DIAGNOSTIC CORRELATION OF ULTRASOUND AND THYROID FUNCTION TESTS IN EARLY THYROID DISEASES: A CROSS SECTIONAL STUDY

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ABSTRACT

BACKGROUND: Thyroid disease is a growing problem in young people and adolescents. Ultrasonography (US) serves as an optimal imaging modality for thyroid gland evaluation due to its ease of use, cost-effectiveness, non-invasiveness, and absence of ionizing radiation. It is used for detecting the growth of lumps in the neck or adjacent structures and serves as a valuable tool for uncovering thyroid gland abnormalities and detecting lesions that cannot be felt manually alongside the use of thyroid function tests.

OBJECTIVES: The purpose of this study was to determine if thyroid function tests (TFTs) and ultrasound characteristics are correlated in patients who report with palpable masses and neck swelling. This would allow for an evaluation of the usefulness of ultrasonography as a thyroid problem diagnostic tool.

METHODOLOGY: A cross-sectional study with 126 participants was carried out with an emphasis on symptomatic candidates who were 12 years of age or older. Participants had ultrasound exams and TFTs performed. Using standardized imaging techniques, ultrasound impressions were gathered, and the results were correlated with TFT reports.

RESULTS: The results of the study showed that the TFT reports, and ultrasound characteristics had a very strong positive link (Pearson correlation coefficient = 0.694, $p < 0.01$). Among 126 participants, 69.8% exhibited abnormal thyroid function. Ultrasound identified various thyroid pathologies, including nodules, hyperthyroidism, thyroiditis, Hashimoto's disease, cysts, goiter, and thyroid atrophy.

CONCLUSION: The study underscores the clinical utility of ultrasound in diagnosing thyroid disorders. The strong correlation observed emphasizes ultrasound's complementary role in thyroid disease diagnosis. Integrating ultrasound into routine assessments can enhance diagnostic accuracy, enabling early intervention and personalized treatment plans. These insights advocate for a holistic approach to thyroid disease management, ensuring optimal outcomes and improved quality of life for affected individuals.

KEYWORDS: Thyroid disorders, thyroid function tests, ultrasound, diagnosis, correlation.

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INTRODUCTION:

Thyroid disease is a growing problem in young people and adolescents. Thyroid dysfunction and structural anomalies are frequently observed, with various factors such as environmental influences, genetic predisposition, age, and gender playing significant roles in these aberrations[1]. Various conditions, including iodine deficiency necessary for thyroid hormone production, diffuse thyroid diseases, and thyroid nodules, can result in morphological changes in the thyroid gland. The predominant category of diffuse thyroid diseases encompasses autoimmune thyroid diseases (AITD), which include Hashimoto's thyroiditis (HT) and Graves' disease (GD)[2], [3].

Ultrasonography (US) has been a longstanding diagnostic tool employed for the assessment and monitoring of thyroid disorders [4]. Ultrasonography (US) serves as an optimal imaging modality for thyroid gland evaluation due to its ease of use, cost-effectiveness, non-invasiveness, and absence of ionizing radiation. It is not limited to the assessment of nodular thyroid diseases but also finds utility in detecting autoimmune thyroid diseases (AITD) [5], [6]. Kim et al. documented the utility of real-time ultrasonography (US) in distinguishing diffuse thyroid disease from normal thyroid parenchyma [7]

In autoimmune thyroid diseases (AITD), a reduction in thyroid echogenicity results from lymphocyte infiltration and disruption of normal tissue structure. Reduced echogenicity in ultrasonography (US) observations can help in the early identification of AITD [4], [8], [9].

For this age group to grow and thrive, early identification is crucial. Pregnant women often have thyroid dysfunctions, which are far more common in females [10]. Thyroid functional tests (TFTs), physical examination, and high-resolution ultrasonography are available methods for evaluating thyroid glands; TFTs are the preferred evaluation technique [11].

When assessing thyroid disorders—whether they are diffusely vascular or localized—Doppler imaging is a useful tool. Volumetric analysis is essential for size estimation, especially when thyroid function is compromised, and it facilitates the follow-up procedure [11]. Thyroid dysfunctions, which include disorders such as hypothyroidism and hyperthyroidism, and structural illnesses such as goiter, nodules, and malignancy, are the two main groups of thyroid diseases. Although these illnesses are usually easy to manage, there are always hazards involved, including the possibility of incorrect diagnosis, overdiagnosis, and unsuitable therapy [12].

