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Original Research Article

Assessment of the ultrasonological findings of goitrogenous lesions associated with hypothyroidism

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Abstract

Introduction: Patients suffering from hypothyroidism frequently present with diffuse swellings of the thyroid gland. This is a result of compensatory hypertrophy of the thyroid gland in order to trap more iodine for hormone generation. Ultrasonography is a part of routine evaluation of the thyroid gland and in this particular study we shall be evaluating the specific ultrasonological features associated with hypothyroid goitres.
Aim: To analyze specific ultrasonological findings of goitrogenous lesions associated with hypothyroidism and assess the frequency of their appearance.
Materials and Methods: 80 patients presenting with goitrogenous lesions, in the hypothyroid state attending the Outpatient department in a teaching hospital in South Karnataka were selected. Patients meeting the inclusion criteria were included in the study. Detailed history taking and examination were done. Informed and written consent was taken from the patients before participating in the study. Patients selected were in the hypothyroid state as noted in the thyroid function tests, underwent ultrasonological analysis of the lesions. The findings were analyzed and the frequency of their appearance were assessed.
Results: 80 patients were included in this study. Significant correlations were found between radiological diagnosis and echotexture, vascularity and TIRADS scores of the lesions. The most common diagnosis were thyroiditis, multinodular goiter and colloidal goiter.
Conclusions: When evaluating goiters in the hypothyroid state, thyroiditis was noted to be the most common diagnosis, followed by multinodular goiter and colloidal goiter. Heterogenous echotexture and increased vascularity are common findings in hypothyroid lesions, particularly thyroiditis and multinodular goiter. In our study, we also noted patients with thyroiditis to have low risk of malignant transformation, while a higher risk was seen in patients with multinodular goiter. Ultrasonography is a highly sensitive, reproducible, non-invasive and cost effective diagnostic tool for thyroid lesions.

Keywords: Thyroid, ultrasound, Goiter, Hypothyroidism.

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1. Introduction

Based on pathology in the thyroid, pituitary, hypothalamus, or peripheral tissue, respectively, hypothyroidism is categorized as primary, central, or peripheral. The most common kind, acquired primary hypothyroidism, is more often brought on by persistent autoimmune thyroiditis in locations with abundant iodine than by severe iodine deprivation.[1-2] Most of the time, hypothyroidism has a subtle onset, and symptoms may appear later in the course of the condition.

Through examination and palpation, a clinical diagnosis of goiter is made and thyroid dysfunction is not always indicated by the development of goiter.[3]

The WHO classifies goitre into three grades: Grade 0 is no palpable swelling; Grade 1 is a mass in the neck which is not visible but is palpable when the neck is in the normal position and Grade 2 is a swelling visible in the normal position which is also palpable clinically and is consistent with an enlarged thyroid gland.[4] It also notes ultrasound to be a safe, feasible investigation when evaluating thyroid nodules, especially when prevalence of visible nodules is small.

Most mistakes occur when taking length measurement of lobes exceeding the length of the transducer's head. Resulting in a 20% difference in the calculated thyroid volume.[5] Inter-

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observer variation is believed to be the reason for the low sensitivity and specificity of clinical palpation.[6]

Kalra et al have noted the sensitivity, specificity, positive predictive value, negative predictive value of TIRADS to be 88%, 49%, 49%, 88% and 94% respectively when compared with fine needle aspiration cytology results.[7]

Such statistics further increase the importance of ultrasonography as a diagnostic tool in the evaluation of thyroid nodules.

2. Materials and Methods

Sources of data: 80 patients presenting with goitrogenous lesions, in the hypothyroid state attending the Outpatient department in a teaching hospital in South Karnataka.

2.1. Sampling procedure

Purposive sampling method.

2.2. Study design

Prospective, single centre, cross sectional, descriptive study.

2.3. Study duration

12 months.

2.4. Inclusion criteria

1. Patients between 10-70 years of age.
2. Patients in the hypothyroid state (biochemically proven) with goitrogenous lesions.

