Left Ventricular Diastolic and Systolic Performance: A Study Using Tei Index in Adulthood Patients with Thalassemia Major

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Abstract

Introduction: Cardiac complications, including heart failure, are the most important secondary ones of the thalassemia major disease, which manifests itself in adolescence and early adulthood. Appropriate, low cost diagnostic tools available as well as knowing its related factors are the most important components of therapy in these patients, given the importance of these complications, or by examining and revealing early symptoms. Thus, in this study, we intend to examine the systolic and diastolic ventricular effects in adult patients with the help of Tei index.

Methods: 70 adult patients with thalassemia major were examined in this study. Frequency of Tei index and its association with factors such as age, sex, level of packed cell injection, as well as hemosiderosis were measured in two blood levels of more than 1000 ferretins.

Results: In this study, 70 youth adult patients with thalassemia major with an average age of 21.3 ± 2.8 years were studied, 31 were male (44.4%). Tei index were abnormal in 16 patients (24%). There is no statistically significant correlation between the Tei index and one of the variables of age, gender, number and duration of blood transfusion and deferoxamine, the hemoglobin level and the number of ferretins ($P > 0.05$).

Discussion: Study on Tei index shows that many patients are subclinically involved in the disease before the onset of clinical symptoms of heart failure, the subject which raises the need for early diagnosis of the disease; and it seems that none of the demographic factors or factors related to disease cannot be considered as a main cause or warning of the disease; and the above results can be confirmed only on the basis of paraclinical tests.

Keywords: Tei Index, Thalassemia Major, Left Ventricular Performance

Introduction

The patients with thalassemia major usually suffer from various diseases related to heart and blood vessels. Anemia, splenic injury, increased iron levels in the blood, nutritional deficiencies and lung damage (such as pulmonary hypertension) are some of the complications associated with thalassemia. Chronic heart failure in patients is due to myocardial hemosiderosis, and usually begins in the second decade of life.

Mechanism of iron-induced myocardial damage occurs as a result of free iron and its impact on myocytes through increasing oxidative damage to lipids and proteins and related immunological reactions.

Cardiac involvement, which often leads to chronic heart failure (CHF) in these patients, is the most important cause of death among them; and it results in secondary hemosiderosis and chronic anemia in 63.6% and about two thirds of these people, respectively.

Although CHF occurs due to a combination of systolic and diastolic dysfunction and failure, in one third of these patients, diastolic dysfunctions are seen with deficiencies in left ventricular function, particularly in younger patients.(1- 4)

Generally, the first symptom in young people is filling defect of left ventricle (LV), which usually occurs with defects of relaxation pattern, while systolic left ventricular function is normally done.

Several studies have been done in this case, most of which are based on the belief that if heart defects are diagnosed at an early stage, it is reversible in this case, and heart deficiencies are largely

compensated.(5, 6) This treatment usually occurs with high doses of desferrioxamine chelators before increase in concentrations of iron.(6)

MPI or Tei index is an Doppler-derived index that measures the performance of the ventricle, and is separated from the left ventricle genometry. This criterion is derived from the amount of atrio-ventricular input stream.

The diagnostic role of this index has been demonstrated in several studies on the diagnosis of left ventricular dysfunctions.(9- 12)

Heart failure and cardiovascular complications are among the common problems caused by the initial disease in patients with thalassemia major.

More detailed studies have been carried out on these complications; and the tools to measure them have been already discussed in few studies; hence the need to this study is felt in the related medical research. In this study, we decided to evaluate the cardiac complications of left ventricle with Tei index.

Methods

Those adult patients with thalassemia major who referred to a blood and heart clinic of one of the third-level hospitals in Tehran for follow-up and treatment on a regular basis, have been entered into the study with the following conditions:

•Recommended follow-ups and treatments are carried out regularly.

•At the beginning of the study, they do not have severe anemia or clinical heart failure.

Meanwhile, the average Hb and serum ferritin levels in patients, as well as the number of blood transfusions and deferoxamine injections were extracted from their cases, calculated and then entered into the study.

Tei Index is extracted from echocardiographical reports of the patients. The Tei index greater than 0.4 is considered abnormal; and left ventricular ejection fraction (LVEF) greater than 50% is considered abnormal. Then, the relationship between Tei and the variables of age, sex, hemosiderosis, frequency and the number of packed cells were reviewed.

Mean, median, range, standard deviation, frequency and frequency percentage were determined using statistical software SPSS V.19 and using descriptive analyses. For comparison of qualitative means, independent T test was used after the normal distribution of data was tested to determine whether it is followed by 1-sample KS; and k.s-Ttest-Chisquare statistical test was used for the comparison of qualitative ratios. In all tests, significance level was considered as two tails, and P <0. 05.

Results

In this study, 70 youth patients with thalassemia major were studied: 31 were male (44.4%), and 39 were female (55.7%). 16 people (24%) had Tei equal to or greater than 0.4 (abnormal), whose average age was 21.3± 2.8 years (from 18 to 24 years). The mean Tei index was 0.37 ± 0.08 (from 0.3 to 0.79); and average duration of blood transfusion was 46.6 ± 6 months (28 to 112 months). Average number of their packed cell units was 252.3 ± 93 (from 76 to 487).

