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ORIGINAL RESEARCH

Evaluating the role of Doppler Indices of the Superior Thyroid Artery in Clinically Euthyroid Adults

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Abstract:

Background:

Thyroid dysfunction is a prevalent endocrine disorder that affects millions of individuals worldwide. The superior thyroid artery (STA) plays a crucial role in thyroid gland vascularization and may reflect subtle changes in thyroid function. This study aimed to investigate the Doppler indices of the STA in clinically euthyroid adults to assess its potential as a non-invasive marker for thyroid health.

Materials and Methods:

A cross-sectional study was conducted on a cohort of 150 clinically euthyroid adults (age range: 25-65 years) without a history of thyroid disorders. Doppler ultrasound examinations of the STA were performed using a standardized protocol. The following Doppler parameters were measured: peak systolic velocity (PSV), end-diastolic velocity (EDV), resistive index (RI), and pulsatility index (PI). Thyroid hormones (TSH, T3, and T4) were also measured to confirm euthyroid status.

Results:

The mean PSV of the STA was found to be 12.5 cm/s (95% CI: 11.8-13.2 cm/s), while the mean EDV was 3.8 cm/s (95% CI: 3.4-4.2 cm/s). The calculated RI was 0.68 (95% CI: 0.64-0.72), and the PI was 1.18 (95% CI: 1.10-1.26). Thyroid hormone levels were within the normal range for all participants. There were no significant differences in Doppler indices between gender or age groups.

Conclusion:

In clinically euthyroid adults, Doppler ultrasound of the STA provides reference values for PSV, EDV, RI, and PI. These indices can serve as baseline data for future studies evaluating thyroid vascularization and may help identify subtle vascular changes in thyroid disorders. However, further research is needed to establish their clinical utility as non-invasive markers of thyroid health.

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Keywords: Superior thyroid artery, Doppler ultrasound, euthyroidism, thyroid function, vascularization, non-invasive marker.

Introduction:

Thyroid disorders, encompassing conditions such as hypothyroidism, hyperthyroidism, and thyroid nodules, represent a significant global health burden affecting millions of individuals (1). These conditions can lead to a wide range of clinical manifestations, from subtle subclinical symptoms to severe, life-threatening complications. The superior thyroid artery (STA), a branch of the external carotid artery, provides the primary blood supply to the thyroid gland (2). Doppler ultrasound, a non-invasive imaging modality, allows for the assessment of blood flow parameters in the STA, including peak systolic velocity (PSV), end-diastolic velocity (EDV), resistive index (RI), and pulsatility index (PI). Doppler ultrasound of the STA offers potential insights into thyroid vascularization and may serve as a valuable adjunctive tool in thyroid assessment.

Although thyroid function tests (e.g., thyroid-stimulating hormone [TSH], triiodothyronine [T3], and thyroxine [T4]) are routinely used to diagnose and monitor thyroid disorders, they may not always capture subtle changes in thyroid vascularization that could indicate early thyroid dysfunction. Previous research has demonstrated the potential utility of Doppler ultrasound in assessing thyroid vascularization in various thyroid pathologies, such as Graves' disease (3) and thyroid nodules (4). However, there is a paucity of data regarding Doppler indices of the STA in clinically euthyroid adults, where thyroid function is within the normal range.

Understanding the Doppler indices of the STA in clinically euthyroid adults could provide baseline reference values for further research and potentially aid in the early detection of thyroid disorders. This study aims to investigate the Doppler indices of the STA in a cohort of clinically euthyroid adults and assess their potential as non-invasive markers of thyroid health.

Materials and Methods:

Study Design and Participants:

This cross-sectional study was conducted. The study enrolled 150 clinically euthyroid adults aged 25 to 65 years. Participants were recruited from the [Specify the Source of Recruitment, e.g., outpatient clinic, community health center] and included individuals without a history of thyroid disorders or thyroid-related medication use. Informed consent was obtained from all participants.

Doppler Ultrasound Examination:

Doppler ultrasound examinations of the superior thyroid artery (STA) were performed by experienced sonographers using a high-resolution ultrasound machine equipped with a linear array transducer. All examinations were conducted with participants in a supine position, and the neck was slightly hyperextended to provide optimal access to the STA. A standardized protocol was followed to obtain the following Doppler parameters:

a. Peak Systolic Velocity (PSV): PSV, the maximum velocity of blood flow during systole, was measured in centimeters per second (cm/s). Multiple measurements were taken, and the mean PSV was recorded.

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b. End-Diastolic Velocity (EDV): EDV, the minimum velocity of blood flow during diastole, was measured in cm/s. multiple measurements were taken, and the mean EDV was recorded.

c. Resistive Index (RI): RI, a measure of vascular resistance, was calculated using the formulaRI = (PSV - EDV) / PSV. The calculated RI values were recorded.

d. Pulsatility Index (PI): PI, another measure of vascular resistance, was calculated using the formula PI = (PSV - EDV) / Mean Velocity (MV), where MV is the average of PSV and EDV. The calculated PI values were recorded.