2.5. Exclusion criteria

1. Patients suffering from malignancies of the thyroid.
2. Patients suffering from hyperthyroidism and those in the euthyroid state.

2.6. Data collection method

Patients meeting the inclusion criteria were included in the study. Detailed history taking and examination were done. Informed and written consent were taken from the patients before participating in the study. Patients suffering from goitre in the hypothyroid state as noted in the thyroid function tests underwent ultrasonological analysis of the lesions. The findings were analyzed and the frequency of their appearance were assessed.

2.7. Outcome measures

Ultrasound reports of the included patients.

2.8. Statistical analysis

Categorical data was represented in the form of frequency and percentage Association between variables was assessed with Chi Square Test and Fisher's Exact test if the cell values were small. Quantitative data was represented as Mean & Sd Diagnostic accuracy between FNAC & Ultrasound findings was assessed with sensitivity, specificity, PPV, NPV.

A P value of <0.05 was considered statistically significant.

Data was analyzed with IBM SPSS Version 28 for windows.

3. Results

Table 1: Frequency of ultrasonological diagnosis

Radiological diagnosis	No of Patients	Percentage
Colloidal goitre	10	12.5
Multinodular goitre	14	17.5
Solitary nodule	7	8.8
Thyroiditis	40	50.0
Tirads II lesion	1	1.3
Tirads III lesion	3	3.8
Tirads IV lesion	4	5.0
Normal study	1	1.3
Total	80	100.0

In a total of 80 patients, 40 patients were diagnosed with thyroiditis, 14 with multinodular goiter, 10 with colloidal goiter, 7 with solitary nodules, 4 with TIRADS IV lesions, 3 with TIRADS III lesions, 1 with TIRADS II lesion, 1 was a normal study.

Figure 1: USG image of tirads 2 lesion in right lobe of thyroid

Figure 2: USG image of Tirads 3 lesion in right lobe of thyroid

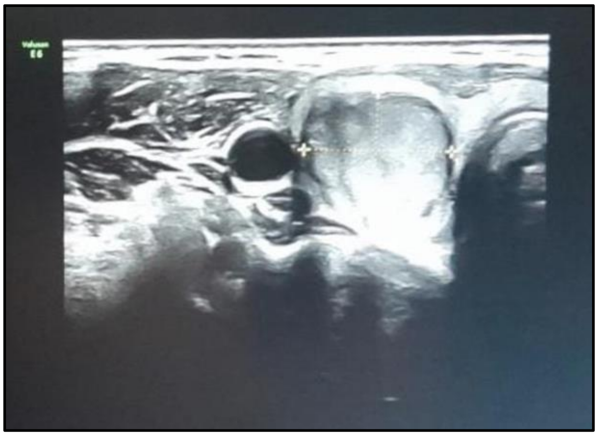

Figure 3: USG image of TIRADS 4 lesion in Right lobe of thyroid.

59 patients were found to have inhomogeneous echotexture in their lesions while 21 had homogeneous echotexture. Significant correlation was noted between the radiological diagnosis and echotexture. 33 patients with thyroiditis, 13 with multinodular goiter, all patients with TIRADS IV lesions were found to have inhomogeneous echotexture in their lesions. In contrast, 8 patients with colloidal goiter had lesions with homogeneous echotexture, out of 10.

39 patients had normal vascularity in their lesions while 41 had increased vascularity. Significant correlation was noted between the radiological diagnosis and vascularity of the lesions. Of the 50 patients with thyroiditis, 25 had increased vascularity. 3 of the 3 patients with TIRADS III lesions had increased vascularity, while 3 of the 4 patients with TIRADS IV lesions had increased vascularity. Of the 10 of the patients with colloidal goiter, 8 had normal vascularity.

