Assessment of right and left ventricular function by tissue Doppler image in young patients with hyperthyroidism

Evaluación de la función ventricular derecha e izquierda mediante imagen Doppler tisular en pacientes jóvenes con hipertiroidismo

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Abstract

Background: Hyperthyroidism is a thyroid hormone excess condition, and is the second most common thyroid dysfunction after hypothyroidism. Clinical symptoms associated with cardiovascular disorders differ between individuals and can include sinus tachycardia in both inactive and active formal and atrial arrhythmias, in specific atrial fibrillation in ageing persons with pre-existing heart disorders. Conventional Echo is a broadly presented procedure to identify subclinical heart failure in hyperthyroidism patients. Aim of study: to evaluate left and right function of ventricles in hyperthyroidism young patients used tissue Doppler appearance. Methods: A 45 case of hyperthyroidism and 45 healthy control with age more than 18 years and overt hyperthyroidism that confirmed by endocrinologist were included in this study that conducted between the first of March and the first of June of 2020. The Blood samples were drawn for all participants for Serum thyroid hormone levels measurement. The Echocardiography was performed with participants positioned at left lateral decubitus according to protocol of ASE guide lines with the use of GE Medical System Vivid nine ultrasound machine equipped with transducer a with frame rate 60-80 frame\sec. TDI imaging needs great frame rates (>100fps) for image acquirement with outstanding temporal determination. Result: Among echocardiographic parameters there were no significant differences in EF% between two groups (p=0.62), TDI examination for left ventricle shown that: S´, E/A and e´ were significantly decrease in cases than control participants, Tei index and E/e´ were significantly advanced in cases than control persons and a´ no any significant difference between normal persons and hyperthyroidism. TDI examination for right ventricle shown that: S´, E/A, e´ and E/e´ were no any significant difference between normal persons and hyperthyroidism, Tei index and a´ no any significant difference between normal persons and hyperthyroidism. Conclusions: Thyroid derangement especially hyperthyroidism, have a significant effect on cardiac functions. TDI measurements are useful, inexpensive, and easy to perform indices for detection of early LV and RV systolic and diastolic functional abnormalities in patients with hyperthyroidism.

Keywords: Right and left ventricular function, tissue Doppler image, young patients, hyperthyroidism.

Resumen

Antecedentes: el hipertiroidismo es una afección por exceso de hormonas tiroideas y es la segunda disfunción tiroidea más común después del hipotiroidismo. Los síntomas clínicos asociados con trastornos cardiovasculares difieren entre individuos y pueden incluir taquicardia sinusal en arritmias formales y auriculares inactivas y activas, en fibrilación auricular específica en personas de edad avanzada con trastornos cardíacos preexistentes. Eco convencional es un procedimiento ampliamente presentado para identificar insuficiencia cardíaca subclínica en pacientes con hipertiroidismo. Objetivo del estudio: para evaluar la función izquierda y derecha de los ventrículos en el hipertiroidismo, los pacientes jóvenes utilizaron la apariencia del Doppler tisular. Métodos: Se incluyeron en este estudio 45 casos de hipertiroidismo y 45 controles sanos con edad mayor de 18 años e hipertiroidismo manifiesto que confirmaron por endocrinólogo que se realizó entre el primero de marzo y el primero de junio de 2020. Las muestras de sangre fueron extraídas para todos los participantes para la medición de los niveles de hormona tiroidea en suero. La ecocardiografía se realizó con los participantes colocados en decúbito lateral izquierdo de acuerdo con el protocolo de las guías de ASE con el uso de la máquina de ultrasonido GE Medical System Vivid nine equipada con un transductor a con una frecuencia de cuadro de 60-80 cuadros \ seg. Las imágenes TDI necesitan grandes