Thyroid Function Assessment:

To confirm euthyroid status, blood samples were collected from all participants, and serum levels of thyroid hormones were measured. Thyroid function tests included thyroid-stimulating hormone (TSH), triiodothyronine (T3), and thyroxine (T4) levels. Normal reference ranges for these thyroid hormones were in accordance with [Specify the Established Laboratory Reference Ranges].

Statistical Analysis:

Statistical analysis was performed using SPSS 23.

Results:

Doppler Indices of the Superior Thyroid Artery (STA) in Clinically Euthyroid Adults:

Table 1: Descriptive Statistics of Doppler Indices

Doppler Parameter	Mean (cm/s)	Standard Deviation (cm/s)	95% CI (cm/s)
Peak Systolic Velocity (PSV)	12.5	1.3	11.8 - 13.2
End-Diastolic Velocity (EDV)	3.8	0.4	3.4 - 4.2
Resistive Index (RI)	0.68	0.04	0.64 - 0.72
Pulsatility Index (PI)	1.18	0.08	1.10 - 1.26

Thyroid Hormone Levels in Clinically Euthyroid Adults:

Table 2: Thyroid Function Test Results

Thyroid Hormone	Mean Value (mIU/L or ng/dL)	Standard Deviation	95% CI
Thyroid-Stimulating Hormone (TSH)	2.1	0.3	1.9 - 2.3
Triiodothyronine (T3)	1.9	0.2	1.7 - 2.1
Thyroxine (T4)	7.5	0.6	7.0 - 8.0

Gender and Age Differences in Doppler Indices:

Table 3: Gender Differences in Doppler Indices

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Doppler Parameter	Male (n=75)	Female (n=75)	p-value
PSV (cm/s)	12.7	12.4	0.432
EDV (cm/s)	3.9	3.7	0.219
RI	0.67	0.69	0.317
PI	1.19	1.17	0.524

Table 4: Age Group Differences in Doppler Indices

Doppler Parameter	25-44 years (n=60)	45-65 years (n=90)	p-value
PSV (cm/s)	12.6	12.4	0.681
EDV (cm/s)	3.8	3.7	0.493
RI	0.68	0.68	0.918
PI	1.18	1.17	0.743

The mean values of Doppler indices (PSV, EDV, RI, and PI) for the entire study cohort were well within the normal range. Thyroid hormone levels (TSH, T3, and T4) were also within the normal reference ranges established by the laboratory.

Gender and age subgroup analyses revealed no statistically significant differences in Doppler indices, indicating that these parameters were consistent across gender and age groups among clinically euthyroid adults.

These findings suggest that Doppler ultrasound of the STA provides reliable baseline values for further investigations into thyroid vascularization in clinically euthyroid individuals. However, it is important to note that this study did not identify significant variations in Doppler indices based on gender or age.

Discussion:

The Doppler ultrasound examination of the superior thyroid artery (STA) in clinically euthyroid adults provides valuable insights into the vascularization of the thyroid gland, potentially serving as a non-invasive adjunctive tool for assessing thyroid health. In this study, we aimed to establish baseline values for Doppler indices (peak systolic velocity [PSV], end-diastolic velocity [EDV], resistive index [RI], and pulsatility index [PI]) of the STA in a cohort of euthyroid individuals. Our results demonstrated that these Doppler indices fell within the normal range, indicating normal thyroid vascularization in the study population.

The PSV values observed in our study (mean: 12.5 cm/s, 95% CI: 11.8-13.2 cm/s) are consistent with those reported in previous studies involving euthyroid individuals (5). The EDV values (mean: 3.8 cm/s, 95% CI: 3.4-4.2 cm/s) were also in line with expected values (6). These findings suggest that the STA's blood flow velocities are maintained within normal limits in euthyroid adults.

The resistive index (RI) and pulsatility index (PI) values in our study (mean RI: 0.68, 95% CI: 0.64-0.72; mean PI: 1.18, 95% CI: 1.10-1.26) are consistent with previous research on STA Doppler indices in healthy individuals (7). RI and PI provide insight into vascular resistance and compliance, and our results indicate that the STA's vascular characteristics were within expected ranges.

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The assessment of thyroid hormone levels (TSH, T3, and T4) confirmed that all participants were clinically euthyroid, with values within the normal reference ranges. This suggests that our study cohort indeed represented individuals with normal thyroid function.

While the Doppler indices in our study were consistent with euthyroid status, it is essential to acknowledge that the clinical utility of these parameters as markers of thyroid health remains to be fully established. Doppler ultrasound of the STA has shown promise in differentiating thyroid pathologies, such as Graves' disease (8) and thyroid nodules (9). However, the absence of significant differences in Doppler indices between gender and age groups in our study may indicate that these parameters alone may not be sensitive enough to detect subtle variations in thyroid vascularization in clinically euthyroid individuals.

Our study's limitations include its cross-sectional design, which limits the ability to establish causality, and the relatively small sample size. Additionally, the study was conducted in a specific demographic, which may limit the generalizability of the findings to other populations.

Conclusion:

In conclusion, this study provides reference values for Doppler indices of the STA in clinically euthyroid adults, indicating normal thyroid vascularization in this cohort. While these findings may contribute to the understanding of thyroid physiology, further research is needed to determine the clinical significance and utility of Doppler ultrasound of the STA as a non-invasive marker of thyroid health in euthyroid individuals.

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