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Assessment of Morphological Changes Using Ultrasonography of the Thyroid Gland among Hemodialysis Patients

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Abstract

Objective: Assessment of the thyroid nodularity, thyroid volume and morphological changes (using ultrasonography) in a random sample of hemodialysis patients. **Design/Methods**: A cross-sectional study of 60 CKD patients stage 5 on hemodialysis with an estimated glomerular filtration rate (eGFR) below 15 ml/min/1.73m2. Patients from Cairo university hospital - nephrology clinic and hemodialysis unit While Control group involved sixty age-matched normal persons –with normal serum creatinine and eGFR - will be included in the study as a control group for the thyroid nodularity and volume. **Results**: Mean Thyroid volume is significantly increased in end stage renal disease (ESRD) patients 9.98 ml compared to that of controls 8.38ml with significant P value (0.007). The percent of renal patients with thyroid nodules is higher in ESRD than control. It was 30% (18 cases) in ESRD group while it was 18.3% (11 cases) in control with p value 0.349. **Conclusion**: Increased thyroid volume and nodularity are more common in HD patients compared with controls

Introduction

An increased prevalence of goiter and thyroid gland volume has been reported in patients with chronic kidney disease (CKD) **(1)**. Increased volume of the thyroid gland was found in about 50% of hemodialysis (HD) patients without clinically manifested goiter. Potential pathogenic factors are “capture” of iodine in the thyroid gland and possible accumulation of unidentified substances goitrogens in uremic plasma. Thyroid nodules are more common in patients with CKD and HD compared to general population. Goiter in patients on renal replacement therapy may be induced by reduced renal iodide excretion **(2).**Thyroid nodules may be detected in ultrasonography in 19%–68% of randomly selected individuals depending on age, sex and family history **(3)**.

Thyroid dysfunction can be correlated to the presence of structural abnormalities of the thyroid gland (diffuse goiter, multinodular goiter or single thyroid nodule). These changes may result from functional abnormalities or neoplasm. In patients with ESRD, benign and malignant nodules are more common than in the general population **(4).**

It has been reported that due to reduced renal excretion of iodide, serum iodide levels are increased among patients with end-stage renal failure, despite decreased dietary iodide intake. Although inorganic iodide is removed by HD, serum iodide has been reported to be increased in HD patients. Use of povidone-iodine for disinfecting arteriovenous fistulas for HD may contribute to the rise in serum iodide in some dialyzed patients. Decreased urine iodide excretion and thus increased serum iodide may result in thyroid gland enlargement and subsequent goiter formation. The incidence of goiter in patients with renal failure has been reported to be higher than in general population. In a study of U. lebkowska, the prevalence of goiter was 50% in HD (according to WHO classification of goiter). **(2).**

Patients and Methods

A cross-sectional study of 60 CKD patients stage 5 on hemodialysis with an estimated glomerular filtration rate (eGFR) below 15 ml/min/1.73m2. Patients from Cairo university hospital - nephrology clinic and hemodialysis unit While Control group involved sixty age-matched normal persons –with normal serum creatinine and eGFR - will be included in the study as a control group for the thyroid nodularity and volume. Exclusion criteria include history of thyroid disease or treatment, History of thyroidectomy, malignancy, neck surgery / irradiation and history of amiodarone or lithium therapy, or recent administration of iodinated radiologic contrast.

The study population was subjected to Thorough history and clinical (including thyroid) examination and Renal history was taken; the study population was evaluated for serum creatinine, estimation of GFR by modification of diet in renal disease (MDRD) equation, also Assessment of Body mass index **(BMI)** (kg/m2) for every subject and it was calculated as= weight / height^2, finally Thyroid ultrasound including assessment of thyroid gland volume and nodularity and morphological changes. **Procedure:** Thyroid volume was estimated by using ultrasound (HDI 5000) portable instrument with color Doppler ultrasound scanner and a 7.4 MHz linear transducer. The examination was performed by experienced internal medicine specialist in endocrinology outpatient clinic in Cairo university hospitals. The subjects were supine position with the hyperextension of neck for examination. The dimensions of each lobe (width, length and depth) were measured. The thyroid volume of each lobe was calculated using the formula: width (cm) × length (cm) × depth (cm) × 0.479 for each lobe. The thyroid volume was the sum of the volume of both lobes. Isthmus volume was not taken into account. Vascularization pattern was classified as normal and increased according to color pixels density.

