Original Study

INVESTIGATION OF CARDIAC COMPLICATION OF SICKLE CELL DISEASE BY ECHOCARDIOGRAPHY AND MRI

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ABSTRACT

Aim: Cardiovascular complications in patients with sickle cell disease are known as cardiomegaly, ischemia, dysfunction of the ventricles, and increased pulmonary artery pressure diffuse vascular obstruction can affect any other organ. Cardiac involvement is common in patients with sickle cell disease and it is less commonly diagnosed.

Materials & Method: The size of heart cavities, the right and left ventricular function, and the abnormal flow of valves were measured in 65 patients referred for 6 months using by echocardiography and 2D and TDI and M-mode. The iron deposition in the liver and the heart is measured by the T2 * MRI.

Results: The mean age of patients was 26 years, 45 male, and 20 female patients. The rate of left ventricular function was 57.2 ± 1.6 Pulmonary hypertension was found in 22 patients (33% of patients), mild in 17 patients (26%), and moderate in 5 patients (7.6% of patients) has been. There were iron deposition in the liver in 21 patients (32% of patients), mild in 16 (24%) patients and moderate in 5 (7.6%) patients. Also, in any patient, iron deposition of heart has not been reported.

Conclusion: The results of our studies showed that in most sickle cell patients, systolic and diastolic function of left ventricular was maintained, and the abnormality of the heart cavities was mild. Also, pulmonary hypertension is a common echocardiographic finding and cardiac abnormalities have not been associated with iron deposition in the heart.

Key words: Pulmonary hypertension, sickle cell anemia.

Introduction

Sickle cell disease is a hereditary disease, due to mutation in the beta-globin gene, since the old days, the most common problem among patients was painful and unruly pain due to vascular occlusion.[1] Classical sickle cell disease has never been a benign illness; after birth, usually a calm and benign period due to high fetal hemoglobin, then a severe period of illness begins.[2] This condition is one in five hundred It involves African Americans and is estimated to be affected by seventy-two thousand Americans.[3]

There is sickle cell disease in the southern provinces of Iran, common in the native Arabs of Khuzestan. Five genotypes have been identified in the research, the fifth type is Asian or Saudi, and the clinical and laboratory symptoms of this disease (which are high fetal hemoglobin) are similar to those of Saudi Arabia.[2] Both the physical trapping of red blood cells and endothelial reactions with it, causes secondary inflammation and microvascular blockage and frequent ischemic injury. Bone marrow infarctions result in repeated bouts of bone pain and this is the most common complication of sickle cell disease that results in an average of two annual visits to the emergency department.[4,5]

Treatment for patients including increased fetal hemoglobin, penicillin prophylaxis, treatment of infections and blood transfusions have increased life time, which increases the organ damage and increased cardiovascular events, especially progressive vasculopathy, increased pulmonary artery pressure, Systolic and diastolic dysfunction of the left ventricle, increased systemic blood pressure, increased iron overload and thrombosis.[6,7]

Various studies have shown that mild to moderate pulmonary arterial hypertension is common in adults and is associated with a 9 to 15 times risk of death. Echocardiography is a suitable and noninvasive device for screening and patients discovered with increased pulmonary pressure require standard care including right heart catheterization.[8,9]

Cardiac complications are a common symptom of sickle cell disease, an important cause of death and illness in patients. Chronic anemia causes an increase in cardiac output with a slight increase in heart rate, which causes left ventricular eccentric hypertrophy and later significant dilation. Increased ventricular mass causes diastolic dysfunction in both children and adults, which is an independent risk factor for death with a risk ratio of four.[10,11]

In these patients, acute chest pain with abnormal ECG, high troponin, abnormal perfusion scans and abnormal MRI has been observed, while angiography indicated normal coronary arteries. The reason for this is microvascular obstruction and over coagulation conditions. The return of these cases has been shown after major supportive treatment for ischemia.[12,13]

Iron deposition in the heart can be considered as one of the causes of heart problems in patients with sickle cell disease. T2-based MRI imaging studies have shown that iron deposition in the heart, despite the iron deposition in the liver, has a rare with history of blood transfusions and systemic iron overload.[14]

Materials & Method

In this study, 65 patients with sickle cell disease cycle were evaluated within a 6-month period in Shafa hospital in

Ahvaz . Patients with sickle cell disease are included in the study if they have the following conditions:

Subjects People who have already been diagnosed with sickle cell disease

- They are over 18 years of age
- Do not have other simultaneous hemoglobinopathies, such as thalassemia
- And patients are excluded from the study with the following conditions:
- Pregnant patients
- Patients with other simultaneous hemoglobinopathies

The admission primary diagnoses of studied patients were as follow: vaso-occlusive painful crisis, n =; pneumonia and/or acute chest syndrome, n=; cerebrovascular accident, n=...; and congestive heart failure, n: etc.

