

Research Paper

Ultrasound Sonography Features of the Thyroid Papillary Carcinoma in West Azerbaijan Province, Iran



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ABSTRACT

Objectives: The most frequent form of thyroid cancer (TC) is papillary thyroid carcinoma (PTC), which has been significantly increasing worldwide. This study aimed to determine the relative frequency of various sonographic PTC findings in the West Azerbaijan Province, Iran.

Methods: In this retrospective study, the ultrasonic features of 67 patients with proven PTC, confirmed by pathology, were analyzed. The sonographic features were categorized into low-risk (hyperechoic echogenicity, macrocalcification, peripheral vascularity, puff appearance, spongy form nodule, comet tail shadowing) and high-risk (irregular margin, hypoechoic echogenicity, microcalcification, central vascularity, taller-than-wide shape, twinkling, two-lobe nodule, neck lymphadenopathy) PTC features.

Results: The frequency of hypoechoic echogenicity was higher in both genders (81.8% in males and 72.5% in females) and among three groups of ages ($P=0.55$). Microcalcification had a higher frequency in both genders (65.4 in males and 65.5 in females) and in two age groups of 20-45 and more than 45 years (68.3% and 66.7%, respectively) ($P=0.4$ and $P=0.99$, respectively). Central vascularity was more frequent in men (61.5%), and peripheral vascularity was more frequent among females (57.1%) and in two age groups of 20-45 and more than 45 years (68.3% and 66.7%, respectively) ($P=0.41$). Also, taller-than-wide shape had a high frequency in males (20%). Sponginess, puff appearance, and comet tail had the same frequency among the three age groups. In the age group under 20 years, peripheral incomplete halo had a high frequency (17.8%).

Discussion: The appearance of high-risk papillary carcinoma sonographic features is typical in PTC patients. Moreover, low-risk sonographic PTC features occur more often than expected in our patients. We can infer that the frequency of PTC ultrasonography features in the West Azerbaijan Province of Iran can be due to iodine deficiency due to being far from the sea and the lack of easy access to seafood.

Keywords:

Ultrasonography, Thyroid nodule, Papillary carcinoma

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Introduction

Early diagnosis of thyroid cancer (TC) by ultrasonography (US), fine-needle aspiration (FNA) and core-needle biopsy significantly increases the prevalence of TC worldwide [1]. The most frequent form of TC is papillary thyroid carcinoma (PTC), which makes up 70% to 90% of TCs with a good prognosis [2]. Less than 5% of thyroid nodules are malignant; most are benign and do not need treatment [3]. Patients who present with a detectable thyroid nodule frequently face challenging clinical situations. About 3.2% of people in the UK and 4.2% in the USA have a solitary thyroid nodule [4]. These nodules affect women four times more than men; as people age, they become more prevalent [5]. However, there is a high likelihood (34.0%) of cancer, so solitary thyroid nodules should be appropriately explored [6].

Early diagnosis is essential to choosing the best treatment plan and enhancing the prognosis because PTC has a sneaky onset and delayed growth [7]. However, because of the unique clinical signs and more aggressive behavior with regional and distant metastases, papillary thyroid microcarcinoma (PTMC) has a high rate of inaccurate and missing diagnoses [8]. Ultrasonic examination is the best way to diagnose PTC because computed tomography, magnetic resonance imaging, and isotope monitoring are unsuccessful [9].

Many patients' non-palpable thyroid nodules are found during US of the thyroid gland [10]. The precise US findings of PTC are well established, and several authors have given US criteria for use in separating benign from malignant thyroid nodules [11, 12]. Thyroid nodules can be found with high-resolution US, and some forms of malignant histology can be identified definitely [13, 14].

Numerous studies have described the sonographic characteristics of PTC since US is the primary method of evaluating thyroid nodules and serves as a foundation for surgical decisions [15, 16]. Concerning the identification and treatment of thyroid nodules, the American Thyroid Association (ATA) and the American Association of Clinical Endocrinologists (AACE) have published guidelines [17]. The 2016 ATA guidelines provide recommendations regarding US risk categories for thyroid nodule malignancy and the relevant criteria for FNA [18]. As a result, thyroid nodules are divided into two categories, low risk and high risk, based on how likely they are to develop into cancer.