Statistical analysis: Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired test in normally distributed quantitative variables while non-parametric Mann-Whitney test was used for non-normally distributed quantitative variables. For comparing categorical data, Chi square (x2) test was performed. Exact test was used instead when the expected frequency is less than 5.

Consent: Written informed and oral consents were taken from the patients who participated in the study.

Results

Table (1): Comparison between ESRD patients & control: as regards Age, BMI and Thyroid volume, and eGFR:

	ESRD Mean ± SD	**Control Mean ± SD**	**P value**
Age (year)	52 ±12	41 ±10	<0.671[a]
BMI	28.5 ±4.4	25.7 ±3.9	0.001[b]
Thyroid volume(ml)	9.98 ±3.2	8.38 ±2.63	0.007[c]
	Median (range)	**Median (range)**	
e GFR(ml/min)	8 (4-14)	102 (94-108)	<0.001[d]

SD: Standard deviation, P value <0.05 is considered significant, a: Controls are mildly younger than Cases with ESRD (P value <0.671 for both), b: BMI is significantly low in controls compared to ESRD (P value 0.022& 0.001 respectively), c: Thyroid volume is significantly increased in ESRD compared to controls (P value 0.005). d: e GFR is significantly low in ESRD compared to control (P value <0.001 for both)

- Mean Thyroid volume is significantly increased in ESRD patients 9.98 ml compared to that of controls 8.38ml with significant P value (0.007).

Table (2): Comparison between ESRD patients & control as regard thyroid function, increased thyroid volume, nodularity and vascularity

	ESRD n=60 (%)	**Control n=60 (%)**	**P value**
Age groups (year)			
18-40	12 (20)	26 (43.1)	<0.001
>40	48 (80)	34 (56.9)	
Sex			
Female	28 (46.7)	29 (48.3)	0.215
Male	32 (53.3)	31 (51.7)	
Thyroid volume (ml)			
Normal thyroid volume <11 ml	37 (61.7)	52 (86.7)	0.006
Increased thyroid volume ≥ 11 ml	23 (38.3%)	8 (13.3%)	
Nodularity			
No nodule	42 (70)	49 (81.7)	0.596
Single nodule	8 (13.3)	5 (8.3)	
Multiple nodules	10 (16.7)	6 (10)	
Nodularity			
No nodule	42 (70)	49 (81.7)	0.611
Single nodule	8 (13.3)	5 (8.3)	
Two nodules	8 (13.3)	6 (10)	
> Two nodules	2 (3.3)	0 (0)	
Nodularity			
No	42 (70)	49 (81.7)	0.349
Yes	18 (30)	11 (18.3)	
DM			
Yes	15 (25)	5 (8.3)	0.048
No	45 (75)	55 (91.7)	
HTN			

Yes	55 (91.7)	7 (11.7)	<0.001
No	5 (8.3)	53 (88.3)	

P value <0.05 is considered significant, DM: Diabetes mellitus, HTN: Hypertension

Because of the wide variation in the range of normal thyroid volume, and there is no definite number for the upper limit of normal thyroid volume. So in our study we consider the subjects of control (Egyptians normal subjects) as cornerstone for determine the average of normal thyroid volume, whereas the mean for the thyroid volume of the subjects of control was 8.38 SD±2.63 .So we consider 11 ml as our upper limit of normal thyroid volume and the volumes more than 11 ml are considered increased according to our study.

- The percent of renal patients with increased thyroid volume (≥ 11 ml) is statistically higher in ESRD than control. It was 38.3% (23 cases) in ESRD group while it was 13.3% (8 cases) in control with significant p value 0.006.
- The percent of renal patients with thyroid nodules is higher in ESRD than control. It was 30% (18 cases) in ESRD group while it was 18.3% (11 cases) in control with p value 0.349.

