



Radio-Diagnosis

INFERIOR THYROID ARTERY DOPPLER: A NEW TOOL IN DIFFERENTIATION OF GRAVE'S DISEASE AND HASHIMOTO'S THYROIDITIS. A NOVEL RADIOLOGICAL-PATHOLOGICAL CORRELATION STUDY

Dr Rohan V

Senior Resident, Department Of Radio-diagnosis, Bangalore Medical College And Research Institute.

Dr Yogaisvariya J
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Senior Resident, Department Of Surgery, Bangalore Medical College And Research Institute.

ABSTRACT

Background: Autoimmune thyroid diseases are characterized by diffuse involvement of thyroid gland with hypoechogenicity and altered echotexture at gray scale ultrasound being a characteristic feature. An overlap of this pattern in patients affected by Graves' disease or Hashimoto's thyroiditis. Differentiation between causes of thyrotoxicosis at time of diagnosis, either hyperthyroidism due to Graves' disease or destructive thyrotoxicosis due to thyroiditis, is very important as management of each is completely different. **Aims and Objectives:** Comparison of Doppler indices in patients of Diffuse thyroid disease (Graves' and Hashimoto's) on ultrasound with normal study population. **Material & Methods** Participants were recruited in the ultrasound unit at the Victoria hospital, Bangalore medical college and research institute. We conducted a prospective study on a group of 20 Normal individuals and 40 patients with Diffuse thyroid disease on Ultrasonography (20 cases of Hashimoto's thyroiditis and 20 cases of Graves disease). The thyroid glands of all patients were evaluated by gray scale ultrasonography for size, shape and echotexture. Color-flow Doppler ultrasonography of the thyroid tissue was performed and spectral flow analysis of both inferior thyroid arteries was assessed. Inferior thyroid artery Doppler parameters were calculated in all patients. **Results** Mean PSV of normal individuals was 16.4. Hashimoto's patients who had their mean PSV was 36.2 and Graves patients who had their mean PSV 86.4. On applying unpaired t test, the two tailed p value was less than 0.05 (0.001 and 0.0001 respectively), which found statistically highly significant. The comparison of Doppler indices of Hashimotos disease and Graves diseases - On applying unpaired t test, the two tailed p value was less than 0.05 (0.0001) which was found statistically highly significant. **Conclusion** Blood flow is a useful marker in initial diagnosis of diffuse thyroid. The high correlation between Doppler indices with pathological diagnosis establishes this modality as an acceptable alternative to Nuclear imaging. Its role in pregnancy and lactation where nuclear imaging is contraindicated needs to be emphasised.

KEYWORDS : Color doppler; Diffuse thyroid disease; Grave's Disease; Hashimoto's ;

INTRODUCTION

The most common cause of thyrotoxicosis is Graves' disease. [1-3] Autoimmune thyroid diseases are characterized by diffuse involvement of thyroid gland with hypoechogenicity and altered echotexture at gray scale ultrasound being a characteristic feature. An overlap of this pattern in patients affected by Graves' disease or Hashimoto's thyroiditis.

Differentiation between causes of thyrotoxicosis at time of diagnosis, either hyperthyroidism due to Graves' disease or destructive thyrotoxicosis due to thyroiditis, is very important as management of each is completely different. If with absence of specific signs of Graves' disease like ophthalmopathy, skin and nail changes it may be difficult to distinguish it from thyroiditis, especially when the disease is mild or subclinical. [4-5]

Thyroid scintigraphy by technetium99 (Tcm99) pertechnetate or iodine 123 radioisotopes can be used for this purpose. However, these methods are not usually available. It is non portable, time consuming and associated with an increased cost. Nuclear imaging is expensive and is contraindicated during pregnancy and lactation. (6-7) Thyroid hypoechogenicity at ultrasound is a characteristic of autoimmune thyroid diseases, with an overlap of this echographic pattern in patients affected by Graves' disease or Hashimoto's thyroiditis. However, an increased thyroid blood flow is pathognomonic of untreated Graves' disease and an abnormal color flow Doppler (CFD) pattern identifies the majority of Graves' patients with a normal thyroid ultrasound pattern. Thus, CFD sonography may be useful in distinguishing patients with Graves' disease and Hashimoto's thyroiditis with a similar thyroid echographic pattern.