Table 2: Correlation between echotexture and radiological diagnosis

Radiological diagnosis	**Echotexture**		**Chi Square test**	
	Inhomogeneous	**Homogeneous**	**χ^2 Value**	**P Value**
Colloidal goitre	2	8	26.285	P<0.001
Multinodular goitre	13	1		
Solitary nodule	5	2		
Thyroiditis	33	7		
Tirads II lesion	0	1		
Tirads III lesion	2	1		
Tirads IV lesion	4	0		
Normal study	0	1		
Total	59	21		

Table 3: Correlation between vascularity and radiological diagnosis.

Radiological diagnosis	**Vascularity**		**Chi Square test**		**Radiological diagnosis**	**TIRADS**				**Chi Square test**	
	Normal	**Increased**	**$\chi 2$ Value**	**P Value**		**I**	**II**	**III**	**IV**	**$\chi 2$ Value**	**P Value**
Colloidal goitre	8	2	14.488	P<0.01	Colloidal goitre	5	4	1	0	87.856	P<0.001
Multinodular goitre	5	9			Multinodular goitre	1	0	9	4		
Solitary nodule	5	2			Solitary nodule	2	0	4	1		
Thyroiditis	15	25			Thyroiditis (Hashimoto)	24	13	3	0		
TIRADS II lesion	1	0			Tirads II lesion	0	1	0	0		
TIRADS III lesion	3	0			Tirads III lesion	0	0	3	0		
TIRADS IV lesion	1	3			Tirads IV lesion	0	0	0	4		
Normal study	1	0			Normal study	1	0	0	0		
Total	39	41			Total	33	18	20	9		

Table 4: Correlation between TIRADS score and radiological diagnosis

Radiological diagnosis	Tirads				Chi Square test	
	I	II	III	IV	χ^2 Value	P Value
Colloidal goitre	5	4	1	0	87.856	P<0.001
Multinodular goitre	1	0	9	4		
Solitary nodule	2	0	4	1		
Thyroiditis	24	13	3	0		
Tirads II lesion	0	1	0	0		
Tirads III lesion	0	0	3	0		
Tirads IV lesion	0	0	0	4		
Normal study	1	0	0	0		
Total	33	18	20	9		

Significant correlation was found between the TIRADS score and the radiological diagnosis. 33 patients had TIRADS I lesions, 18 had TIRADS II lesions, 20 had TIRADS III lesions, 9 had TIRADS IV lesions. 24 of the patients with thyroiditis had lesions in the TIRADS I category, 13 in TIRADS II category, 3 in TIRADS III category. Patients with colloidal goiter had lesions predominantly in the TIRADS I and II categories, while patients with multinodular goiter had lesions predominantly in TIRADS III and IV categories.

4. Discussion

Hypothyroidism is a metabolic disorder caused due to reduced levels of thyroid hormone, the causes for which are usually classified as – primary and secondary. Primary is caused due to reduced production and is seen in autoimmune conditions like hashimotos thyroiditis, de Quervain disease, deficiency in iodine intake, also in patients who take medications like a amiodarone, thalidomide, oral tyrosine kinase inhibitors. Secondary hypothyroidism is on the other hand caused due to defect in the hypothalamic-pituitary axis and is also called central hypothyroidism.[8]

Tirads scoring system uses several thyroid ultra sonographic characteristics like composition, echogenicity, shape, margin, and echogenic foci to assess the need for FNA cytology and to propose when to recommend active surveillance.[9] It was proposed by the American College of Radiology.[10]

The scoring is done as follows:

One score is assigned from each of the following categories:

Composition: (choose one)

1. cystic or completely cystic *: 0 points
2. spongiform *: 0 points
3. mixed cystic and solid: 1 point
4. solid or almost completely solid: 2 points

Echogenicity: (choose one)

1. Anechoic: 0 points
2. Hyper- or isoechoic: 1 point
3. Hypoechoic: 2 points
4. Very hypoechoic: 3 points

Shape: (choose one) (assessed on the transverse plane)

1. wider than tall: 0 points
2. taller than wide: 3 points

Margin: (choose one)

1. Smooth: 0 points
2. ill-defined: 0 points
3. Lobulated/irregular: 2 points
4. Extra-thyroidal extension: 3 points

Any and all findings in the final category are also added to the other four scores.