Average time to get blood was 3.4 ± 0.75 weeks (from one to five weeks). The average number of hemoglobin in them was 9.3 ± 1.8 units (from 6.3 to 11.8).

Average age of starting to receive deferoxamine was 8.8 ± 1.6 years (from 1 to 11 years). Average diameter of the left ventricle of these patients was 111± 49.1 mm. The average number of ferretins was 2476± 1533 (from 45 to 100 thousand).

Patients were divided into two groups with normal Tei index (less than 0.4) and abnormal (equal or greater than 0.4); the averages of the above variables are determined as abnormal or normal Tei indices in Table- 1.

Patients were divided into two categories of less and more than 20 years of age. 28 people (40%) were less than 20 years of age; and 42 people (60%) equal to or more than 20 years of age. There was no significant relationship between age and the state of being normal of Tei. (P= 0.2)

Analytical study also showed that gender was significantly related to the fact whether Tei is abnormal or normal (0.7= p). In addition, there is no statistically significant relationship between normal/abnormal Tei index and anemia (p= 0.77).

The serum ferretin level over 1000 was considered as criterion of hemosiderosis. In this case, 12 subjects (18.5%) had ferretins less than 1000; and 48 (81.5%) had ferretins more than 1,000.

Comparison of abnormal Tei index associated with this level of hemosiderosis suggests no statistically significant relationship between them (P= 0.3). There was no significant relationship between age group and anemia (P= 0.56) and hemosiderosis (P= 0.7).

Discussion

Despite the fact that it is being discussed in most previous studies that patients with thalassemia are involved in cardiac complications and even its

Table- 1. The study variables separated as normal or abnormal Tei indices

Variable	Tei index		P value	Statistical Significance
	Normal	Abnormal		
Age	20.6±3.2	21.9±3.8	0.8	No
Time to get blood	17.5±8	18.6±6	0.7	No
Number of PC received	253±97	253±76	0.5	No
Time intervals to receive PC	3.1±0.8	3.3±0.7	0.7	
Last hemoglobin	9.3±0.9	9.3±1.1	0.82	No
Time for starting deferoxamine	8.2±2	8.3±1.5	0.42	No
LV diameter of left ventricle	112±45	111±48	0.76	No
Last ferretin	2226±123	2210±120	039	No

PC= packed cell

etiology, the diagnostic tools used and the results of these studies were different.

As these studies are limited, it is very difficult and even impossible to evaluate the results. So far, only in one study, the Tei index was used for cardiac complications in patients with Thalassemia.(8) Therefore, in this study, we intended to make a Doppler echocardiography in these patients, while studying the status of their ventricular systolic and diastolic functions using Tei index.

Our results showed that about a quarter of these patients have abnormal Tei indices, while none of them have clear symptoms and evidence of overt cardiovascular diseases or heart failure. This result, on which many of these patients to some extent are affected with heart failures even before onset of clinical symptoms, has been shown in some previous studies.(9, 11)

The study by Marci is one of the studies in which asymptomatic patients were studies in terms of the parameters of echocardiography and Doppler tissue techniques, the results of which are suggestive of heart failure without clinical symptoms.(9)

This result makes us aware of the fact that it is better that we be ever vigilant to cardiac complications in these patients, and that we show symptoms of systolic function failure by screening tests before the onset of clinical symptoms, because the early diagnosis of these complications, especially in cases associated with iron overload (hemosiderosis) can help us to eliminate some complications through timely treatment with chelators.(5, 6)

In our study, it was shown that even in abnormal cases, there is no relationship between Tei index and any other variables such as demographic variables, hemoglobin of patients, iron overload (hemosiderosis), left ventricular diameter, number and time intervals of blood sampling.

It appears that cardiac dysfunctions diagnosed by the Tei index are not related to any of the above factors, or that it appears much earlier than the onset of these disorders.

As the number of studies in this area (especially with the Tei index) is very limited, the results of this study clearly can not be compared with other studies. However, the result on which complications from heart failure (especially at the beginning, and in asymptomatic patients) is not associated with many factors (such as frequency of injections, volume of the injected blood, ventricle diameter and/or value of hemoglobin), has been shown in some previous studies.(11)

Whether Tei is an efficient index in the early diagnosis of heart disease in thalasemics, is a question which cannot be answered on the basis of the results of these investigations.

Leonardi et al, who compared the results of the Tei index with the MRI results in phase T2, found that Tei index is not very good especially in ventricular failures, and that MRI is more appropriate in this case.(8) It is recommended that to find an appropriate answer to this question, patients are evaluated by two means (one of which is the gold standard for diagnosing heart diseases) and then the results are compared. In this case, the diagnostic value of the Tei can be showed individually to find all the symptoms of heart failure.Finally, the study of Tei index showed that many patients are subclinically involved with the disease before the onset of clinical symptoms of heart failure; and it seems that none of the demographic factors or factors related to disease can not be considered as a primary cause or warning of the disease; and the above results can be confirmed only on the basis of paraclinical tests.

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