velocidades de cuadro (> 100 fps) para la adquisición de imágenes con una excelente determinación temporal. Resultado: Entre los parámetros ecocardiográficos no hubo diferencias significativas en el% de FE entre dos grupos (p=0,62), el examen TDI para el ventrículo izquierdo mostró que: S´, E / A ye´ disminuyeron significativamente en los casos que los participantes de control, índice Tei y E / e´ fueron significativamente avanzados en los casos que las personas de control y no hubo ninguna diferencia significativa entre las personas normales y el hipertiroidismo. El examen TDI para el ventrículo derecho mostró que: S´, E / A, e´ y E / e´ no hubo ninguna diferencia significativa entre personas normales e hipertiroidismo, índice Tei y a´ ninguna diferencia significativa entre personas normales e hipertiroidismo. Conclusiones: Los trastornos tiroideos, especialmente el hipertiroidismo, tienen un efecto significativo sobre las funciones cardíacas. Las mediciones de TDI son índices útiles, económicos y fáciles de realizar para la detección de anomalías funcionales sistólicas y diastólicas tempranas del VI y del VD en pacientes con hipertiroidismo.

Palabras clave: función ventricular derecha e izquierda, imagen Doppler tisular, pacientes jóvenes, hipertiroidismo.

Introduction

Hyperthyroidism is a thyroid hormone excess condition, and is the second most common thyroid dysfunction after hypothyroidism, showing a five to tenfold lower prevalence. At present, epidemiological data on hyperthyroidism are scarce and depend mainly on biochemical thyroid function tests (e.g., TSH and FT_4)[1]. Many of the clinical manifestations of hyperthyroidism derive from thyroid hormones capacity to change cardiovascular hemodynamics[2]. Clinical appearances related with cardiovascular illnesses vary between persons and can consist of sinus tachycardia in together inactive or active state and atrial arrhythmias, in specific atrial fibrillation in old persons with pre-existing heart illnesses[3]. Some features of cardiovascular hemodynamics like heart production, blood stream and pressure of pulmonary artery are better in person with hyperthyroidism, whereas the mean systemic pressure is reduced[4]. Cardiac contractility is improved, for both systolic and diastolic functions, and hyperthyroidism increases cardiac production and resting heart rate[2]. Echocardiography is very important in diagnosis and detection of heart function and is necessary in management of patients with thyrotoxicosis. The early Echo for patients with thyrotoxicosis can detected LV-enhanced systolic and diastolic functions[5]. Conventional Echo is a broadly presented procedure to identify subclinical heart failure in hyperthyroidism patients. Tissue Doppler imaging (TDI) is a relatively new echocardiographic technique can used widely to overcome some problems of conventional echocardiography. However, no recent studies have used TDI parameters for evaluation of left and right ventricle in hyperthyroidism patients, so this study was justifying that function.

Methods

A case control study (45 case of hyperthyroidism and 45 healthy control participants) that conducted between the first of March and the first of June of 2020. The data collection was carried out in echocardiography unit in medical department of Marjan medical city in Hilla city, Iraq and among patients attended diabetes and endocrine center in same hospital. where all participants who were: Age more than 18 years and overt hyperthyroidism confirmed by endocrinologist were included and Excluded every participant with: Smoking history, Alcohol consumption, Medical history of hypertension, diabetic mellitus and renal diseases, History of cardiac surgery, Medical history of ischemic heart disease, valvular heart disease, history of CABG and arrhythmia. Blood samples collect from patients from the antecubital vein after patient fasting for 12 hours, the blood collect without any anticoagulant, centrifuged for 15 min and then collect serum, thyroid hormone profile (T3, T4 and TSH) assessment. The Echocardiography was performed on all participants with use of GE Medical System Vivid nine-ultrasound machine equipped with 1.5- 5 MHz sector transducer probe. With participants located in left lateral decubitus plus ECG of 3 leads linked to apparatus analogous used to symmetrical record electrical activity of the heart throughout the echocardiographic check, echocardiographic checks were done subsequent the strategies of the American Society of Echocardiography. EF, designed by usage of the Simpson's technique. TDI was done via a 1.5- to 4-MHz transducer TDI imaging moreover needs great edge rates (>100fps) for image achievement with brilliant temporal perseverance. Longitudinal annulus motions calculated by color Doppler from top of 4 chambers. Systolic velocity of myocardial (s´) calculate systolic plus diastolic function of LV, early and late velocity of diastolic myocardial (e´& a´), isovolumic contraction and relaxation time (IRT & ICT), function of LV diastole assessed by velocity of blood inside mitral valve in initial diastole (E) as well as in delay diastole (A), mitral annular velocity: initial diastolic (e'), delay diastole (a'). Ratio (e'/a', E/ a', E/e') assessed by dividing early peak wave of transmitral stream of blood in initial velocity of diastolic myocardial that detect from systolic functions of TDI RV and LV that also evaluated by used TDI. Myocardial presentation show index of RV and LV. TDI (LMPI, RMPI) assessed by (a-b)/b, (a) represented the time of starting isovolumic contraction to finish of IVRT and (b) the time of ejection. Septal and lateral mitral annulus Doppler, measures of S' wave (systolic speed of the mitral ring) and E/E' ratio; S wave of the right ventricle (cm/s); indexed left atrial size (mL/m^2). To assess left ventricular function, the

