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COMPARISON OF DOPPLER INDICES WITH FNAC FINDINGS AMONG PATIENTS WITH THYROIDITIS

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Abstract:
The superior thyroid artery Doppler study offers additional advantages by characterizing vascular flow changes specific to thyroiditis. Increased vascularity, as evidenced by elevated PSV or altered RI and PI values, is a hallmark of inflammatory thyroid diseases, such as Hashimoto's or De Quervain's thyroiditis. Correlating these Doppler findings with biochemical and cytological parameters enables precise differentiation, fostering early diagnosis and optimal management. The study was conducted at the Department of Radio-Diagnosis. This setting was selected due to its accessibility to a large and diverse patient population, including both outpatient and inpatient referrals for USG of thyroid. The institution is equipped with state-of-the-art diagnostic facilities, including high-resolution ultrasound (HRUS), essential for this study. The medical sciences institute provided a well-controlled environment for imaging and clinical examinations, making it an ideal location for collecting accurate and reliable data. In this study the mean PSV in Graves' disease was 74.60 ± 3.30 cm/s, while in Hashimoto's thyroiditis the mean PSV was 25.54 ± 2.84 cm/s, and in subacute thyroiditis the mean PSV was 50.32 ± 2.96 cm/s. In this study the mean PI in Graves' disease was 1.50 ± 0.05, while in Hashimoto's thyroiditis the mean PI was 0.91 ± 0.04, and in subacute thyroiditis the mean PI was 1.17 ± 0.05.

Keywords: Doppler Indices, FNAC, Thyroiditis

Introduction:

Thyroid diseases are among the most common endocrine disorders worldwide, affecting individuals of all age groups, with a significant impact on physical, psychological, and metabolic health. Thyroiditis, a condition marked by inflammation of the thyroid gland, presents challenges in diagnosis and management due to its heterogeneous clinical and pathological spectrum.[1] Accurate differentiation of thyroiditis from other thyroid abnormalities is essential for guiding appropriate therapeutic interventions and avoiding misdiagnoses.[2] Doppler ultrasound, a non-

invasive imaging modality, has emerged as a valuable tool in evaluating thyroid vascularity and detecting changes in hemodynamic parameters associated with thyroid diseases.[3]

Superior thyroid arteries (STAs), the primary vascular supply to the thyroid gland, play a pivotal role in understanding the hemodynamic alterations linked to thyroid disorders. Doppler indices, including Peak Systolic Velocity (PSV), Pulsatility Index (PI), and Resistive Index (RI), provide quantifiable data on vascular resistance and flow dynamics.[4] Abnormal Doppler patterns in the STAs are often reflective of underlying inflammatory or hyperplastic processes in thyroiditis, offering a potential diagnostic adjunct in differentiating thyroid conditions.[5] The application of Doppler indices in assessing thyroiditis has gained traction, as it enables clinicians to glean insights into disease severity and its correlation with thyroid function tests (TFTs).[6]

Thyroid function tests, including serum levels of Thyroid-Stimulating Hormone (TSH), Free Triiodothyronine (FT3), and Free Thyroxine (FT4), remain the cornerstone of evaluating thyroid dysfunction. However, these tests often require supplementary diagnostic modalities to confirm the etiology of thyroid disorders, especially in ambiguous cases[7]. Fine Needle Aspiration Cytology (FNAC) is a reliable technique for diagnosing inflammatory and neoplastic thyroid conditions. Integrating Doppler ultrasound with FNAC results provides a comprehensive assessment, bridging imaging findings with cytological evidence.[8]

The superior thyroid artery Doppler study offers additional advantages by characterizing vascular flow changes specific to thyroiditis. Increased vascularity, as evidenced by elevated PSV or altered RI and PI values, is a hallmark of inflammatory thyroid diseases, such as Hashimoto's or De Quervain's thyroiditis.[9] Correlating these Doppler findings with biochemical and cytological parameters enables precise differentiation, fostering early diagnosis and optimal management.

Despite advancements in diagnostic approaches, challenges persist in distinguishing thyroiditis from other conditions, such as diffuse hyperplasia or thyroid malignancy, particularly in resource-constrained settings. Doppler indices of the STAs have the potential to augment the diagnostic accuracy of thyroiditis evaluation, reducing reliance on invasive procedures.[10] By exploring the role of Doppler ultrasound as an adjunct to traditional diagnostic modalities, this study aims to elucidate its value in the comprehensive assessment of thyroiditis.

