Evaluation of 2D speckle strain in β-thalassemic patients of pediatric age group for early detection of left ventricular dysfunction

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Abstract

**Background:** Thalassemia is a disease caused by abnormal hemoglobin synthesis with a resulting of chronic anemia. Major cause of death is heart failure due to combination of anemia and excess iron from repeated transfusion. **Objectives:** To evaluate the role of 2D speckle strain in thalassemic patients in early detection of cardiac dysfunction. **Methods:** This is a case control study included 20 thalassemic patients with mean age (10 ±3.8 year), and compared with 20 healthy subjects as control group with (mean age 11± 1.7 year). They were enrolled from obstetric and pediatric hospital-thalassemic center in Babylon province. 2D speckle tracking strain was evaluated in both groups. **Results:** Segmental strain values were significantly lower at the basal anteroseptal LV (19.5 ± 3 vs. 22 ± 2.7; \(P = 0.01\)), basal posterior LV (-19 ± 5 vs. 22 ± 3.5; \(P = 0.05\)), mid anterior (22 ± 5 vs. 24± 2.3; \(P = 0.05\)) as compared to controls. Average longitudinal strain (ALS) were lower in patients with TM that receive blood in a period less than 15 days than in patients that receive blood in a period more than 15 days. However, these changes are not significant (\(P>0.05\)). **Conclusions:** From the early changes in segmental strain values, early detection of cardiac dysfunction could be achieved, and the intervals between blood transfusion also affects the development of cardiac dysfunction, the longer duration the less development of cardiac dysfunction.

**Keywords:** thalassemia major, 2D speckle tracking, heart failure.


Introduction

Thalassemia is a result of abnormality in the synthesis of hemoglobin that leads to the development of chronic anemia. Alpha (α) and beta (β) thalassemia are the major types of this disease. The chronic anemia and iron over load from frequent blood transfusion worsen the condition of heart failure. Blood transfusion with the use of iron chelating agent lead to improvement of health condition. Advanced echocardiographic measurements that included 2D Speckle tracking strain could identify subclinical impairments of the heart in much heart disease. Strain defined as a percentage of the
changes of the length of the fibers from the original one, so it is a dimensionless index.

Speckle tracking strain consist of global longitudinal strain (GLS), circumferential strain (CS) and radial strain (RS). GLS is a very sensitive to the subendocardial region of the heart while the CS is sensitive for mid myocardial and epicardial region. In a current studies only GLS was used because of its availability. In thalassemic patients the chronic anemia and hypoxia may affect the heart and the GLS may be affected. First technique that used for measuring strain is TDI. TDI strain limitations are the angle dependency and the noise. While STE is angle independent so it's preferable to be used. Additionally, STE allowed to differentiate between active and passive segmental deformation. Moreover, Normal strains obtained from the apical views to determine the apex and from short axis (SAV) view the CS and RS were determined.

The aim of this study was to evaluate the role of 2D speckle strain in thalassemic patients of pediatric age group in early detection of cardiac dysfunction.

Materials and Methods

This is a case control study included 20 thalassemic patients with mean age (10 ±3.8 year), and compared with 20 healthy subjects as control group with (mean age 11± 1.7 year). They were enrolled from obstetric and pediatric hospital -thalassemic center in Babylon province. The diagnosis of thalassemia major were done according to hemoglobin electrophoresis, and all of patients were with frequent blood transfusion. Matching between patients and control groups (age and sex) was done. Information regarding intervals of blood transfusion were taken. Advanced echocardiographic measurements includes speckle tracking were done to about 20 patients and 20 control. In which offline measurements were performed by using special software in GE. Three views were stored and then analyzed including apical 4 chamber view, apical 3 chambers (A3C) view and 2 chamber view. Initially the A3C view was analyzed for timing of the aortic valve closure which done automatically and controlled by visual assessment. Then the endocardial border was automatically traced and corrected if needed then approved. The eye ball strain was appeared and average longitudinal strain was calculated (Figure 1).

Results

Speckle tracking strain was compared between thalassemic and control groups. The results showed that there is significant differences between patients and control in basal anteroseptal, basal posterior and mid anterior part of strain.
Also, there is a decrease in most of the other speckle tracking parameter in patients group but these changes is in significant (P>0.05)(Table 1 & Figure 2).

**Table 1:** Speckle tracking parameters between patients and control groups.

<table>
<thead>
<tr>
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<th>Patients</th>
<th>Control</th>
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<tbody>
<tr>
<td>GLS</td>
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<tr>
<td>Apex</td>
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<td>24.9±2.5</td>
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<td>-21.8±2.6</td>
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<td>-21.9±2.1</td>
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<tr>
<td>Basal L</td>
<td>-21.2±6-</td>
<td>-22±3.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Basal P</td>
<td>-19.6±5-</td>
<td>-22.4±3.1</td>
<td>0.04*</td>
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<tr>
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<tr>
<td>Basal S</td>
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<td>0.1</td>
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<tr>
<td>Mid AS</td>
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</tr>
<tr>
<td>MidA</td>
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<tr>
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<tr>
<td>Apical L</td>
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<tr>
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</tbody>
</table>

GLS= Global longitudinal strain, AS= Anteroseptal, A= Anterior time, L= Lateral, P= posterior, I= inferior, S= septal.*P, 0.05.
The effect of blood transfusion

The percentage of average longitudinal strain were less in patients with TM that receive blood in a period less than 15 days than in patients that receive blood in a period more than 15 days. but, these changes are in significant (P>0.05). Also there were decrease in the percentage of BLS, MLS, ALS and apex in patients with TM that receive blood in a period of < 15 days, but these changes are in significant (P>0.05) (Figure 3).

![Figure 3: Effect of frequency of blood transfusion on strain](image)

AGLS=average global longitudinal strain, BLS=basal longitudinal strain, MLS=mid longitudinal strain, ALS=apical longitudinal strain.

Discussion

This study found that there are no significant differences in the average GLS. This result was matched with previous study that concluded that GLS was statistically not differences between patients and control. On contrary, there are segmental significant decreases in basal part of the heart and in the mid anterior segment of the heart. Fitchett and his coworker explain these results by which iron deposition precipitated on the myocytes and these precipitation was patchy. These results were agreed with other study conducted by Abhinav and his colleagues who found that there is a segmental decrease in the global strain. They also found that there were lower strain level in basal lateral, septal and mid lateral and septal. Other study found that there were significant increase in the strain in the basal lateral segments, while there were no any differences in the other segments strain between patients and control and explained these results was due the heart function initially was not affected until late stages of the disease. Moreover, this study showed that the percentage of average longitudinal strain were less in patients with TM that receive blood in a period less than 15 days than in patients that receive blood in a period more than 15 days. Although these changes is not significant but other study improve that chronic receiving blood will affect adversely on the functions of the organ including the heart.

Conflicts of interest: None of the authors have any conflicts of interest relevant to this research subject.
**Ethical consideration**

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee.

**References**