following transmitral inflow parameters were measured (pulsed wave Doppler registration with gate placed at the tip of open mitral valve leaflets sample volume 1-3 mm): highest velocity of the initial E-wave transmitral stream (E), highest velocity of late A-wave transmitral stream (A), and the ratio (E/A) was resulting. Approvals of the scientific committee in the department of Medicine in Babil College of Medicine where obtained. The purpose of study explained to participant to get their verbal consent. Data was analyzed using SPSS version 23. Analytic statistics as Student –t test used to find association between categorical variables and continuous variables. The P-value below or equal to 0.05 considered statistically significant for a 95% CI.

90 participants were enrolled in this study. The two samples were homogenous in age and gender (p=0.24 and 0.13 respectively), table -1-.

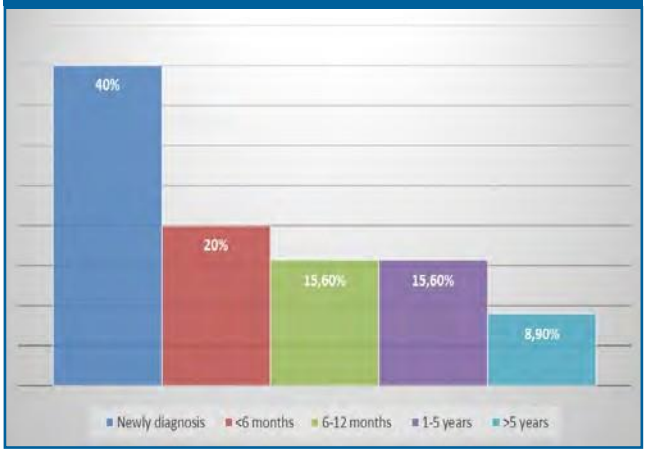
Table 1. Characteristic of participants.

Characteristic of participants		Participant		P value
		Case No (%)	Control No (%)	
Age	<30 years	7(15.6%)	12(26.7%)	O.24*
	30-39 years	23(51.1%)	21(46.7%)	
	40-45 years	15(33.3%)	12(26.7%)	
	Mean ±SD	36.2 ±5.6	32.8± 6	
Gender	Male	15(33.3%)	22(48.9%)	0.13**
	Female	30(66.7%)	23(51.1%)	

*Student T test, ** chi-square test, significant ≤0.05.

The duration of hyperthyroidism for cases shown in figure -1-.

Figure 1. Duration of hyperthyroidism in cases.



The thyroid function test for two groups shown that: the cases had significantly lower TSH than control participants (p<0.001) and T3, T4 were significantly higher in cases than control participants (p=0.036, <0.001 respectively), table -2-.