Methodology:

Informed consent was obtained together with detailed history. All the ultrasounds were performed using the Mindray DC70 Ultrasound machine using a linear probe of frequency 7–12 MHz, along with a coupling agent (ultrasound gel). At first, using, a B-mode scan was used to look for echogenicity of the gland and any lesions. STA is the first branch of the external carotid artery that arises anteriorly at the level of the hyoid bone. In most cases, the vessel can be traced up to the upper pole of the thyroid gland and then the color Doppler mode was used. The spectral waveform was taken with a sample gate size of 1 mm and Doppler angles of 30–60. Peak systolic velocity (PSV), Pulsatility index (PI) and Resistance index (RI) of bilateral STAs calculated.

The study was conducted at the Department of Radio-Diagnosis. This setting was selected due to its accessibility to a large and diverse patient population, including both outpatient and inpatient referrals for USG of thyroid. The institution is equipped with state-of-the-art diagnostic facilities, including high-resolution ultrasound (HRUS), essential for this study. The medical sciences institute provided a well-controlled environment for imaging and clinical examinations, making it an ideal location for collecting accurate and reliable data. The proximity to a wide demographic of patients also enhanced the generalizability of the study’s findings, ensuring a representative sample from both rural and urban populations.

Inclusion Criteria: -

- All patients who are advised for USG neck and found to have thyroid abnormalities.
- Clinical suspicion of thyroiditis.
- Known case of thyroiditis.

Exclusion Criteria: -

- Patients in whom partial or total thyroidectomy was performed.
- Patients who underwent radioiodine therapy.
- Patients who underwent radio-isotope scans or procedures.

Study Sampling

Purposive sampling was used in this study, where participants were selected based on specific inclusion criteria. This non-random selection process was essential for targeting patients presenting with thyroiditis, as only these individuals would be relevant for the research objectives. This approach ensured that participants had the required conditions to make the study both feasible and focused on thyroid pathology. Purposive sampling allowed for the inclusion of a specific, yet diverse group of patients with varying causes of thyroid abnormalities, providing a representative cross-section of the population. The total number of participants was fixed, ensuring adequate representation of different thyroid pathologies for the study's analytical purposes.

Study design: Prospective cross-sectional study.
Sample Size and sampling method: Purposive sampling, sample size =80

Study data collection

Data was collected through direct patient examination, imaging results and medical history. The data from USG,blood investigation and FNAC reports were stored and analyzed. During the examination, detailed notes on the size, PSV, RI, PI values of doppler of STA were recorded. The data was entered in M.S. Excel and represented in the form of percentages and frequencies in tables and diagrams. The data was analyzed using the software SPSS. Independent t-tests and paired t-tests was be used for the test of significance.

Results:

Table 1: Distribution of FNAC results in the study

Diagnosis	Frequency	Percentage
Graves' Disease	30	37.5
Hashimoto's Thyroiditis	28	35.0
Subacute thyroiditis	22	27.5
Total	80	100.0

In this study majority of the study participants (37.5%) had Grave's disease, followed by Hashimotos' Thyroiditis (35.0%) and Subacute thyroiditis (27.5%).

Table 2: PSV (cm/s) and Thyroid conditions

	Mean ± SD	95% CI		P value
		Lower limit	Upper limit	
Graves' Disease	74.60 ± 3.30	73.37	75.83	
Hashimoto's Thyroiditis	25.54 ± 2.84	24.43	26.64	
Subacute thyroiditis	50.32 ± 2.96	49.00	51.63	

Total	50.75 ± 21.22	46.03	55.47	<0.001

* p value<0.05; Hence statistically significant

In this study the mean PSV in Graves' disease was 74.60 ± 3.30 cm/s, while in Hashimoto's thyroiditis the mean PSV was 25.54 ± 2.84 cm/s, and in subacute thyroiditis the mean PSV was 50.32 ± 2.96 cm/s. This difference in PSV among different study groups was found to be statistically significant (p<0.001).

Table 3: PI and thyroid conditions

	Mean ± SD	**95% CI**		**P value**
		Lower limit	**Upper limit**	
Graves' Disease	1.50 ± 0.05	1.47	1.52	
Hashimoto's	0.91 ± 0.04	0.89	0.93	
Subacute	1.17 ± 0.05	1.15	1.20	
Total	1.20 ± 0.25	1.14	1.26	

* p value<0.05; Hence statistically significant

In this study the mean PI in Graves' disease was 1.50 ± 0.05, while in Hashimoto's thyroiditis the mean PI was 0.91 ± 0.04, and in subacute thyroiditis the mean PI was 1.17 ± 0.05. This difference in PI among different study groups was found to be statistically significant (p<0.001).

