ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 08 | August - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

DIAGNOSTIC ROLE OF SUPERIOR THYROID ARTERY PEAK SYSTOLIC VELOCITY (DOPPLER) IN DIFFERENTIATING GRAVES' DISEASE FROM THYROIDITIS

Radio-Diagnosis

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ABSTRACT

Introduction: Thyrotoxicosis is characterized by increased thyroid hormone levels, includes conditions like hyperthyroidism resulting from overactive thyroid gland. Sometimes it can be challenging clinically in differentiating Graves' disease from thyroiditis. The gold standard test (thyroid nuclear imaging scan) is expensive, not routinely available, and has radiation exposure. Color Doppler ultrasonography of thyroid can be used for differentiating these conditions by studying thyroid blood flow parameters and is more accessible, available, and cost-effective tool. Assessment of the superior thyroid artery (STA) flow parameters with color Doppler ultrasonography is useful for differentiating Graves' disease from thyroiditis. **Aims:** Assessment of the superior thyroid artery (STA) flow parameters with color Doppler ultrasonography for differentiating Graves' disease from thyroiditis. **Materials and Methods:** The study was conducted in Department of Radiodiagnosis, JJMMC, Davangere. This is a cross-sectional study on 50 patients with newly diagnosed thyrotoxicosis (30 with Graves' disease and 20 with thyroiditis) and 45 years of age. The patients underwent clinical examination and necessary investigations. Color Doppler ultrasonography of the thyroid gland and spectral flow analysis of both superior thyroid arteries was done using standard protocol. Sensitivity and specificity for mean peak systolic velocity of STA (STA-PSV) cut-offs were calculated using receiver operating characteristic curves. **Results:** Of 50 patients, 30 had Graves' disease and 20 had thyroiditis. The mean STA-PSV of patients with Graves' disease (62.4+/-7.22) was significantly higher than thyroiditis (34.65+/-7.84) group. The Receiver Operating curve analysis indicated that mean STA-PSV greater than 51cm/s had 93% sensitivity and 100% specificity in diagnosing Graves' disease. **Conclusion:** Results showed that mean STA-PSV in Graves' disease significantly exceeds those in thyroiditis and cutoff value of PSV > 51 cm/s has high sensitivity and specificity in differentiating Graves' disease from thyroiditis and can be used in clinical practice as a simple diagnostic tools, giving a cost-effective and widely available alternative to more expensive diagnostic methods.

KEYWORDS

Graves' disease, Peak systolic velocity, Superior thyroid artery, Thyrotoxicosis, Thyroiditis

INTRODUCTION

The metabolic increase in thyroid hormone levels are the hallmarks of thyrotoxicosis. A group of thyrotoxic diseases known as hyperthyroidism is caused by the overactive thyroid gland. Hyperthyroidism represents a specific subset of thyrotoxic disorders which is caused due to hyperfunctioning of thyroid gland. Graves' disease, toxic multinodular goitre, and toxic adenoma are commonly encountered causes of hyperthyroidism. On the other hand, inflammation of thyroid gland (destructive thyroiditis) with release of stored thyroid hormones or excessive exogenous thyroid hormone preparation ingestion (thyrotoxicosis factitia) can also lead to thyrotoxicosis without actual hyperfunctioning of gland. Diffuse thyroid illness and thyrotoxicosis are caused by Graves' disease and destructive thyroiditis. It is crucial to distinguish between these two illnesses because their treatment plans and prognoses are totally different. Antithyroid medications, radioiodine therapy and thyroidectomies are a few of the treatment options for Graves' disease. On the other hand, nonsteroidal anti-inflammatory medications (NSAIDs) and blockers are used in the conservative management of destructive thyroiditis. Goitre, ophthalmopathy, and dermopathy make up the traditional Graves' disease triad. But without these results, it might be very difficult clinically to distinguish between destructive thyroiditis and Graves' illness. The gold-standard diagnostic to distinguish between these two conditions is thyroid scintigraphy using technetium 99 (Tc-99m) pertechnetate or iodine-123 radioisotope. Nuclear imaging is usually expensive and not recommended for use when pregnant or nursing. According to recent studies of PSV-STA's usefulness in separating Graves' illness from destructive thyroiditis, the test has good sensitivity and specificity.The diagnostic accuracy of these methods has been compared to findings from nuclear scans such radioactive iodine uptake or Tc-99m pertechnetate in previous research analyzing the function of color Doppler flow parameters in the diagnosis of thyrotoxicosis. Thyrotropin (thyroid stimulating hormone [TSH]) receptor antibody levels can also be measured because they are directly linked to the diagnosis of Graves' illness. The evaluation of thyroid problems can benefit greatly from the use of high-resolution ultrasonography as a diagnostic tool. It is the most used non-invasive, low-cost radiographic approach for the diagnosis of thyroid disorders. Blood flow and tissue vascularization can be assessed using Color Doppler sonography. Qualitative (visual examination of thyroid vascularity) and quantitative (peak systolic velocity [PSV] of superior thyroid arteries) assessment are included in the evaluation. Autoimmune thyroiditis is characterized by thyroid hypoechogenicity, and thyroiditis and Graves' disease share this echographic pattern. When comparing the thyroid blood flow in thyroiditis and Graves' disease, Doppler ultrasound can be utilized to distinguish between these disorders and gives more details on the functional health of the thyroid underneath. The benefit of ultrasound is that it can reveal thyroid nodules that were previously unidentified and may have been cancerous. We conduct this study to generate cut-offs that might be more effectively used in our population as earlier studies had been conducted in many populations and generated various cut-offs with differing sensitivity and specificity. This study gives how to distinguish between Graves' disease and thyroiditis using PSV of the superior thyroid artery (STA), also known as PSV-STA. Sometimes it can be challenging clinically in differentiating Graves' disease from thyroiditis. Color Doppler ultrasonography of thyroid can be used for differentiating these conditions by studying thyroid blood flow parameters.