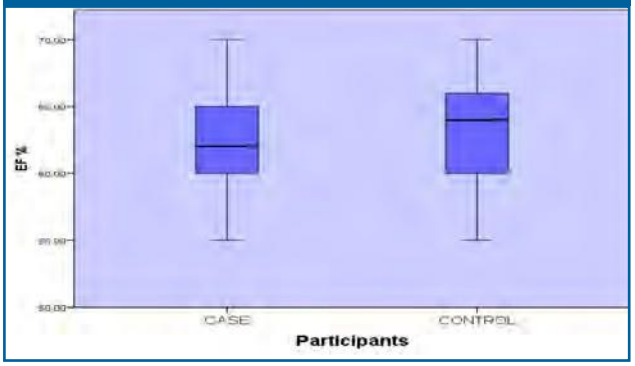
Table 2. Difference in Thyroid function test for both groups.

Thyroid function test		Mean	Std. Deviation	P value
TSH	Case	0.2552	0.22118	<0.001*
	Control	2.4378	1.26979	
T3	Case	2.2287	1.55667	0.036*
	Control	1.7149	0.43078	
T4	Case	133.3660	39.01952	<0.001*
	Control	79.8807	13.89587	

*Student T test, significant ≤0.05.

Ejection fraction assessment for both groups shown that, the mean ±SD EF% for cases was 63.3±4.1%, median was 62 % and ranging between 55%-70% while the mean ±SD EF% for control was 63.7±3.9%, median was 64 % and ranging between 55%-70% and there were no significant differences in EF% between two groups (p=0.62), figure -2-.

Figure 2. Difference in EF% between studied groups.



TDI examination for left ventricle shown that: S´ was significantly lower in cases than control participants (8.28 VS 10.77, p<0.0001), Tei index was significantly higher in cases than control participants (0.7 vs 0.38 p=0.021), E/A was significantly lower in cases than control participants (p=0.01), e´ significantly decrease in cases than control participants (10.95 vs 14.53 p<0.0001), E/e´ was significantly higher in cases than control participants (8.65 vs 6.9 p=0.001) and a´ shown no significant difference between cases and control participants (12.73 vs 11.7, p=0.073), table -3-.

Table 3. Difference in Left ventricle parameters by TDI.

Parameters	Participants	Mean	Std. Deviation	P value
S´	Case	8.2889	1.53182	<o.ooo1*
	Control	10.7778	1.67724	
Tei index	Case	0.7022	0.88946	0.021*
	Control	0.3889	0.07454	
E/A	Case	0.8822	0.31282	0.011*
	Control	1.4089	1.31630	
e´	Case	10.9556	2.89949	<0.0001*
	Control	14.5333	2.62505	
E/e´	Case	8.6556	2.93068	0.001*
	Control	6.9156	1.86413	
a´	Case	12.7333	2.51721	0.073*
	Control	11.7000	2.86515	

*Student T test, significant ≤0.05.

TDI examination for right ventricle shown that: S´ was no significant difference between cases than control participants (p=0.93), Tei index was significantly higher in cases than control participants (0.86 vs 0.36 p=0.015), E/A was no any significant difference between normal persons and hyperthyroidism (p=0.47), e´ no any significant difference between normal persons and hyperthyroidism (p=87), E/e´ no any significant difference between normal persons and hyperthyroidism (p=0.85) and a´ was significantly higher in cases than control participants (15.77 vs 12.7, p<0.0001), table -4-.

Table 4. Difference in right ventricle parameters by TDI.

Parameters	Participants	Mean	Std. Deviation	P value
S´	Case	12.6222	1.21148	0.93*
	Control	12.8667	1.50151	
Tei index	Case	0.8667	1.34028	0.015*
	Control	O.3689	0.09001	
E/A	Case	1.3311	1.68494	0.47
	Control	1.6422	2.40619	
e´	Case	13.2444	4.52345	0.87
	Control	13.1136	2.72982	
E/e´	Case	5.3311	1.12812	0.85
	Control	5.2956	0.71190	
a´	Case	15.7778	3.65494	<0.0001*
	Control	12.7500	2.58011	

*Student T test, significant ≤0.05.

