



## Characterization of thyroid gland using Doppler Ultrasonography and Thyroid Scintigraphy

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### ABSTRACT:

characterize the thyroid gland using Doppler Ultrasonography and Thyroid Scintigraphy at ultrasound department at King Saud Medial Center (KSMC) in Saudi Arabia. The total number of patients was 144 where the males was 33 with percent 22.9 and the number of females was 111 with percent 77.1. group statistics for patients according to their gender. For TSH the mean  $\pm$  standard deviation for female was  $0.88 \pm 1.89$  and for male was  $1.377 \pm 3.82$ , for T4 female was  $32.47 \pm 31.51$  and for male was  $31.39 \pm 19.77$ , for right lobe length female was  $4.99 \pm 1.79$  and for male was  $5.77 \pm 1.75$ , right lobe width for female was  $2.99 \pm 1.47$  and for male was  $3.09 \pm 1.52$ , right lobe size female was  $14.53 \pm 7.37$  and for male was  $17.83 \pm 8.75$ , right lobe volume for female was  $14.95 \pm 12.999$  and for male was  $19.41 \pm 17.77$ . For left lobe length for female was  $4.55 \pm 1.87$  and for male was  $5.64 \pm 2.14$ , left lobe width for female was  $2.74 \pm 1.44$  and for male was  $3.17 \pm 1.53$ , left lobe size for female  $12.71 \pm 7.65$  and for male was  $18.92 \pm 10.83$ , left lobe volume for female was  $11.35 \pm 9.97$  and for male was  $17.55 \pm 16.10$ , for thyroid uptake for female was  $7.43 \pm 9.21$  and for male was  $8.74 \pm 9.89$ .

Analysis of variance for thyroid uptake with other variables, where the p.value show no significant difference between the thyroid uptake with right lobe length, right lobe width, right lobe size, right lobe volume and left lobe volume were the p.value was 0.550, 0.105, 0.992, 0.965 and 0.938 respectively. While show significant difference between the thyroid uptake with left lobe length, left lobe width and left lobe size were the p.value was 0.047, 0.000 and 0.004 respectively. Correlation between the thyroid uptake with t4 hormone were the rate of change for thyroid uptake increase by 0.1172 with each value for T4 hormone.

**Key wards:** thyroid gland, Doppler Ultrasonography, Thyroid Scintigraphy, thyroid hormone

### I. INTRODUCTION:

High- resolution ultrasonography (USG) is the most sensitive imaging modality available for examination of the thyroid gland and associated abnormalities. Ultrasound scanning is non- invasive, widely available, less expensive, and does not use any ionizing radiation. Further, real time ultrasound imaging helps to guide diagnostic and therapeutic interventional procedures in cases of thyroid disease. The major limitation of ultrasound in thyroid imaging is that it cannot determine thyroid function, i.e., whether the thyroid gland is underactive, overactive or normal in function; for which a blood test or radioactive isotope uptake test is generally required [1,2].

Thyrotoxicosis refers to the hypercatabolic state resulting from elevated serum levels of thyroid hormone, mainly free tetraiodothyronine (FT<sub>4</sub>) and/or triiodothyronine FT<sub>3</sub>. Thyrotoxicosis is not synonymous with hyperthyroidism [3]. It may be caused either by hyperthyroidism or by inflammation of the thyroid with release of stored thyroid hormone but is not accelerated synthesis. It may also be caused by ingestion of exogenous thyroid hormone. Graves' disease causes hyperthyroidism with diffuse thyroid disease while thyrotoxicosis due to destructive thyroiditis includes various subsets like lymphocytic thyroiditis, subacute thyroiditis and postpartum thyroiditis [4-7]. 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 case is completely different. The absence of specific signs of Graves' disease like ophthalmopathy, skin and nail changes may make it difficult to distinguish it



from thyroiditis, especially when the disease is mild or subclinical.