Doppler thyroid ultrasonography is a useful, inexpensive, non-invasive and widely available method for measuring tissue vascularization and blood flow. The evaluation can be both qualitative (visual assessment of thyroid vascularity) and quantitative (measuring peak systolic, end diastolic and mean velocities in the inferior thyroid arteries). CFD ultrasonography of the thyroid gland can provide valuable information about underlying thyroid functional status and is useful in the differential diagnosis of thyrotoxicosis [8-11].

By conducting this simple yet novel correlation study, we hope to possibly reduce ambiguity in reporting thyroiditis with help of Colour

Doppler and Spectral Doppler of Inferior thyroid artery Doppler.

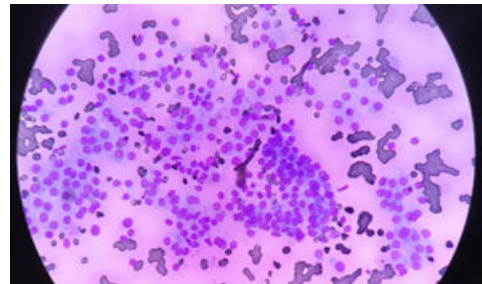
Graves' disease

Figure 2 - Histopathology - Smears studied show thyroid follicular cells in sheets and in repetitive micro and macrofollicular pattern. Cytoplasmic vacuolation noted at places. Background shows hemorrhage and scant colloid

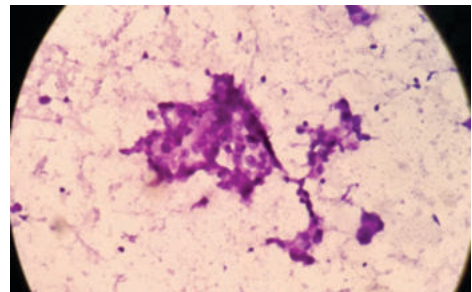
Hashimoto's thyroiditis

Figure 1 - Histopathology - Smears studied show thyroid follicular cells showing lymphocytic infiltration and follicular destruction. Few cells show Hurthle cell (Askenazy cell) change. Background shows lymphoid cells and hemorrhage.

Aims And Objectives

Comparison of Doppler indices in patients of Diffuse thyroid disease (Graves' and Hashimoto's) on ultrasound with normal study population

METHODOLOGY

Source of data: Participants were recruited in the Ultrasound Unit at the Victoria hospital, Bangalore medical college and research institute

Study design: This was a Prospective Comparison study.

Study period: Dec 2021 – June 2022

Sample size : 60 cases.

Inclusion Criteria

- Patients willing to give consent
- Patients with clinical and blood investigations
- Baseline TSH, fT3 and fT4 levels
- Serum Anti-TPO, Anti-Thyroglobulin and Anti-TSH receptor antibody level titres
- Ultrasonography report of Diffuse thyroid disease
- FNAC with diagnosis of Hashimoto's/ Graves disease

Exclusion Criteria

- Patients with Thyroid nodule
- Patients who are already started on treatment

We conducted a prospective study on a group of 20 Normal individuals and 40 patients with Diffuse thyroid disease on Ultrasonography (20 cases of Hashimoto's thyroiditis and 20 cases of Graves disease). The thyroid glands of all patients were evaluated by gray scale ultrasonography for size, shape and echotexture. Color-flow Doppler ultrasonography of the thyroid tissue was performed and spectral flow analysis of both inferior thyroid arteries was assessed using Linear High resolution probe (L 12-5) of Philips Affiniti 50G ultrasound machine under Thyroid setting. Inferior thyroid artery Doppler parameters were calculated in patients with 20 normal healthy individuals with normal thyroid function tests.