This research is rooted in the initial ultrasound findings related to thyroid gland disorders, showcasing its effectiveness as the optimal method for detecting the growth of lumps in the neck or adjacent structures. It serves as a valuable tool for uncovering thyroid gland abnormalities and detecting lesions that cannot be felt manually. The study aims to identify different early thyroid gland nodule pathologies, suspicious lesions, and carcinomas using ultrasound imaging alongside Thyroid Function Tests [13], [14].

METHODOLOGY

A cross-sectional, cohort study was performed to find correlation of ultrasonography and thyroid function tests in early thyroid diseases in the Radiology Department of Premier Institute of Health and Management Sciences from June to September 2023. Convenience sampling technique was used and 126 patients encompassing both symptomatic and asymptomatic individuals participated in this study. All participants underwent Thyroid Function Tests (TFTs) and subsequently received ultrasound examinations as part of the diagnostic evaluation process.

The sample selection for this study comprised individuals of all genders, with a specific focus on those meeting certain criteria. Included in the study were symptomatic patients aged 12 years and older, as well as individuals belonging to high-risk populations or those with a family history of thyroid cancer. Patients with normal Thyroid Function Tests (TFTs), those who had had surgery, including lobectomies, and those undergoing chemotherapy were not allowed to participate in the research. Patients with established hereditary disorders, such as multiple endocrine neoplasia type-II, were also excluded from this research, as were those who were already being monitored for thyroid cancer because they had a prior history of the condition. Data analytics were performed using SPSS version 26 software. A correlational analysis was planned to explore the associations between TFTs lab Reports and Ultrasound features.

For the ultrasound examination, all measurements were performed using a standardized imaging procedure by the same radiologist, who possesses over ten years of experience in vascular ultrasound and who were blind to the patients. The patient was positioned in the supine position with their neck extended, and a folded towel was placed beneath their shoulders to provide proper support. The ultrasound transducer was positioned transversely over the anterior region of the neck. To ensure a clear connection and prevent artifacts, ultrasound gel was applied. The transducer was then gently moved down the entire length of the thyroid gland, starting from the sternal notch and extending up to the mandible. Ultrasonographic images were acquired from both longitudinal and transverse angles to thoroughly assess the thyroid gland.

The same radiologist, who has over 10 years of expertise in vascular ultrasonography, carried out all measures for the ultrasound examination using a standardized imaging process while remaining blind to the patients. With their neck extended and a folded towel under their shoulders for support, the patient was put in the supine position. The front portion of the neck was covered by the transversely positioned ultrasound transducer. Ultrasound gel was used to guarantee a clean connection and avoid artifacts. After that, the transducer was gradually advanced from the sternal notch all the way up to the jaw, along the whole length of the thyroid gland. To fully evaluate the thyroid gland, transverse and longitudinal ultrasonography pictures were obtained.

In addition to the thyroid gland, the internal jugular vein, common carotid artery, and cervical lymph nodes were also closely examined throughout the examination. Conventional sonographic imaging methods were used to evaluate the submandibular gland and normal thyroid tissue's echotexture with those of any localized lesions and diffuse parenchymal abnormalities, such as color Doppler grayscale imaging and B-Mode ultrasonography. This all-encompassing method made it possible to thoroughly assess the thyroid gland and the organs that surround it.

Ethical approval was obtained from Premier Institute of Health and Management Sciences with the reference number EC/119/2023 and issued on May 30, 2023.

RESULTS

A total of 126 individuals in all who had palpable lumps or masses in their necks and widespread edema were enrolled in this research to be evaluated. The cohort, which included 45 men (35.7%) and 81 women (64.3%), all had ultrasound exams. The subjects in the study ranged in age from 12 to 77 years, with a notable percentage of 51 individuals (40.5%) falling between the 26 to 40 age brackets. Furthermore, a significant proportion of the participants—78 people, or 61.9 percent—were married.

All patients had their medical histories carefully gathered, with particular attention to any symptoms pertaining to thyroid gland diseases, as depicted in Figure 1. Among the 81 female

participants, 32 exhibited a normal menstrual cycle, while 49 individuals (60.49%) reported a disturbed menstrual cycle pattern. Subsequently, thyroid function tests were administered to the entire cohort of 126 participants. The results revealed that 88 individuals (69.8%) exhibited abnormal thyroid function, while 38 participants (30.2%) displayed normal thyroid function.

