



COLOR DOPPELER OF SUPERIOR THYROID ARTERY IN EUTHYROID INDIVIDUL: AN OBSERVATIONAL STUDY

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Conflicts of Interest: Nil

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Abstract:

INTRODUCTION: The estimate of blood flow mode is very subjective and also difficult for quantification. Also for quantification of thyroid blood supply complicated post-examination software processing is required. Hormonal assays are more specific in evaluating thyroid status but ultrasonography of thyroid gland is routinely done. Thyroid glandular parenchyma are often found normal in early stages of diseases. This study was carried out to find the normal ranges of Doppler indices of superior thyroid arteries.

MATERIAL AND METHODS: A Study subject includes clinically euthyroid individuals and not diagnosed previously of any thyroid disease and hormonal assay are normal. STA was identified as the first branch of external carotid artery that arises anteriorly at the level of hyoid bone. The artery could be traced up till the upper pole of thyroid gland, where the artery was sampled using color Doppler mode. Peak systolic velocity (PSV), pulsatility index (PI), and resistivity index (RI) of both the STAs were calculated.

RESULTS: Ultrasonography of all 134 subjects were carried out of which in 15 subjects some abnormality or nodule was detected hence were excluded from the study. Doppler evaluation of bilateral STAs was done in the remaining 119 individuals. Age range was between 23 years to 69 years. Study includes 79 female and 40 male. All subject has undergone hormonal assay which was normal. Of the total 119 subjects included in the study 40(33.6%) were male and 79(66.4%) were female. Mean age of male subjects was 36 ± 15.7 years and of female subjects was 37 ± 17.9 . STAs could be traced at the superior poles in 110 subjects in 9 subjects vessels were sampled closer to their origins from the external carotid arteries. Average peak systolic velocity of female was 16.51 ± 4.9 cm/sec and of male was 17.24 ± 5.9 cm/sec with total average was 16.84 ± 5.1 cm/sec. Pulsatility index in female was 0.82 ± 0.29 and in males it was 1.08 ± 0.39 with total average 0.97 ± 0.35 . Resistivity index in female was 0.52 ± 0.11 and in males it was 0.61 ± 0.21 with total average 0.58 ± 0.17 . While statistical significance was noted in Pulsatility index and Resistivity index. **CONCLUSION:** Mean values of Doppler indices of STA in euthyroid individuals in which peak systolic velocity was 16.84 ± 5.1 cm/sec. Pulsatility index was 0.97 ± 0.35 and 0.58 ± 0.17 , Resistivity index was 0.58 ± 0.17 . These values can be used as reference for future studies.

Introduction

Color Doppler flow sonography (CDFS) of thyroid, as an indicator of thyroid blood flow status and also has some practical values in the differentiation of thyrotoxicosisⁱ. The estimate of blood flow mode is very subjective and also difficult for quantification. Also for quantification of thyroid blood supply complicated post-examination software processing is requiredⁱⁱ. The variation of vessel lumen sizes and artery spreading directions may interfere with the blood flow velocity detectionⁱⁱⁱ. Angiogenesis which is the development of new blood vessels from pre-existing vessels, is an important pathogenic process in both benign and malignant disease^{iv}.

Hormonal assays are more specific in evaluating thyroid status but ultrasonography of thyroid gland is routinely done. Thyroid glandular parenchyma are often found normal in early stages of diseases^v. There are very limited studies done to establish normal Doppler parameters of thyroid arteries^{vi}. This study was carried out to find the normal ranges of Doppler indices of superior thyroid arteries (STAs).

MATERIAL AND METHODS

This is a prospective, observational study carried out in a tertiary care hospital—Chandulal Chandrakar memorial Medical College. Study subjects include clinically euthyroid individuals and not diagnosed previously of any thyroid disease and hormonal assay are normal. Detailed clinical evaluation which

includes history, resting pulse rate, neck examination, etc., prior to ultrasonography was done.

Before Doppler evaluation of the thyroid gland, the study subjects were made to rest for 10 min. B-mode scan was done to look for echogenicity of the gland and also to look for any lesions. The normal gland is granular and homogeneously echogenic. STA was identified as the first branch of external carotid artery that arises anteriorly at the level of hyoid bone. The artery could be traced up till the upper pole of thyroid gland, where the artery was sampled using color Doppler mode. Peak systolic velocity (PSV), pulsatility index (PI), and resistivity index (RI) of both the STAs were calculated. PI represents the variability of the flow velocity in the sampled vessel. RI signifies the resistance offered to the blood flow by distal vascular bed.

All observations were entered in a Microsoft excel. Statistical analysis was done using SPSS software

RESULTS

A total of 134 subjects were included in the study with no previous pathology or abnormalities in thyroid gland. Ultrasonography of all 134 subjects were carried out of which in 15 subjects some abnormality or nodule was detected hence were excluded from the study. Doppler evaluation of bilateral STAs was done in the remaining 119 individuals.