The major indication for sonography of the thyroid gland is to evaluate focal nodules or masses to try to determine its nature. However, ultrasound is also useful in the assessment of diffuse

thyroid disease. Multinodular goitre Patients with multinodular goitre (MNG) are most commonly clinically euthyroid but may be hyperthyroid or borderline with suppressed thyroid-stimulating hormone (TSH) levels but normal free T4 and T3. Hyperthyroidism is a common disease worldwide [8,9]. The diagnosis of hyperthyroidism is based on a persistently subnormal serum thyroid-stimulating hormone (TSH) level with free thyroid hormone levels within or above respective reference intervals. Graves' disease (GD), toxic multinodular goitre (TMG), toxic adenoma (TA) and thyroiditis are the main causes of thyrotoxicosis, each requiring an accurate differential diagnosis as each requires a different therapeutic approach.

## II. METHODOLOGY:

The study was conducted in Saudi Arabia at King Saud Medial Center (KSMC), The data was collected from Picture and Communication System (PACS) of nuclear medicine department with different age, gender and thyroid abnormalities. This study was conducted from 2017-2021.

**Machine:** Procedure was done by GE introduces Discovery NM-CT 670 pro and Q.Merix at nuclear medicine department and GE Logiq E9 equipment at ultrasound department.

**Techniques:** A thyroid sonogram was performed with a high-frequency linear array transducer having a short focal zone (1 to 4 cm). The patient was examined in supine position, with the neck extended and pillow under shoulder. Images are obtained in both the sagittal and transverse planes of each lobe and of the isthmus. Normal thyroid tissue is homogeneously fine textured with medium to high levels of echogenicity. The echogenicity is usually greater than the normal neck muscles. Each adult pear-shaped lobe measures approximately 4

to 6 cm in length, 2 to 3 cm in width, and 1 to 2 cm in thickness, with the right lobe typically being the largest. Then the thyroid volume can be calculated using the following formula: length × width × thickness × 0.529. Moreover, each thyroid lobe should be evaluated using color Doppler because the amount of vascularity may be evident of disease.

Then the patient was referred for thyroid uptake and scan, it was performed by preparing patient well as certain foods and medications interfere with radiotracer uptake in the thyroid gland. Firstly, the radiotracer (Technitium 99mTC) which emits gamma radiation was prepared and pulls it into the syringe, the scan was done for full syringe and the counts were collected, then the patient was injected intravenously by radiotracer and the empty syringe was scan again, 20-30 min after radiotracer administration the patient lied down on the movable examination table, and the gamma camera took serial images of the thyroid gland from different angles. The images were analyzed and the counts were collected to calculate the percentage of thyroid uptake using below equation:

$$\text{uptake\%} = \frac{\text{Neck Counts} - \text{Thigh Counts}}{(\text{Admin. counts} \times \text{decay factor}) - \text{Background Counts}} \times 100$$

The normal values of thyroid uptake of radiotracer was (0.5 – 2 %) The thyroid gland can uptake more or less than normal. More than normal uptake of radioactive iodine by the thyroid gland indicates hyperactive thyroid and less than normal uptake infers hypoactive thyroid gland, or interference with the uptake.

## III. RESULTS:

Scan the thyroid gland using Doppler Ultrasonography and Thyroid Scintigraphy at ultrasound department at King Saud Medial Center (KSMC) in Saudi Arabia. The total number of patients was 144 where the males was 33 with percent 22.9 and the number of females was 111 with percent 77.1 were then results presented as tables and figure as shown below:

**Table 1.** show descriptive statistics for all patients:

variables	Mean	Std. Dev	Minimum	Maximum
TSH	.9949	2.46390	.00	18.00
T4	32.2226	29.17742	2.27	228.04
Rt lobe Length (cm)	5.173	1.8033	.0	8.8
Rt lobe width (cm)	3.014	1.4830	.0	8.9
Rt lobe size (cm)	15.2911	7.80445	.00	45.65
RT lobe volume	15.976	14.2860	.0	87.0
LT lobe length(cm)	4.803	1.9801	.0	9.5



LT lobe width (cm)	2.8381	1.47224	.00	8.00
LT lobe size(cm)	14.1361	8.84041	.00	47.88
lt lobe volume	12.776	11.8913	.0	66.4
thyroid uptake	7.732	9.3592	.0	39.8