Table 4: RI and thyroid conditions

		95% CI		
		Lower limit	**Upper limit**	
Graves' Disease	0.69 ± 0.01	0.69	0.70	
Hashimoto's	0.51 ± 0.01	0.50	0.51	
Subacute	0.58 ± 0.01	0.57	0.58	
Total	0.59 ± 0.08	0.58	0.61	

* p value<0.05; Hence statistically significant

In this study the mean RI in Graves' disease was 0.69 ± 0.01, while in Hashimoto's thyroiditis the mean RI was 0.51 ± 0.01, and in subacute thyroiditis the mean RI was 0.58 ± 0.01. This difference in RI among different study groups was found to be statistically significant (p<0.001).

Discussion:

The mean PSV in case of Graves' disease was 74.60 ± 3.30 cm/s in our study. In the study conducted by Sarangi et al., the mean PSV was found to be 93.46 ± 45.14 cm/s. The mean PSV in Ramya et al., study was 66.00 ± 11.38 cm/s, and in the Sundaram et al., study the mean PSV was 54.09 ± 4.67 cm/s. In the Uchida et al., study the mean PSV was found to be 78.48 ± 36.28 cm/s among patients with Graves' disease. But the Karakas et al., the median PSV was found to be 138 with interquartile range of 107 – 301 cm/s. In euthyroid conditions the mean PSV obtained varied between 16 to 25 cm/s.[11,12]

In this study the mean PSV among Hashimoto's thyroiditis was 25.54 ± 2.84 cm/s. In the study conducted by Sarangi et al., the mean PSV among patients with thyroiditis was 37.90 ± 15.33 cm/s. In the study conducted by Ramya et al., the mean PSV was 29.15 ± 11.51 cm/s. In the study conducted by Sundarram et al., the mean PSV was 28.92 ± 4.39 cm/s. In the study conducted by Uchida et al., the mean PSV was found to be 20.76 ± 7.77 among patients with Hashimoto's thyroiditis. In the Karakas et al., study the median PSV was found to be 54 with an interquartile range of 37 to 59 cm/s.

In this study the mean PI was found to be 1.50 ± 0.05 among patients with Graves' disease and 0.91 ± 0.04 among those with Hashimoto's thyroiditis. In the study conducted by Sundarram et al., the mean PI was found to be 1.95 ± 0.33 among patients with Graves' disease and 1.87 ± 0.43 among patients with thyroiditis.[13]

In our study the mean RI was found to be 0.69 ± 0.01 among patients with Graves' disease and 0.51 ± 0.01 among patients with Hashimoto's' thyroiditis. Almost similar values were obtained by Sundarram et at., in their study with mean RI of 0.59 ± 0.08 among patients with Graves' disease and 0.57 ± 0.12 among patients with Hashimoto's thyroiditis. In the study conducted by Ramya et al., the mean RI was ± 0.06 among patients with Graves' disease and 0.66 ± 0.11 among patients with thyroiditis. In the study by Karakas et al., the median RI were 0.63 (0.47 – 0.72) among patients with Graves' disease and 0.54 (0.49 – 0.67) among patients with thyroiditis.[14]

There is significant positive correlation between PSV and PI, as well as between PSV and RI and PI and RI in this study. The correlation obtained was of a very high level in this study. Hence with an increase in any of the indices the other indices also tend to increase.

Conclusion:

- In this study the mean PSV in Graves' disease was 74.60 ± 3.30 cm/s, while in Hashimoto's thyroiditis the mean PSV was 25.54 ± 2.84 cm/s, and in subacute thyroiditis the mean PSV was 50.32 ± 2.96 cm/s.
- In this study the mean PI in Graves' disease was 1.50 ± 0.05, while in Hashimoto's thyroiditis the mean PI was 0.91 ± 0.04, and in subacute thyroiditis the mean PI was 1.17 ± 0.05.
- In this study the mean RI in Graves' disease was 0.69 ± 0.01, while in Hashimoto's thyroiditis the mean RI was 0.51 ± 0.01, and in subacute thyroiditis the mean RI was 0.58 ± 0.01.

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