Table (3): Comparing increased and normal thyroid volume regarding (Age, BMI, Renal status)

	Thyroid volume (ml)		
	<11	**≥ 11**	
	Mean ± SD	**Mean ± SD**	**P value**
Age	44 ±14	48 ±12	0.062
BMI	26.2 ±4.2	30.3 ±3.4	<0.001
	n (%)	**n (%)**	
Renal status			
Control	52 (86.7)	8 (13.3)	0.006
ESRD	37 (61.7)	23 (38.3)	

- Percentage of Increased thyroid volume more than ≥ 11 ml (upper limit of average range) was (38.3%) 23 cases in ESRD which was higher than control subjects (13.3%) 8 subjects, with significant P value <0.05.

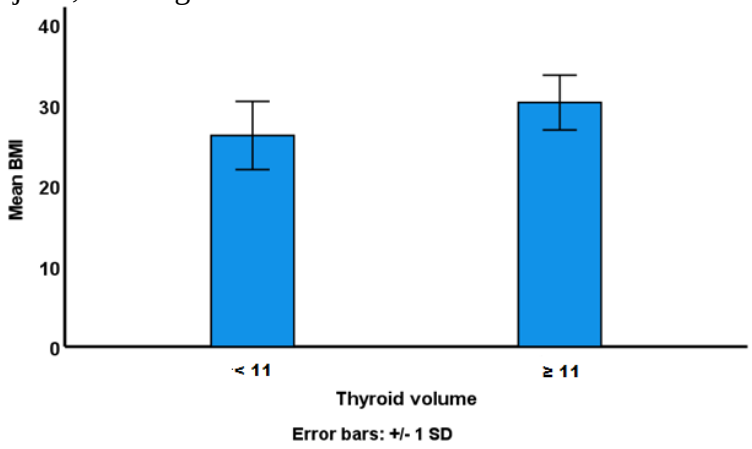

Figure (1): Bar graph representing BMI in relation to thyroid volume

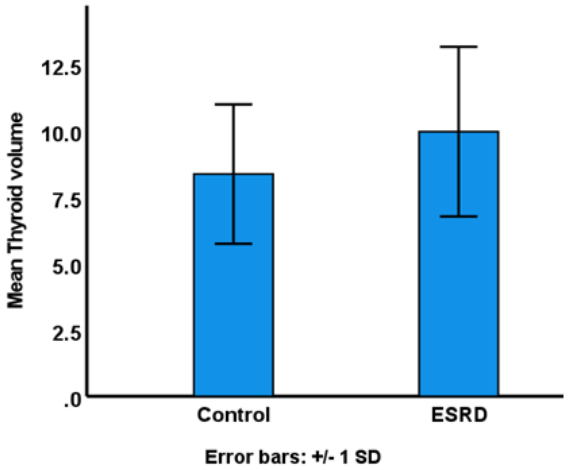

Figure (2): Bar graph representing thyroid volume among study groups

Discussion

In our study the Mean of the thyroid volume in control is less than ESRD patients. We find that the percent of renal patients with thyroid nodules is higher in ESRD than control. It was 30% (18 cases) in ESRD group while it was 18.3% (11 cases) in control with p value 0.349.

Study of Maryam P. demonstrated a higher prevalence of nodular goiter in HD population compared to normal population. (5) There was no correlation between age and sex with goiter; this is in the same line with Kaptein et al.'s study **(6)** but some studies showed that nodular goiter was more prevalent in females and also increased by age. **(7)**

Kaptein et al. reported the prevalence of goiter in ESRD patients was 43% versus 6.7% in the control groups. The possible explanation is due to accumulation of iodides in thyroid gland due to decreased renal clearance in CRF patients. (6)

Kutlay et al**.** detected nodular goiter in 36.8% of the ESRD patients and 17.1% of the control groups. (8) Da Costa et al.'s study demonstrated a clear tendency for HD patients to present with more thyroid nodules compared to control group (24.1% vs. 7.9%); the difference was not statistically significant. Patients with uremia have an increased thyroid volume compared with people with normal renal function and a higher incidence of goiter. (4) Maryam P. found nodular goiter by ultrasonography in 27.9% of HD patients vs. 3.5% of the control group.(5)

Sarita B et al. showed a high prevalence of thyroid morphology abnormalities (diffuse or nodular goiter) in diabetic patients with CKD which is concordant with data from a study conducted by Hegedüs L *et al* showed thyroid gland volume (ultrasonically determined) was significantly increased in patients with CRF. (9,10)

Conclusion:

According to our study results increased thyroid volume and nodularity are more common in HD patients compared with controls.

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