**Table 2.** Show group statistics for patients according to their gender:

	Gender	Mean	Std. Dev	Std. Error Mean
TSH	Female	.8812	1.89253	.17963
	Male	1.3771	3.82381	.66564
T4	Female	32.4676	31.50799	2.99061
	Male	31.3988	19.76986	3.44149
Rt lobe Length (cm)	Female	4.996	1.7876	.1697
	Male	5.767	1.7537	.3053
Rt lobe width (cm)	Female	2.990	1.4780	.1403
	Male	3.094	1.5199	.2646
Rt lobe size (cm)	Female	14.5337	7.37442	.69995
	Male	17.8388	8.75026	1.52323
RT lobe volume	Female	14.955	12.9958	1.2335
	Male	19.410	17.7676	3.0929
LT lobe length(cm)	Female	4.553	1.8661	.1771
	Male	5.645	2.1452	.3734
LT lobe width (cm)	Female	2.7405	1.44794	.13743
	Male	3.1667	1.52800	.26599
LT lobe size(cm)	Female	12.7135	7.65221	.72632
	Male	18.9212	10.83173	1.88556
Lt lobe volume	Female	11.356	9.9740	.9467
	Male	17.555	16.1052	2.8035
thyroid uptake	Female	7.432	9.2197	.8751
	Male	8.742	9.8931	1.7222

**Table 3.** show analysis of variance for thyroid uptake with other variables:

		Sum of Squares	df	Mean Square	F	Sig.
Rt lobe Length (cm)	Between Groups	316.265	98	3.227	.976	.550
	Within Groups	148.770	45	3.306		
	Total	465.035	143			
Rt lobe width (cm)	Between Groups	236.772	98	2.416	1.399	.105
	Within Groups	77.713	45	1.727		
	Total	314.485	143			
Rt lobe size (cm)	Between Groups	4771.827	98	48.692	.556	.992
	Within Groups	3938.214	45	87.516		
	Total	8710.041	143			
RT lobe volume	Between Groups	17006.013	98	173.531	.641	.965
	Within Groups	12178.792	45	270.640		
	Total	29184.805	143			
LT lobe length(cm)	Between Groups	433.719	98	4.426	1.569	.047
	Within Groups	126.969	45	2.822		
	Total	560.688	143			
LT lobe width (cm)	Between Groups	275.693	98	2.813	3.695	.000
	Within Groups	34.260	45	.761		
	Total	309.953	143			
LT lobe size(cm)	Between Groups	9139.407	98	93.259	2.061	.004
	Within Groups	2036.462	45	45.255		



	Total	11175.869	143			
Left lobe volume	Between Groups	12112.884	98	123.601	.686	.938
	Within Groups	8107.621	45	180.169		
	Total	20220.504	143			