Discussion

In current study, there were harmful properties of hyperthyroidism on left ventricle systolic plus diastolic jobs. In adding, alike but fewer distinct variations happened in right ventricle systolic plus diastolic roles, thus designating that hyperthyroidism pretentious together left ventricle and right ventricle role unrelatedly of thyroid hormone heights. The current study showed that hyperthyroidism cases had female predominance (66%), which coincides with Bal et al.[6], who also found female preponderance (83%), suggesting the disease being more common in female population. Most left ventricle size occur at end (diastole or systolic) is greatest typical structures in hyperthyroidism patients. LVEF differences controversy between studies[7-9], in current study there was no significant difference in LVEF between cases and control. s' velocity that processes LV contraction longitudinally and is a spare of LV systolic job, in current study S´ was significantly lower in cases than control participants (8.28 VS 10.77, p<0.0001) this may interpret by contraction of endocardial longitudinal fiber this highly in charge for extended axis purpose, which is liable in a variability of heart situations with also subsequent hypertrophy of LV. Myocardial ischemia, cardiomyopathies, hypertension, coronary artery illness and heart failure have change in function of sub endocardial fiber with decrease in s' velocity, notwithstanding pre-served LVEF[10,11]. Tei-index in patients with hyperthyroidism had a significant higher value than control, which is an indicator of impaired LV systolic function .LV Tei-index was significantly higher in hyperthyroidism compared with control patients[12]. (e' Velocity) is a measure of LV reduction in initial diastole plus it is comparatively load free. In patients with initial DD e' velocity is decreased, occur 10-15 years before decreased of mitral E velocity[14]. e´ significantly lower in hyperthyroidism patients than control patients (p<0.0001). For assessment of function of atrium by late diastolic TDI, a' velocity is a good parameter for function of atrium[15]. e' velocity decrease wide size of left atrium is parameter of cardiac death[16], in current study there is no difference between hyperthyroidism compared with control patients (p=0.073). in patients with hyperthyroidisms and also normal patients the mean E/E' ratio in the same and was good appear at edge of 15, also, there is significant progress in hyperthyroidism compared with control patients characteristic an advanced LV rich pressure in the hyperthyroidism as in Turkey study[12]. In current study documented enhanced systolic and diastolic functions when hyperthyroidism compared with control patients, similar to study in Nigeria stated that the found of abnormal features in patients with hyperthyroidism in left ventricles as the following: 30% associated with systolic function, 34% associated with diastolic function, 10% associated with heart failure and preserved ejection fraction, 6% associated with heart failure and decrease ejection fraction finally 34% associated with left ventricular hypertrophy[5], Anther study in Egypt shown Thyroid disorders have a significant effect on LV systolic and diastolic functions and TDI was useful indices for detection of LV functions in patients with Thyroid disease[12]. Decrease in Tei index and tissue Doppler resulting diastolic parameters in spite of usual results by conservative echocardiography. E/E' ratio increased significantly in patients with thyroid diseases[17]. In patients with Thyroid disease, TDI is a useful echocardiographic parameter in assessment of LV systolic function. However, the influence of thyroid illnesses on RV arrangement and functions still unknown and no recent studies have used this parameter. In this study, using TDI analysis, increase RV index of Tei and A' value in cases compared to the control. This study was limited by it was a Hospital base study; hence, the findings cannot be generalized to the community level.

Conclusions

Thyroid derangement especially hyperthyroidism, have a significant effect on cardiac functions. TDI measurements are useful, inexpensive, and easy to perform indices for detection of early LV and RV systolic and diastolic functional abnormalities in patients with hyperthyroidism. Early diagnostic approach in patients with thyroid dysfunctional states is important for avoidance of cardiac complications that might affect these patients.

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