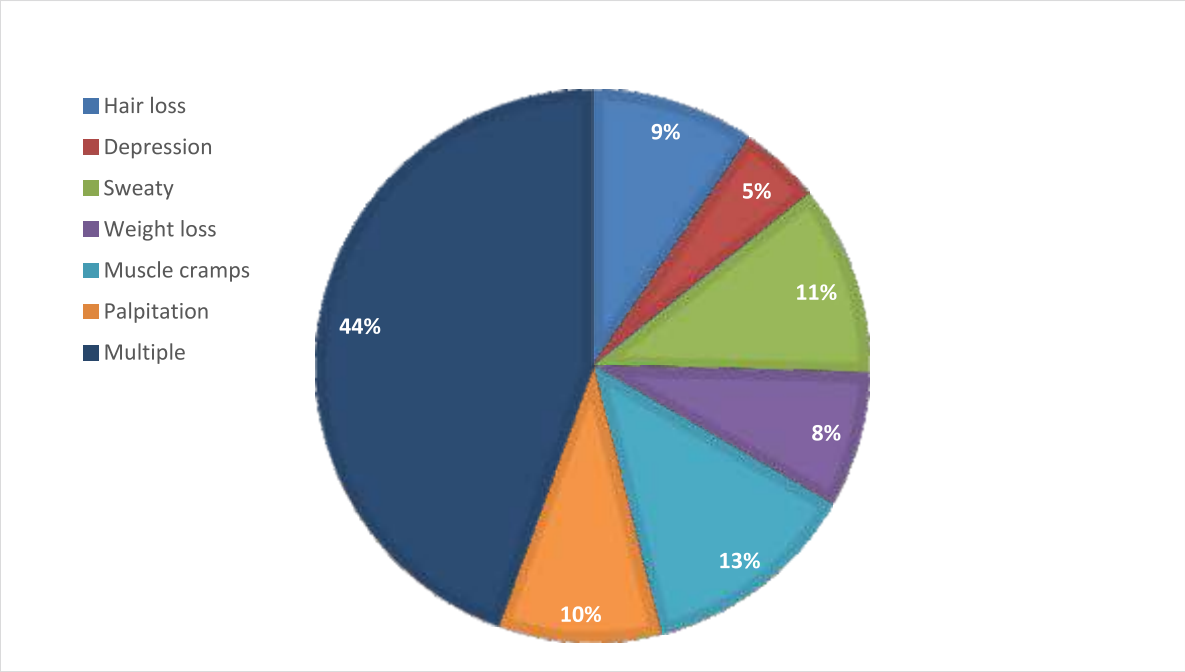

Figure 1: The association of complications with early thyroid diseases

The ultrasound impressions encompass the various diseases identified in the participants who underwent ultrasound diagnosis. The findings revealed the following frequencies of diseases in the neck region: normal thyroid gland was observed in 23 individuals (18.3%), nodules were detected in 19 participants (15.1%), hyperthyroidism was diagnosed in 29 individuals (23.0%), thyroiditis was identified in 5 patients (4.0%), Hashimoto's disease was present in 10 individuals (7.9%), cysts were found in 14 patients (11.1%), and both goiter (enlarged thyroid) and thyroid atrophy were observed in 13 participants (10.3%). The comprehensive analysis involved the evaluation of TFTs lab reports, patient's ultrasound study features, and patient ultrasound impressions.

According to the data presented in Table 1, analysis indicates a strong and statistically significant correlation between the thyroid function test (TFT) reports and the ultrasound features of the patients. As a measure of the direction and intensity of the association between the variables, the estimated Pearson correlation coefficient was found to be 0.694, indicating a very positive correlation. This implies a strong correlation between the TFT findings and the detected ultrasonography characteristics in the patients' neck areas.

The statistical significance of the correlation, as indicated by the significance level of 0.01 (2-tailed), highlights the dependability of the found link. To put it another way, these findings are clinically relevant since the anomalies seen in the TFTs reports closely match the ultrasound characteristics observed in the patients. This robust link implies that detectable ultrasound characteristics in the neck area closely mimic changes in thyroid function, as revealed by TFTs. This information is useful for precise diagnosis and patient treatment.