The Doppler angle of insonation was corrected to 60° or less. There was no significant difference between the PSV of inferior thyroid artery from both sides of the thyroid gland, later arithmetic mean derived from both values was taken in this study. Inferior thyroid artery Doppler parameters including PSV, RI and PI were determined, and the same were later compared with FNAC / Serological reports using appropriate statistical tests.

Statistical Analysis

Data were entered and managed in the Microsoft Excel 2010 spreadsheet. Variables were tabulated and summarised into means for continuous variables and percentages for categorical variables.

Furthermore, the risk differences between the two groups were adjusted for potential differences in their baseline characteristics. Independent t test was used to determine the significance of differences between categorical variables and was used to compare means, all using a 5% significance level.

RESULTS

Thus 60 patients formed the final study group comprised of three divisions

One group each with -

- 20 normal individuals
- 20 evaluated cases of Hashimoto's
- 20 evaluated cases of Graves disease.

The mean +/- SD of PSV , EDV and RI was calculated and tabulated.

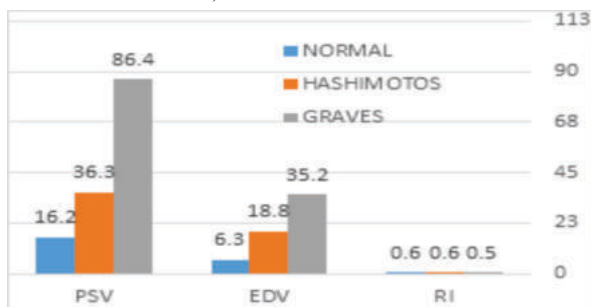


Figure 3– Graph showing the relations of PSV, EDV and RI of normal controls and individuals with Hashimoto's and Graves' disease

The comparison of Doppler indices of Hashimoto's disease and Graves diseases with normal individuals-

Hashimoto's patients had their mean PSV was 36.2 and Graves patients had their mean PSV 86.4. Mean PSV of normal individuals was 16.4. On applying unpaired t test, the two tailed p value was less than 0.05 (0.001 and 0.0001 respectively), which found statistically highly significant.

The comparison of Doppler indices of Hashimoto's disease and Graves diseases-

On applying unpaired t test, the two tailed p value was less than 0.05 (0.0001) which was found statistically highly significant.

Table 1 - Table the relations of PSV, EDV and RI of normal controls and individuals with Hashimoto's and Graves' disease

Characteristic (Mean +/-SD) Group	Inferior thyroid artery Doppler - Mean			
	N	PSV	EDV	RI
Normal population	20	16.2 +/- 2.4	6.4 +/- 1.4	0.64 +/- 0.03
Hashimoto's	20	36.2 +/- 6.4	18.6 +/-3.2	0.56 +/- 0.04
Graves' Disease	20	86.4 +/- 18.2	34.2 +/-5.2	0.46 +/- 0.04

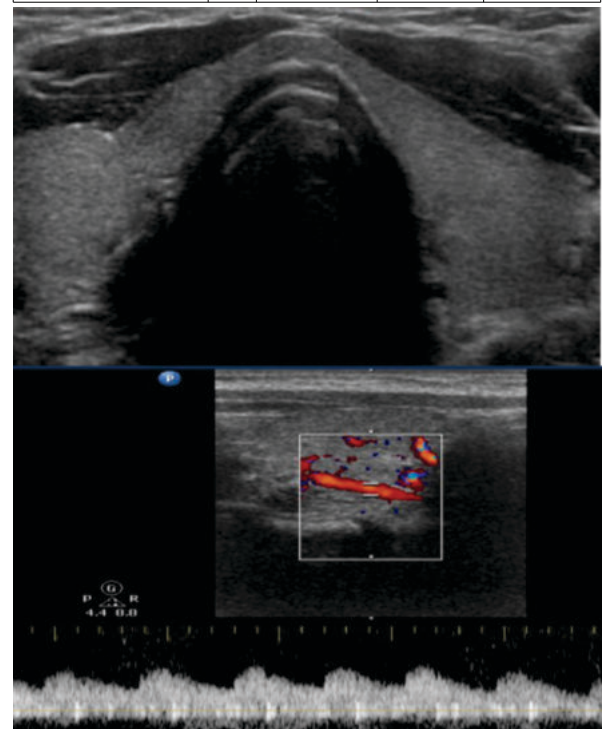


Figure 4 – Gray scale appearance and Doppler evaluation of thyroid gland in normal individuals. Homogenous echotexture of normal thyroid gland.