To our knowledge, no report has been published to date evaluating the frequency of US features of the proven PTCs by separating them into low and high-risk features in the northwest part of Iran.

Materials and Methods

We reviewed retrospectively the records of 67 patients with PTC who had undergone thyroid surgery at the Urmia Imam Khomeini Hospital (Urmia City, Iran) from April 2021 to March 2022. Of the cases analyzed, 21 were male, and 46 were female from all age groups. All the patients underwent preoperative US within two weeks, and a diagnosis of PTC was confirmed by FNA biopsy (FNAB) and pathological examination. In a single session, three experienced endocrinologists reviewed all preoperative sonographic and pathology reports.

The specialists for each PTC nodule evaluated the following 15 US criteria (low-risk & high-risk PTC characteristics). The experts then determined whether each of the 15 criteria was present or absent, classifying the nodule as having or not having each sonographic criterion. When the experts could not agree, a consensus was found through discussion.

US was performed using a 10 MHz linear probe (LOGIQ 7, GE Medical Systems, Milwaukee, WI, USA). The ultrasonographic parameters were assessed and classified into two groups of low-risk and high-risk PTC features echogenicity (hypoechoic, isoechoic, or hyperechoic), calcifications (microcalcification <1 mm in diameter, macrocalcification >1 mm in diameter); nodule shape (taller-than-wide, based on the ratio of the anteroposterior dimension to the transverse dimension [A/T ratio] as ≥ 1 or <1), peripheral incomplete halo, and nodular vascularity (central or peripheral), puffiness, spongy form, comet tail, twinkling (brightness) irregular margin, two-lobe nodules and neck lymphadenopathy (LAP).

Echogenicity was classified regarding the context of the thyroid gland's surrounding areas. Microcalcification and macrocalcification are two different types of calcification. Despite posterior acoustic shadowing, microcalcifications are classified as small, punctate hyperechoic foci typically less than 2 mm. The nodule's surrounding low (thin) echoic halo was called a peripheral incomplete halo. Power Doppler ultrasonographic imaging detects the presence or absence, centrality, and periphery of vascularity. A nodule is described as having intranodular vascularity if both central and peripheral vascularity are found.

Thyroid function test

Serum thyroid-stimulating hormone levels were measured using immunoradiometric assay kits (CIS Bio International, Shering, France).

Statistical analysis

All data are expressed as frequency and percentage. Statistical analyses were performed using the SPSS software, version 21. The chi-squared test (or the Fisher exact test as appropriate) compared the categorical variables. $P < 0.05$ were deemed to indicate statistical significance.

Results

A total of 67 patients with PTC were included in this study. Examination of gender frequency distribution shows that 21 patients (31.3%) were male and 46 (68.7%) were female. There was a higher rate of females among cancer patients. The average age of PTC patients was 41.1 ± 14.9 years; 10.4% were under 20 years, 50.7% were between 20 and 45 years, and 38.8% were over 45 years. The demographic characteristics of the patients are presented in Table 1.

Table 2 compares males' and females' low-risk and high-risk PTC ultrasonographic features. In both groups, many patients demonstrated typical low-risk and high-risk PTC findings.

The frequency of hypoechoic echogenicity was higher than hyperechoic echogenicity in both genders (81.8% in males and 72.5% in females) ($P = 0.55$). Microcalcification had a higher frequency than macrocalcification in both groups ($P = 0.99$). Central vascularity was more frequent in men (61.5%) and peripheral vascularity was

more frequent among females (57.1%) ($P = 0.25$). Also, taller-than-wide shape had a high frequency in males (20%). There was no significant difference in these patterns between the two groups. Irregular margins and two-lobe patterns had the same frequency in the male group (16.9%). No significant difference was observed between the low and high-risk features and gender groups.

