benign nodule groups. Furthermore, a cut-off value of 0.7 AP/ML ratio showed sensitivity and specificity of 0.667 and 0.45, respectively.

Conclusion: AP/ML ratio shows association with increased thyroid papillary carcinoma risk. CC/ML is also associated with increased risk. These rates may also contribute to clinical practice as a diagnostic tool.

INTRODUCTION

The incidence of thyroid cancer in the United States increased from 4.5 to 14.4/100,000 population.[1] Differential diagnosis of thyroid nodules can be challenging due to common thyroid diseases ranging from benign nodules to inflammatory changes.[1,2]

The ultrasound has a key role for detecting a lesion in thyroid and for evaluating significant features including margin characteristics, echogenicity, presence of microcalcifications, intranodal vascularity, and absence of peripheral halo.[3]

Behavior patterns of different thyroid cancers are not similar, and the dimensional characteristics of the associated thyroid nodules may also differ. The diagnostic value of craniocaudal (CC) dimension size and ratios of all dimension sizes to each other for the malignant conditions of thyroid are not well known. We aimed to investigate whether the ratios of CC, anteroposterior (AP), and mediolateral (ML) measurements to each other are useful in diagnosing thyroid papillary carcinoma (TPC) by ultrasound.

MATERIALS AND METHODS

Study Design

This is a single-center retrospective cohort study. This

study was conducted between January 2015 and December 20 patients diagnosed with the E04.1 ICD code (non-toxic single thyroid nodule) and similar subcodes were admitted to the radiology department of Van Yuzuncuyil University Hospital. This study was performed after the Hospital Ethics Committee approved the research (No. 2021/10-09). Records of patients admitted to the community-based hospital radiology department were evaluated.

Study Population

The demographic features, histopathologic results, and ultrasound workup of the patients were recorded. Patients with a solitary thyroid nodule with a histopathological examination result after a transcervical ultrasound-guided fine-needle biopsy were included in this study. The patients without three-dimensional size records or histopathological results, with previous surgery, malignancy or thyroiditis history, pregnancy, and those under 18 were excluded from the study.

Data Collection

All patients underwent transcervical ultrasonography using a 12 MHz linear probe on a Philips Affiniti 70 ultrasound device at supine position. ML and AP dimension sizes were measured by a horizontal approach. CC size was measured by a vertical approach (Figure 1). The proportion of all sizes (ML, AP, and CC) to each other was calculated. Figure 1 shows the dimension measurements on horizontal (A) and vertical (B) aspects of transcervical ultrasound. All ultrasounds were performed by radiologists. Patients were divided to TPC group and benign groups according to histopathologic results.

Study Outcomes

The primary outcome was to evaluate the ratios of CC, AP, and ML measurements to each other in diagnosing solid nodules containing TPC. Secondary outcome was to compare the dimension measurements and demographic features of patients with benign thyroid nodules and nodules containing TPC.

Statistical Analysis

Statistical analysis was conducted with SPSS (the Statistical Package for the Social Sciences) version 20 (IBM Corp., Chicago, IL, USA) for Windows. Descriptive statistics were presented as mean and standard deviation, median, and range (minimum and maximum). Normal distribution of the quantitative data was tested with the Kolmogorov–Smirnov test. Normally distributed quantitative variables were analyzed with Independent Samples t-test. Mann–Whitney U-test was used for the analysis of non-normally distributed quantitative variables. For comparison of categorical data, Pearson Chi-squared test and Fisher exact test were applied. Receiver operating characteristic (ROC) curve analysis and area under the curve values were calculated to determine the overall effectiveness of the variables. A $p < 0.05$ was accepted statistically significant.
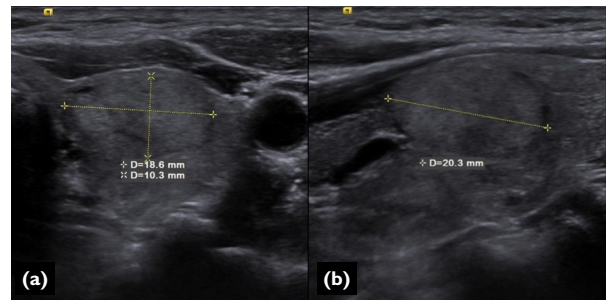

Figure 1. Anteroposterior and mediolateral dimension measurements on horizontal **(a)** and craniocaudal on vertical **(b)** aspects of transcervical ultrasound.