AIMS AND OBJECTIVES

Assessment of the Peak systolic velocity (PSV) of superior thyroid artery (STA) flow parameters with color Doppler ultrasonography for differentiating Graves' disease from thyroiditis. The second objective is, determining cut off value for Peak systolic velocity of superior thyroid artery in differentiating Graves' disease and thyroiditis.

METHODS AND MATERIALS

The study was conducted in Department of Radiodiagnosis, JJMMC, Davangere, India between June and October 2024

This is a cross-sectional study on 50 patients with newly diagnosed thyrotoxicosis without medications for hyperthyroidism were included in the study (30 with Graves' disease and with 20 thyroiditis). Patients with toxic nodular goitre, multinodular goitre, drug induced thyrotoxicosis and previous history of thyroid surgery were excluded. Ethical clearance was obtained from the institutional ethics committee and written informed consent was secured from all individuals before their inclusion in the study. The patients underwent clinical examination and necessary investigations. Color Doppler

ultrasonography of the thyroid gland and spectral flow analysis of both superior thyroid arteries was done using standard protocol. Linear high frequency transducer in a high end ultrasound machines was used, the thyroid gland was examined using both grayscale B mode imaging and Color Doppler. The STA can be distinguished just medial to the CCA at the top pole of the thyroid gland by having an opposing flow direction from the nearby CCA in transverse scanning. Doppler was assessed at the location where the STA crosses the upper pole of the thyroid gland (just before the artery enters the thyroid parenchyma). After accurate angle correction, PSV-STA was measured on both right and left superior thyroid arteries. The Doppler angle was maintained at or below 60 degrees, and the angle correction cursor was parallel to the flow direction. PSV was estimated within the axis of a straight stretch of vessel with the sampling volume set to 3 mm at the vessel's center. Sensitivity and specificity for mean peak systolic velocity of STA (STA-PSV) cut-offs were calculated using receiver operating characteristic curves.