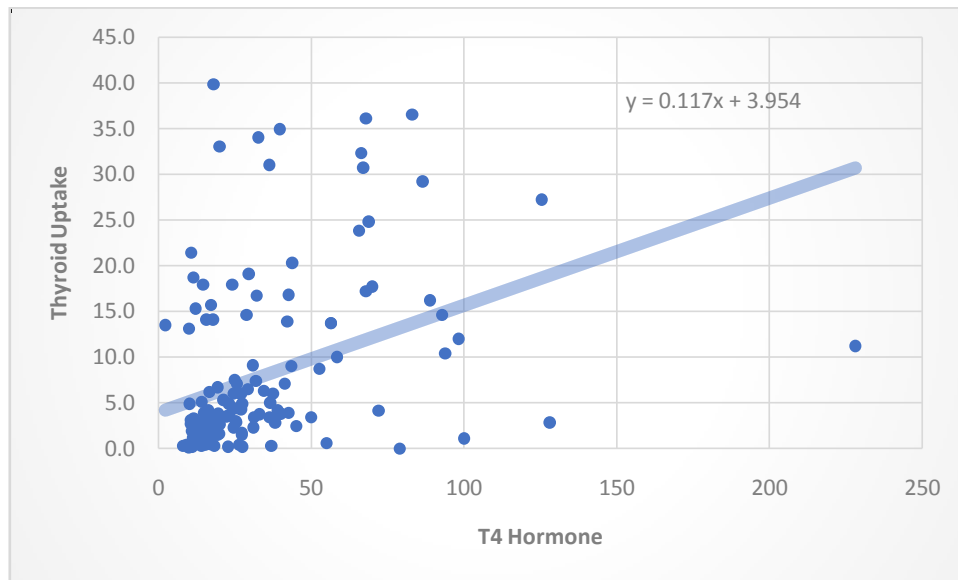


Figure 1. show correlation between the thyroid uptake with t4 hormone

#### IV. DISCUSSION:

Table 1. show descriptive statistics for all patients were the data presented to show mean, standard deviation, minimum and maximum for TSH, T4, right lobe length, right lobe width, right lobe size, right lobe volume, left lobe length, left lobe width, left lobe size, left lobe volume and thyroid uptake. For TSH the mean  $\pm$  standard deviation was  $0.99 \pm 2.46$ , for T4 was  $32.22 \pm 29.18$ , for right lobe length, right lobe width, right lobe size, right lobe volume was  $5.17 \pm 1.80$ ,  $3.01 \pm 1.48$ ,  $15.29 \pm 7.80$  and  $15.97 \pm 14.29$  respectively. For left lobe length, left lobe width, left lobe size, left lobe volume was  $4.80 \pm 1.98$ ,  $2.84 \pm 1.47$ ,  $14.14 \pm 8.84$  and  $12.77 \pm 11.89$  respectively, for thyroid uptake was  $7.73 \pm 9.36$ .

Table 2. Show group statistics for patients according to their gender. For TSH the mean  $\pm$  standard deviation for female was  $0.88 \pm 1.89$  and for male was  $1.377 \pm 3.82$ , for T4 female was  $32.47 \pm 31.51$  and for male was  $31.39 \pm 19.77$ , for right lobe length female was  $4.99 \pm 1.79$  and for male was  $5.77 \pm 1.75$ , right lobe width for female was  $2.99 \pm 1.47$  and for male was  $3.09 \pm 1.52$ , right lobe size female was  $14.53 \pm 7.37$  and for male was  $17.83 \pm 8.75$ , right lobe volume for female was  $14.95 \pm 12.999$  and for male was  $19.41 \pm 17.77$ . For left lobe length for female was  $4.55 \pm 1.87$  and for male was  $5.64 \pm 2.14$ , left lobe width for female was  $2.74 \pm 1.44$  and for male was  $3.17 \pm$

$153$ , left lobe size for female  $12.71 \pm 7.65$  and for male was  $18.92 \pm 10.83$ , left lobe volume for female was  $11.35 \pm 9.97$  and for male was  $17.55 \pm 16.10$ , for thyroid uptake for female was  $7.43 \pm 9.21$  and for male was  $8.74 \pm 9.89$ .

Analysis of variance for thyroid uptake with other variables, where the p.value show no significant difference between the thyroid uptake with right lobe length, right lobe width, right lobe size, right lobe volume and left lobe volume were the p.value was 0.550, 0.105, 0.992, 0.965 and 0.938 respectively. While show significant difference between the thyroid uptake with left lobe length, left lobe width and left lobe size were the p.value was 0.047, 0.000 and 0.004 respectively. As shown in table 3.

Correlation between the thyroid uptake with t4 hormone were the rate of change for thyroid uptake increase by 0.1172 with each value for T4 hormone as shown in figure 1.

#### V. CONCLUSION:

characterize the thyroid gland using Doppler Ultrasonography and Thyroid Scintigraphy at ultrasound department at King Saud Medial Center (KSMC) in Saudi Arabia. The total number of patients was 144 where the males was 33 with percent 22.9 and the number of females was 111 with percent 77.1. the group statistics for patients according to their gender. For TSH the mean  $\pm$



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