RESULTS

In this study, 184 patients with solid thyroid nodules were evaluated. 11 patients were excluded from the study due to other malign fine needle biopsy results. A total of 173 patients with a mean age of 44.49±14.54 years were included. Of the patients included in the study, 137 (79.19%) were female and 38 (20.81%) were male. Mean age of the male patients was 47.67±14.3. Mean age of the female patients was 43.66±14.54. There was no difference between mean age of male and female patient groups (p=0.142).

TPC rate in female group was 30/137 (22.89%). TPC rate in male group was 12/36 (33.3%). There was no significant difference between the malignancy rates of the groups (p=0.19).

AP, ML, and CC measurements showed no significant difference between the TPC and benign groups. AP, ML, and CC measurements of the benign and malign nodules are given in Table 1. AP/ML ratio showed a significant difference between TPC and benign groups (p=0.016). CC/ML ratio showed a significant difference between TPC and benign groups. AP/CC ratio had no significant difference between groups. The ratios are shown in Table 2.

ROC curve analysis of AP/ML measurement ratios showed an area under curve of 0.606 (p=0.038, 95% CI: 0.508–0.705). For a cut-off value of 0.7 AP/ML ratio, sensitivity and specificity were 0.667 and 0.45, respectively. ROC curve is shown in Figure 2. ROC curve analysis of AP/CC

Table 1. Mann Whitney U test results of Anteroposterior (AP), mediolateral (ML) and craniocaudal (CC) measurements

	ML	CC	AP
Benign			
Mean±SD	19,79±9,65	21,85+10,90	14,16+6,73
Median (min-max)	18 (5-74)	19 (8-76)	14 (4-44)
TPC			
Mean±SD	19,17±10,59	21,36+9,15	15,07+7,08
Median (min-max)	17 (8-47)	19,5 (8-45)	14,5 (6-35)
P	0,269	0,474	0,454

Table 2. Independent T-test results of anteroposterior-mediolateral, craniocaudal mediolateral and anteroposterior craniocaudal ratios are shown. (anteroposterior- mediolateral(AP/ML), craniocaudal-mediolateral(CC/ML) and anteroposterior-craniocaudal (AP/CC) ratios)

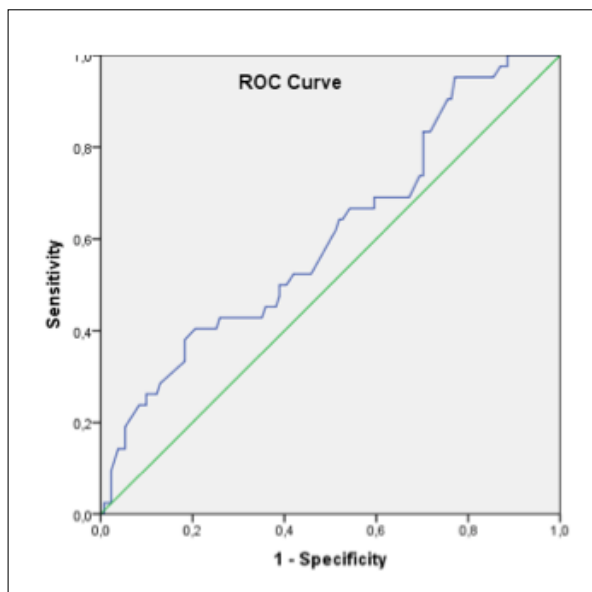|	AP/ML	CC/ML	AP/CC
Benign			
Mean±SD	0,74±0,19	1,08±0,3	0,73±0,27
TPC			
Mean±SD	0,83±0,22	1,2±0,34	0,71±0,18
P	0,021	0,043	0,135

Figure 2. ROC curve of anteroposterior mediolateral measurement ratios.

measurement ratios showed an area under curve of 0.578 (p=0.127, 95% CI: 0.47–0.68).