Age range was between 23 years to 69 years. Study includes 79 female and 40 male. All subject has undergone hormonal assay which was normal.

Table 1: Age and gender distribution.

Number	Male	Female
N=119	40(33.6%)	79(66.4%)
Age (mean ± SD)	36±15.7	37±17.9

SD: Standard deviation

Of the total 119 subjects included in the study 40(33.6%) were male and 79(66.4%) were female. Mean age of male subjects was 36±15.7 years and of female subjects was 37±17.9.

STAs could be traced at the superior poles in 110 subjects in 9 subjects vessels were sampled closer to their origins from the external carotid arteries. All the STAs sampled showed an initial steep systolic upstroke and a more gradual initial down stroke, followed by a plateau in diastolic phase on spectral tracing.

Table 2: Doppler indices

Doppler	Average (female)	Average (male)	Total average
Peak systolic velocity	16.51±4.9 cm/sec	17.24±5.9 cm/sec	16.84±5.1 cm/sec
Pulsatility index	0.82±0.29	1.08±0.39	0.97 ±0.35
Resistivity index	0.52±0.11	0.61±0.21	0.58±0.17

Average peak systolic velocity of female was 16.51±4.9 cm/sec and of male was 17.24±5.9 cm/sec with total average was 16.84±5.1 cm/sec. Pulsatility index in female was 0.82±0.29 and in males it was 1.08±0.39 with total average 0.97 ±0.35. Resistivity index in female was 0.52±0.11 and in males it was 0.61±0.21 with total average 0.58±0.17.

Table 3: Statistics for Peak systolic velocity

Difference	0.730
Standard error	1.020
95% CI	-1.2894 to 2.7494
t-statistic	0.716
DF	117
Significance level	P = 0.4755

Table 4: Statistics for Pulsatility index

Difference	9.980
Standard error	0.063
95% CI	9.8544 to 10.1056
t-statistic	157.392
DF	117
Significance level	P < 0.0001

Table 5: Statistics for Resistivity index

Difference	0.090
Standard error	0.029
95% CI	0.0320 to 0.1480
t-statistic	3.074
DF	117
Significance level	P = 0.0026

(This procedure calculates the difference between the observed means in two independent samples. A significance value (P-value) and 95% Confidence Interval (CI) of the difference is reported. The P-value is the probability of obtaining the observed difference between the samples if the null hypothesis were true. The null hypothesis is the hypothesis that the difference is 0.)

No significant difference was noted in male and female for Peak systolic velocity

While statistical significance was noted in Pulsatility index and Resistivity index

DISCUSSION AND CONCLUSION

Ultrasonography is an essential diagnostic test in the follow-up of thyroid related diseases especially cancer. Color flow Doppler has been proposed in some studies as an additional tool for differentiating benign from malignant cervical lesions in various types of head and neck cancer^{vii}.in a study by

Fukunari N it was found that Color-Doppler imaging examination of 212 follicular tumors characteristic finding was that a high-velocity pulsative blood flow penetrates the tumor in the case of follicular carcinoma,. The differential diagnostic grading score using color-Doppler examination showed diagnostic accuracy of 81.0%, a sensitivity of 88.9% and a specificity of 74.2%. he concluded that ultrasound with the color-Doppler function can play a more important role in the differential diagnosis of thyroid tumors^{viii}.

Trimboli *et al* showed that normal thyroid gland on B-mode ultrasound in 25% of cases did not correlate with normal thyroid hormone levels^{ix}. In contract our study showed normal thyroid hormonal assay. In a study by Diez JJ^x most of the cases showed mild increase in thyroid stimulating hormone levels, which in turn may progress to frank hypothyroidism. In our study pulsatility index in female was 0.82±0.29 and in males it was 1.08±0.39 with total average 0.97 ±0.35. Resistivity index in female was 0.52±0.11 and in males it was 0.61±0.21 with total average 0.58±0.17.these results were statistically significant

We selected STA (Superior thyroid artery) for the study as it is superficial and easily accessible as compared to inferior thyroid artery^{xi}.Macedo *et al*^{xii} in their study of 165 cases of the thyroid in a healthy iodine-non-deficient populationfound mean PSV of STA to be 25.84 cm/s and PI and RI to be 1.03 and 0.62, respectively which was higher than values obtained in our study. In our study PSV of STA in females was found to be lower in females in contract to study by Macedo *et al*¹² in which PSV of STA in females was found to be significantly higher in males. Kim *et al*. in the 60 control subjects to compare PSV of STA in Graves' disease found a mean PSV of 17.55 cm/s, which is near about similar to the present study^{xiii}.

To conclude we found mean values of Doppler indices of STA in euthyroid individuals in which peak systolic velocity was 16.84±5.1 cm/sec. Pulsatility index was 0.97 ±0.35 and 0.58±0.17, Resistivity index was 0.58±0.17. Moresimilar studies are required to confirm the study values and can be used as reference for future studies.

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