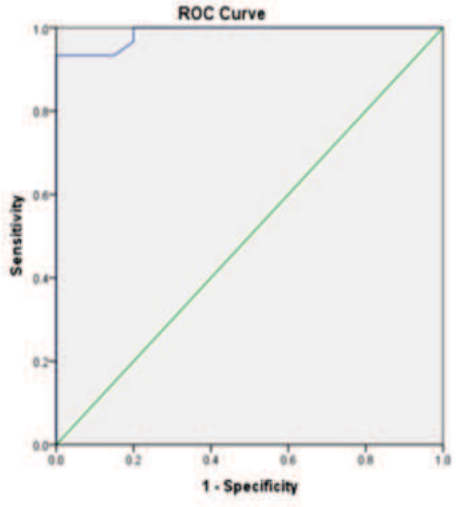
RESULTS

- In this present study of the 50 patients, 30 had Graves' disease and 20 had thyroiditis. The mean PSV values in Graves' disease was 62.4 ± 7.22 and in thyroiditis was 34.65 ± 7.84 which was statistically significant ($p < 0.001$).
- The Receiver Operating Characteristic (ROC) curve analysis of PSV values for Graves' disease showed cut-off threshold value as 51 (95% C.I = 43.78-58.22), with a sensitivity of 93.3%, and a specificity of 100%. The area under the curve (AUC) was 0.987 (95% C.I = 0.966-1.0) with a statistically significant p value ($p < 0.001$).
- The mean STA-PSV of patients with Graves' disease was significantly higher than thyroiditis group.
- Mean STA-PSV greater than 51cm/s had 93%sensitivity and 100%specificity in diagnosing Graves' disease.

Mean Color Doppler Values in Graves Disease and Thyroiditis

	GravesDisease (n=30)	Thyroiditis (n=20)	P value, Sig
PSV-STA (cm/s)	62.4 ± 7.22	34.65 ± 7.84	<0.001, Sig

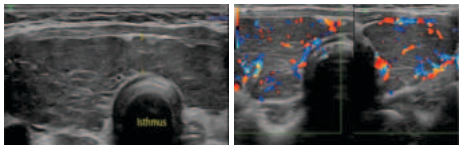
ROC Curve for PSV for Graves' Disease

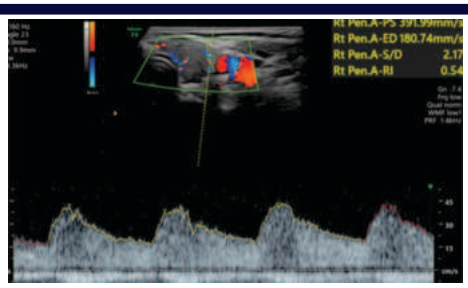


	Cut off for grave's disease (95% CI)	AUC (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	+LR	-LR
PSV-STA (cm/s)	> 51 (43.78 – 58.22)	0.987 (0.966–1.0)	93.3% (84 - 100)	100% (76.8 – 100)	11	0

ROC Curve Values of PSV for Graves' Disease

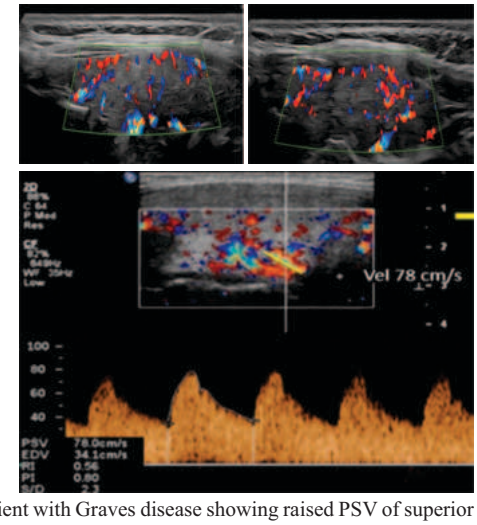
Case 1: Thyroiditis





A patient with thyroiditis showing raised PSV of Superior thyroid artery of 39cm/s

Case 2: Graves Disease



A patient with Graves disease showing raised PSV of superior thyroid artery (78cm/s).

DISCUSSION

- In our study of 50 patients with newly diagnosed thyrotoxicosis without medications for hyperthyroidism (30 with Graves' disease and with 20 thyroiditis) the mean PSV values in Graves' disease was 62.4+/-7.22 and in thyroiditis was 34.65+/-7.84 which was significantly higher in Graves' disease compared to thyroiditis. In our study the optimum cut off value for mean STA-PSV was 51(95% CI = 43.78-58.22).
- Nuclear imaging is expensive and not advised during pregnancy or lactation, despite being the gold-standard test. Color Doppler ultrasound is a more accessible, available, and affordable diagnostic technology.

CONCLUSION

- The mean PSV-STA in Graves' disease is significantly higher than thyroiditis. Mean STA-PSV has high sensitivity and specificity in differentiating Graves' disease from thyroiditis. In our study, mean STA-PSV >51cm/s had a good sensitivity and specificity in diagnosing Graves' disease and, can be used in clinical practice as a simple diagnostic tool.

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