DISCUSSION

The discrimination between benign and malign thyroid nodules is a challenge because thyroid lesions are very common in general population. Malignant lesions may be seen in relatively younger patients. Ultrasound is the most common used modality to detect nodules as well as examine the features suggestive of a malignant process.[4]

The mean size of thyroid nodules is not associated with malignancy, while irregular margin, intranodal vascularity, microcalcification, and hypoechogenic morphology were found significantly more common in malignant thyroid lesions than benign ones. Furthermore, the lesions with a craniocaudal size more than transverse (TR) size were reported with significantly higher malignancy risk.[4,5]

Previous studies concluded that AP and TR ratio (AP/TR)

>1 suggests increased risk of malignancy and may be used for a criteria for recommending biopsy of a thyroid nodule.[6,7] Other studies revealed that nodules taller than wide were associated with an increased malignancy risk.[5,7] This finding is accepted as a suspicious finding in thyroid imaging reporting and data system.[8-11]

Previous studies commonly evaluated different thyroid malignancies together and investigated the differences of malign lesions from benign lesions. As one size will not fit all, different thyroid malignities may have different dimensional ratio properties. Our study tried to highlight the dimensional features of thyroid papillary carcinoma.

In our study, AP/ML ratio and CC/ML ratio showed a significant difference between TPC group and benign nodule group. Cut-off value of 0.7 AP/ML ratio showed sensitivity and specificity of 0.667 and 0.45, respectively.

The major limitations of our study are retrospective design and relatively small patient numbers in some groups. Our study focuses only on TPC. Dimensional ratio features should be evaluated for different thyroid carcinoma types.

Conclusion

Our findings suggest the association of AP/ML with increased TPC risk. CC/ML was also associated with increased risk. The nodules with higher AP dimension than ML dimension must be highlighted in the report for the increased malignancy risk.

Ethics Committee Approval

This study approved by the Van Yuzuncuyil University Ethics Committee (Date: 10.09.2021, Decision No: 2021/10-9).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: N.H., M.Ö.; Design: R.Ç., U.Ö., S.Ö.; Supervision: N.H.; Fundings: M.B.A., N.H., M.Ö.; Materials: R.Ç., S.Ö.; Data: F.D., M.B.A.; Analysis: F.D., U.Ö.; Literature search: N.H., M.Ö.; Writing: U.O., N.H., S.Ö.; Critical revision: F.D., M.B.A., S.Ö.

Conflict of Interest

None declared.

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Solid tiroid Nodüllerinin 3 Boyutlu Ölçüm Oranları ile Tiroid Papiller Karsinomunun İlişkisi: Retrospektif Kohort Çalışması

Amaç: Ultrason ile kraniokaudal, anteroposterior ve mediolateral ölçümlerin birbirine oranlarının, tiroid papiller karsinomu tanısında yararlı olup olmadığını araştırmayı amaçladık.

Gereç ve Yöntem: Bu çalışmaya, tru-cut ince iğne biyopsisi sonrası histopatolojik inceleme ile tanı konulan, ultrasonografide solid tiroid nodülü saptanan hastalar alındı. Her üç boyutun da birbirine oranları kaydedilerek değerlendirildi.

Bulgular: Yaş ortalaması 44.49±14.54 olan toplam 173 hasta çalışmaya dahil edildi. Çalışmaya alınan hastaların 137'si (%79.19) kadın, 38'i (%20.81) erkekti. Anteroposterior-mediolateral oran (p=0.016) ve kraniokaudal-mediolateral oran tiroid papiller karsinom grubu ile benign nodül grupları arasında anlamlı fark gösterdi. Ayrıca 0.7 AP/ML oranı kestirim değeri, sırasıyla 0.667 ve 0.45 duyarlılık ve özgüllük gösterdi.

Sonuç: AP/ML oranı, artmış tiroid papiller karsinom riski ile ilişki göstermektedir. CC/ML ayrıca artmış risk ile ilişkilidir. Bu oranlar da tanısal birer araç olarak klinik pratiğe katkı sunabilir.

Anahtar Sözcükler: Papiller tiroid karsinomu, tiroid nodülü, ultrason, üç boyutlu görüntüleme.