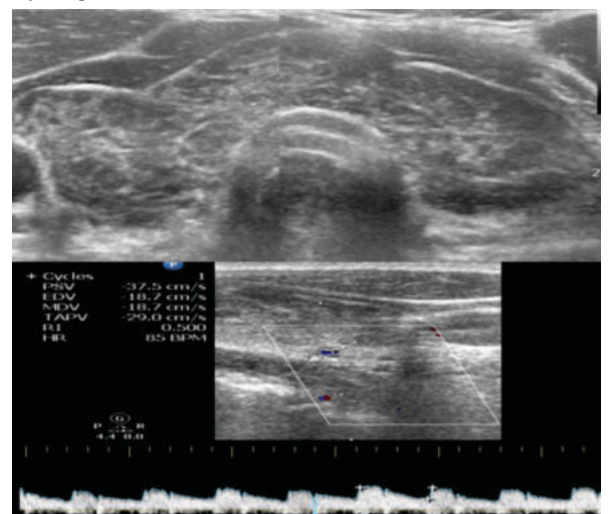


Figure 5 – Gray scale appearance and Doppler evaluation of thyroid

gland in patients with Hashimoto's thyroiditis. Gray scale shows diffusely altered echotexture with multiple hypoechoic areas and intervening hyperechoic fibrous strands. Doppler evaluation shows PSV of 37 cm/sec.

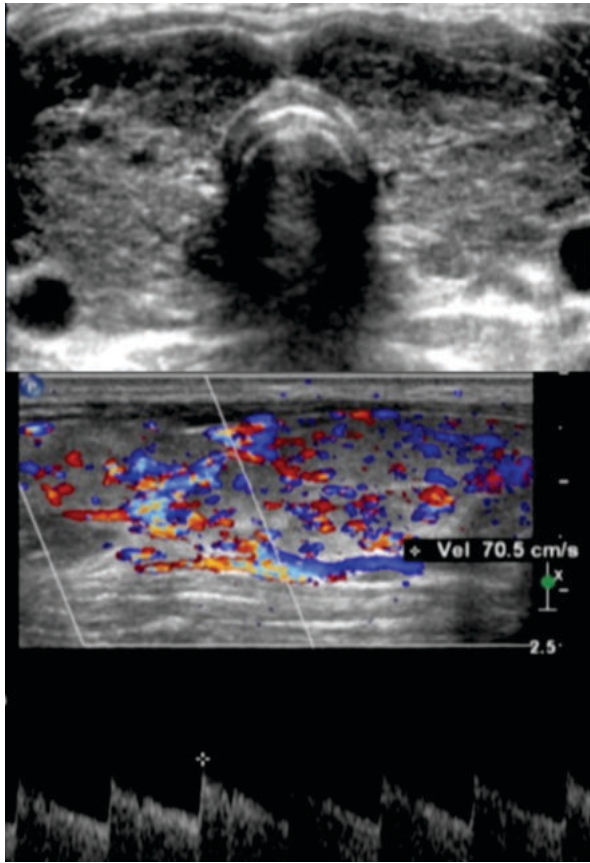


Figure 6– Gray scale appearance and Doppler evaluation of thyroid gland in patients with Graves disease. Gray scale shows diffusely altered echotexture with multiple hypoechoic areas. Doppler evaluation shows high PSV of 70 cm/sec.

DISCUSSION

Inferior thyroid artery is the third branch of thyrocervical trunk and forms the major arterial supply to the thyroid gland compared to superior thyroid artery. Doppler evaluation of Inferior thyroid artery is more practical and helps in better understanding of changes in the thyroid gland vasculature in case of thyroid gland pathology.