Table 3 presents high- and low-risk ultrasonographic PTC features among three age groups. Hypoechoic echogenicity was more frequent than hyperechoic among all three groups ($P = 0.71$). Microcalcification patterns had high frequency in two age groups of 20-45 and more than 45 years (68.3%, 66.7%, respectively) ($P = 0.41$). Macrocalcification was more frequent in the age group less than 20 years (57.1%). Peripheral vascularity was more frequent in age groups under 20 and 20-45 years (57.1% and 56.5%, respectively). Sponginess, puff appearance and comet tail showed the same frequency among the three age groups. In the age group under 20 years, peripheral incomplete halo had a high frequency (17.8%).

Discussion

Up to 50% of people have thyroid nodules, frequently detected by sonography [19]. Numerous studies have demonstrated the wide variation in papillary carcinoma's sonographic appearance, the most frequent TC and the substantial overlap in features between benign and malignant nodules [20, 21]. In the present study, low- and high-risk ultrasonographic findings of PTC patients with differences in gender and age groups were typical and there was a higher rate of females among PTC patients. Hypoechoic echogenicity, microcalcification, central vascularity, and taller-than-wide shape were frequently seen in these patients. The results confirmed that high-risk features were more frequent than low-risk features in PTC patients.

Table 1. Demographic characteristics of the patients

Characteristics		No. (%)
Age (y)	<20	7(10.5)
	20-45	34(50.7)
	>45	26(38.8)
	Total	67(100)
Gender	Male	21(31.3)
	Female	46(68.7)
	Total	67(100)

Table 2. Ultrasonographic PTC patients according to gender

Parameter		No. (%)		P
		Male	Female	
High-risk PTC features	Hypoechoic echogenicity	18(81.8)	37(72.5)	0.55
	Microcalcification	17(65.4)	36(65.5)	0.99
	Central vascularity	8(61.5)	15(42.9)	0.25
	Taller than wide shape	13(20)	24(18.3)	0.96
	Twinkling	7(10.8)	21(16)	0.94
	Irregular margin	11(16.9)	21(16)	0.94
	Two-lobe nodule	11(16.9)	16(12.2)	0.91
	Neck LAP	8(12.3)	18(13.7)	0.93
Low-risk PTC features	Hyperechoic echogenicity	4(18.2)	14(27.5)	0.55
	Macrocalcification	9(34.6)	19(34.5)	0.99
	Peripheral vascularity	5(38.5)	20(57.1)	0.25
	Puff appearance	0	3(2.3)	0.88
	Spongy form nodule	2(3.1)	3(2.3)	0.90
	Comet tail shadowing	5(7.7)	10(7.6)	0.87

Furthermore, the lack of low-risk features was generally prevalent in PTC patients. However, our results showed that these features, such as macrocalcification, hyperechoic echogenicity, puff appearance, or spongy form nodules, were presented considerably in the US results. However, there was no significant difference between age, gender, and PTC US features.

Numerous studies have shown that most malignant nodules are hypoechoic, and thyroid nodules can be distinguished based on their degree of echogenicity as a high-risk feature [22, 23]. In contrast to our analysis, Siddiqui et al. [24] found that age over 45 was a significant predictor of PTC and was associated with patient's survival rates and recurrence. In this context, Zhang et al. discovered that PTC patients' ages varied significantly from each other [25]. In contrast to this result, the female gender rate was predominant in our investigation. Another study [26] showed that the male gender was one of the predicting factors for the presence of PTC.

According to Nam et al.'s study [27], PTCs with more aggressive biological behaviors (lymph node metastasis, extrathyroidal extension, and advanced stage) were those with more frequent and well-recognized ultrasonographic

features, such as taller-than-wide shape, marked hypoechogenicity, microcalcifications, and infiltrative borders. This study discovered that PTC patients had higher rates of hypoechoic echogenicity, microcalcification, central vascularity and taller-than-wide shape. Although the majority of earlier research [28, 27] exclusively showed high-risk PTC characteristics, in agreement with our study, Langer and Mandel [29] found that 10% of PTC patients had macrocalcification as a low-risk characteristic. Another study [30] revealed that middle-aged women comprise the majority of people affected by thyroid nodules, and PTC patients frequently had sonographic characteristics that were taller-than-wide shape. Our findings support their hypothesis on the increased prevalence of thyroid nodules in females and the high frequency of high-risk characteristics. Since the first observation by Moon et al. [31], who found that a taller-than-wide shape had 93% specificity for identifying malignancy, the shape of a nodule has gained diagnostic value for the separation between benign and malignant nodules.