Table 1: Correlations between TFTs Reports and Ultrasound features

		TFTs reports	Ultrasound features
TFTs reports	Pearson Correlation	1	.694**
	Sig. (2-tailed)		0
Ultrasound features	Pearson Correlation	.694**	1
	Sig. (2-tailed)	0	
****. Correlation is significant at the 0.01 level (2-tailed).**			

DISCUSSION

The thyroid gland, a pivotal endocrine organ, plays a fundamental role in maintaining overall body metabolism and homeostasis. Consequently, accurate diagnosis of thyroid disorders is paramount for effective patient management. This study delved into the correlation between thyroid function tests (TFTs) and ultrasound features in 126 participants exhibiting neck swelling and palpable masses. The robust correlation coefficient of 0.694 uncovered a highly positive association between TFTs and ultrasound findings. This significant correlation reinforces the clinical utility of ultrasound in diagnosing a spectrum of thyroid conditions, ranging from nodules and hyperthyroidism to thyroiditis, Hashimoto's disease, cysts, goiter, and thyroid atrophy.

The demographics of the studied population underscored the prevalence of thyroid disorders, particularly among adults aged 26 to 40. This age group's susceptibility might be attributed to various factors, such as environmental triggers, lifestyle changes, and hormonal imbalances. Moreover, the gender distribution revealed a higher incidence among females, corroborating existing literature highlighting the increased vulnerability of women to thyroid dysfunctions [15]. Notably, our study unveiled a compelling connection between menstrual irregularities and thyroid disorders in female participants. While this correlation demands further exploration, it hints at intricate hormonal interplays that might influence both menstrual cycles and thyroid function. Understanding these intricate relationships can significantly enhance our comprehension of thyroid-related pathophysiology.

The clinical implications of our findings are profound. The strong correlation between TFTs and ultrasound features emphasizes the complementary role of imaging modalities, especially ultrasound, in thyroid disease diagnosis. Ultrasound's ability to visualize thyroid abnormalities, including nodules and inflammation, provides invaluable insights for clinicians. These visual cues empower healthcare professionals to make accurate diagnoses and formulate tailored treatment strategies. Moreover, the non-invasiveness and cost-effectiveness of ultrasound render it a practical choice for routine thyroid assessments, especially in resource-constrained healthcare settings.

While our study illuminates critical correlations, several limitations merit consideration. The sample size, though adequate for the current analysis, could be expanded in future studies to enhance statistical robustness. Longitudinal investigations are imperative to elucidate the dynamic progression of thyroid disorders over time. Additionally, exploring the influence of genetic predispositions, environmental factors, and lifestyle choices on thyroid health could enrich our understanding of disease etiology.

In the context of broader healthcare strategies, our findings advocate for a holistic approach to thyroid disease diagnosis and management. Integrating ultrasound into routine assessments can significantly enhance diagnostic accuracy, enabling early intervention and personalized treatment plans. Furthermore, raising awareness about the correlation between menstrual irregularities and thyroid disorders among women is crucial. Healthcare providers should consider thyroid screenings for patients reporting menstrual abnormalities, ensuring timely detection and appropriate management.

Our study aligns with prior research emphasizing the pivotal role of ultrasound in thyroid disease diagnosis. Smith-Bindman et al.'s population-based study corroborates our findings, demonstrating ultrasound's efficacy in identifying thyroid abnormalities [16]. Moreover, Durfee et al.'s retrospective review underscores the utility of thyroid ultrasound in clinical practice, reinforcing its relevance as a diagnostic tool [17].

CONCLUSION

Our study sheds light on the intricate interplay between TFTs and ultrasound features in thyroid disease diagnosis. The robust correlation observed underscores the pivotal role of ultrasound as a complementary diagnostic modality. As we navigate the complexities of thyroid disorders, integrating ultrasound into routine assessments emerges as a prudent choice. This non-invasive, cost-effective imaging technique empowers healthcare professionals to make accurate diagnoses, fostering early intervention and personalized patient care. Embracing these insights, healthcare providers can revolutionize thyroid disease management, ensuring optimal outcomes and enhanced quality of life for affected individuals.

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Key for Author Contributions:

A. Conception and Planning of the research
B. Acquisition of data/participation in designing methodology
C. Interpretation, analysis and discussion
D. Review of the manuscript