The important concern for the clinician in the outpatient setting would be to distinguish Graves from Thyroiditis in a thyrotoxic patient.

Ultrasonography with color doppler is widely available and is increasingly used to evaluate thyroid gland in their outpatient setting. Performing an USG examination of thyroid will be an extension of clinical evaluation in the outpatient department with the results available immediately for choosing the management strategy. [12-13]. Ralls et al [14] used doppler in patients with Graves' disease and concluded the increased blood flow in the thyroid gland. They coined the term thyroid inferno for the increase in thyroid parenchyma vascularization. Since then, doppler has been used to investigate the pathogenesis of thyrotoxicosis in Graves' disease. Increased thyroid parenchyma vascularization can also occur in thyroiditis, but to a lesser extent when compared to graves' disease.

In most literatures, it has been observed that the vascularity of thyroid gland correlated with the underlying functional status of the gland. It was low when the disease was under control and more in cases of relapse. The method used in thyroid artery doppler is a quantitative measurement of the blood flow pattern in the thyroid gland parenchyma.

Doppler has the potential to monitor therapy response in patients, as well as distinguish Graves' patients from Diffuse Thyroiditis without the need for expensive laboratory assays in their studies.

Inference From Present Study -

Doppler indices in Graves' disease is significantly higher when compared to other autoimmune thyroid diseases and normal individuals.

Past Studies Corroborating With The Result -

Study by Ali S. Alzahrani, MD, FACE1; Graziano Ceresini, MD, PhD2; Saleh A. Aldasouqi, MD, FACE, FACP, ECNU3 concluded that Colour Doppler evaluation in Graves and Hashimoto's can be used as a cost effective and diagnostic alternative to Nuclear imaging. [15]

Study by dos Santos, T.A.R.R., Pina, R.O.G., de Souza, M.T.P. and Chammas, M.C. concluded that Doppler is an excellent alternative to radioisotopes exams, with similar accuracy and without any contraindication.

Study by KS Thalavai Sundarram et.al has demonstrated the utility of High resolution ultrasound combined with Color Doppler in the evaluation of the most common forms of hyperthyroidism in a simpler and cost-effective way, negating the use of scintigraphy in selected patients. [16]

In a study by Donkol et al, 20 the mean PSV of 40.0 cm/s in Inferior Thyroid Artery was higher and suggestive of Graves Disease, while most other studies proposed a PSV of above 50.0 cm/s. Values above 100 cm/s can be reached in newly diagnosed patients or patients not responsive to treatment. [17]

The 2011 American Thyroid Association guidelines mentioned ultrasound with color doppler as an important and reliable indicator of thyroid blood flow, and that it may have a practical value in the differentiation of cause of thyrotoxicosis, especially in pregnant patients or patients with recent iodine exposure. [18]

CONCLUSION

Blood flow is a useful marker in initial diagnosis of diffuse thyroid disease.

The high correlation between Doppler indices with pathological diagnosis establishes this modality as an acceptable alternative to Nuclear imaging with an additional benefit of being cost effective and easily available. Its role in pregnancy and lactation where nuclear imaging is contraindicated needs to be emphasized. Investigations such as Thyroid Scintigraphy does has high operating cost and also considering strict measures to be adhered when handling the Radioactive material, which is expensive and also has a short shelf life. The man power resources involved in the process of performing the test is also more. Performing a thyroid doppler ultrasound would be more cost effective, non invasive and portable being the advantage than performing a Scintigraphy. The implementation of Color Doppler Flow module, which takes into account the objective parameters of Color Doppler e.g. PSV of thyroid artery has significantly decreased the rate of ambiguous reports of thyroiditis in clinical practice. Measurement of thyroid blood flow by Doppler should be an essential part of initial investigations of thyrotoxicosis Doppler analysis can be also used to monitor therapeutic response in patients with Graves disease. This topic needs to be further research.

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