Echogenic foci: (choose one or more)

1. None: 0 points
2. Large comet-tail artifact: 0 points
3. Macrocalcifications: 1 point
4. Peripheral/rim calcifications: 2 points
5. Punctate echogenic foci: 3 points

The scores are added and graded as

1. Tirads 1: Benign (0 points).
2. Tirads 2: Not suspicious for malignancy(1-2 points).
3. Tirads 3: Mildly suspicious (3 points).
4. Tirads 4: Moderately suspicious (4-6 points).
5. Tirads 5: Highly suspicious (more than 7 points).[11]

The sonographic appearance of autoimmune thyroiditis are inhomogenous, hypoechogenic pattern (as compared to the echogenicity of the neck muscles), increased vascularity. While in iodine deficient patients is a diffuse goitre which often becomes nodular with normal perfusion.[12]

Gonzalez and Pascual, in their study on 114 patients with primary hypothyroidism, noted 19% of the patients with negative antithyroid antibodies to have a diagnosis of chronic thyroiditis. They noted 42.1% of the patients to have clinically unsuspected nodular goiter.[13] In our study, we noted 50% of the cases to have thyroiditis, 17.5% to have multinodular goiter and 12.5% to have colloidal goiter, making these the predominant diagnoses in our study.

Lazlo Hegedus noted in his paper that simple, diffuse goitre had discretely irregular echotexture, poorly defined nodules and various degrees of hypo echogenicity. Decreased intrathyroidal blood flow was also noted to be associated with chronic thyroiditis.[14] In our study, we found inhomogeneous echotexture to be associated more with multinodular goiter than colloidal goiter. In cases of multinodular goiter and thyroiditis, we found increased vascularity associated with the lesions. Hashimoto's thyroiditis has been noted to have increased vascularization in the acute and subacute phases and decreased vascularization in the chronic phases.[15]

In cases of chronic thyroiditis, the lower thyroid artery's systolic peak velocities typically fall below 40 cm/s. Due to significant fibrosis, ultrasound findings in the latter chronic phase of Hashimoto's thyroiditis include a tiny, poorly defined gland with diffusely inhomogeneous parenchyma and no flow on Doppler ultrasound.[15] Inhomogeneous echotexture of the thyroid parenchyma was also noted predominantly in cases of chronic thyroiditis and Grave's disease in our study. The inhomogeneous echotexture is due to lymphocytic infiltration of the gland, fibrosis and apoptosis of the normal thyroid parenchyma.[16]

In cases of multinodular goiter, well marginated, diffuse enlargement of the gland with increased vascularity and inhomogeneous echotexture has been noted in our study. Cystic components if present, have been found to be highly unlikely to be associated with malignant transformation. The inhomogeneous internal echoes have been noted to be because of internal haemorrhage, internal accumulation of debris and formation of blood clots.[16]

5. Conclusions

When evaluating goiters in the hypothyroid state, thyroiditis was noted to be the most common diagnosis, followed by multinodular goiter and colloidal goiter. Heterogenous echotexture and increased vascularity are common findings in hypothyroid lesions, particularly thyroiditis and multinodular goiter. In our study, we also noted cases of thyroiditis to have low risk of malignant transformation, with most of the lesions having a grading of TIRADS I or II on ultrasound. In contrast, multinodular goiter showed a higher risk of transformation, with 9 of the recorded cases having a TIRADS score of III.

Ultrasonography is a cost-effective, noninvasive technique, reproducible and highly sensitive technique for evaluating the thyroid gland. Further imaging workup is rarely needed and in B mode ultrasound, echogenicity is best assessed.

6. Source of Funding

None.

7. Conflict of Interest

None.

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