A low intake of iodine and a high dose can cause thyroid problems. According to previous studies, low iodine consumption may increase the development of thyroid nodules [32, 33]. On the other hand, a few studies have

Table 3. Ultrasonographic characteristics of patients according to age

Parameter		No. (%)			P
		<20	20-45	>45	
High-risk features	Hypoechoic echogenicity	7(87.5)	25(71.4)	23(69.7)	0.71*
		1(12.5)	10(28.6)	7(30.3)	
	Microcalcification	3(42.9)	28(68.3)	22(66.7)	0.41*
		4(57.1)	13(31.7)	11(33.3)	
	Central vascularity	3(42.9)	10(43.5)	10(55.6)	0.73*
		4(57.1)	13(56.5)	8(44.4)	
	Taller than wide shape	4(8.9)	18(9.9)	15(9.3)	0.82
	Irregular margin	2(4.4)	18(9.9)	12(7.4)	0.88
	Twinkling	4(8.9)	16(8.8)	8(4.9)	0.88
	Two-lobe nodule	3(6.7)	10(5.5)	14(8.6)	0.84
Neck lymphadenopathy	3(6.7)	11(6.1)	12(6.7)	0.81	
Low-risk features	Hyperechoic echogenicity	1(12.5)	10(28.6)	7(30.3)	0.71
	Macrocalcification	4(57.1)	13(31.7)	11(33.3)	0.41
	Peripheral vascularity	4(57.1)	13(56.5)	8(44.4)	0.73
	Peripheral incomplete halo	8(17.8)	15(8.3)	23(14.2)	0.79
	Puff appearance	7(15.6)	31(17.1)	26(16)	0.85
	Spongy form nodule	7(15.6)	31(17.1)	26(16)	0.86
	Comet tail	7(15.6)	31(17.1)	26(16)	0.79

*Fisher exact test.

revealed that consuming too much iodine may cause thyroid nodules, too. Furthermore, another study showed the prevalence of PTC in females in iodine-deficient regions [34] because females are more vulnerable to hormone levels and varying iodine intake levels [35]. According to the latest national monitoring performed in 2018, West Azerbaijan Province is known as a region with mild iodine deficiency [36]. According to these studies and our findings, we can infer that the frequency of PTC US features in the West Azerbaijan Province of Iran, which is different from other areas, is due to being far from the sea and lack of easy access to seafood.

The primary limitation of this study is the retrospective analysis of patients' records, imaging results, and pathology data. Due to this retrospective methodology, we might not have been able to recognize crucial US findings that provide a clue to the diagnosis in real time;

this drawback could have impacted the investigators' opinion. Additionally, recurrence or metastasis might go unreported because some patients had relatively short follow-up periods.

Conclusion

The appearance of high-risk papillary carcinomas sonographic features, such as hypoechoic echogenicity, microcalcification, central vascularity, and taller-than-wide shape, is typical in PTC patients. Moreover, low-risk sonographic PTC features, such as macrocalcification, hyperechoic echogenicity, puff appearance, or spongy form nodules, were found to occur more often than expected in our patients. Based on the mentioned studies and our findings, we can infer that the high frequency of PTC US features in the West Azerbaijan Province of Iran can be due to iodine deficiency, being far from the sea, and lack of easy access to seafood.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the Ethics Committee of [Urmia University of Medical Sciences](#) (Code: IR.UMSU.HIMAM.REC.1400.009) and was conducted under the Declaration of Helsinki.

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Authors' contributions

Conceptualization: Ebrahim Mohammadi; Methodology and data collection: Mozghan Taghizad; Investigation, data analysis and writing: Ebrahim Mohammadi; Supervision and project administration: Neda Valizadeh.

Conflict of interest

The authors declared no conflict of interest.

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