The size of the cavities, the right ventricular systolic function and the abnormal flow of valves, cardiac function and to estimate pulmonary artery systolic pressure (PASP). Heart chamber size, ventricular dysfunction, and abnormal flow through the cardiac valves were categorized into mild, moderate, and severe on the measured by using echocardiography and 2D, tissue Doppler imaging (TDI), and M-mode images. Simpson's method was used to evaluate left ventricular systolic function. Using the maximum tricuspid valve flow and IVC, calculation of systolic pulmonary artery pressure was performed and were classified mild, moderate and severe disturbances according to echocardiographic criteria. The pulmonary pressure of more than 30 was considered as hypertension of the pulmonary artery and was classified as follows:

- Mild 30-39
- modrate 40-54
- severe More than 55

Then the iron deposition rate in the liver and heart was measured by the T2 * MRI

Ethical clearance

This study received ethical clearance from the Health Research Ethics Committee, Faculty of Medicine, Ahvaz University of Medical Sciences. All patients had given written consent for this study.

Statistical analysis

Descriptive statistics such as frequency distribution tables and mean standard deviation was used.

Pearson correlation was used for examining the relationship between quantitative variables, and independent T-test was used the relationship between quantitative and qualitative variables. The SPSS software version 20 was used for data analysis.

Results

In this study, 65 patients with sickle cell disease were evaluated for a 6-month priod. The mean age of patients was 26 years, and their age ranged from 21 to 50 years. Also, 45 patients were male, and 20 were female. None of the patients had a history of frequent blood transfusions in the last 5 years. And most of the symptoms they referred were chest and limb pain. [Table 1]

Characteristics	n (%)
Age (years) mean	26
Sex (n, %)	
Male	45(69%)
Female	20(31%)
History of frequent blood transfusion (n, %)	0
Prior acute chest syndrome (n, %)	27(41%)

Table 1: Distribution of characteristics of subjects with sickle cell disease (SCD) (n=65)

The mean hemoglobin concentration in patients was 8.1 g/dl and its range ranged from 5.2 to 11.2 g/dl , and the serum ferritin level was higher than normal in 34% of patients.

In evaluated patients, according to Doppler echocardiography findings, myocardial relaxation dysfunction was present in 17 patients (27% of patients) and it was mild, and in 48 patients (73% of patients), Doppler echocardiography findings were normal. Left ventricular function was evaluated using the Simpsons method and was 57.2 ± 6. 1. Right ventricular dysfunction has been reported in 4 patients (1.6%), which was mild.

Pulmonary artery Hypertension was observed in 22 patients (33% of patients), which was mild in 17 patients (26%) and moderate in 5 patients (6.6%).

The dilation of heart cavities and valve insufficiency is shown in Table 2

Variables	Overall	Mild	Moderate	Severe
Pulmonary hypertension	22(33)	17(26)	5(6.6)	0
Left ventricular dilation	5(7.6)	5(7.6)	0	0
Right ventricular dilation	10(15.3)	8(12.3)	2(3)	0
Left atrium dilation	14(21)	14(21)	0	0
Right atrium dilation	21(32)	21(32)	0	0
Mitral valve regurgitation	15(23)	13(20)	2(3)	0
Tricuspid valve regurgitation	27(41.5)	16(24.6)	11(17)	0
Left ventricular dysfunction	0	0	0	0
Right ventricular Dysfunction	4(1.6%)	4(1.6%)	0	0

Table 2: Echocardiac features of subjects with SCD (n=65)

In this study, 65 patients with sickle cell disease, heart and liver MRI were performed and the iron deposition rate was evaluated. There were iron deposision in the liver in 21 patients (32% of patients),that was mild in 16 (24%) patients and moderate in 5 (7.6%) patients. Also, in any patient iron deposition of Heart has not been reported.

In addition, iron overload in the liver and heart was compared with serum ferritin levels, and it was observed that there was a significant relationship between iron

deposition in the liver and serum ferritin (p = 0.001). While there was no clear correlation between iron of heart and serum ferritin, p =0.528

Serum ferritin was high in 34% of patients, with higher levels of it correlated with higher iron deposition in the liver, but this association was not observed with iron deposition in the heart.

Discussion

Cardiac complications are a common symptom of sickle cell disease, an important cause of death and illness in patients. Various studies have shown that mild to moderate increases in pulmonary artery pressure are common in adults and there is a risk 9 to 15 times of death. Hypertension was observed in 22% of patients in this study.

In studies like Galdwin *et al*., pulmonary hypertension was found in 34% of 154 patients who were only severe in 9%.[15] In the Simone *et al* study, pulmonary hypertension was 63% of 40 patients.[16]

In addition, pulmonary hypertension increases morbidity and mortality in patients with sickle cell disease. And this is due to impaired exercise and heart failure. The cause of pulmonary hypertension, chronic hypoxia, vasculopathy associated with sickle cell disease, recurrent thromboembolism, increased blood viscosity, increased right ventricular volume, and pulmonary scar as a result of repeated chest pain attacks. In our study, pulmonary artery pressure was obtained non-invasively and from echocardiography data, although catheterization is the standard diagnostic tool for this.

Other disorders observed in our findings are the large heart cavity and hyper dynamic left ventricle. And in all patients with these features, anemia is observed. Cardiac correlation with anemia increases the preloaded due to increased volume, decreased afterload due to decreased systemic vascular resistance and as a result of increased cardiac output.

Mitral and tricuspid valve insufficiency is common, and is more often seen mildly, moderate impairment is seen in patients with enlarged heart cavities and pulmonary hypertension, left ventricular dysfunction is not seen, and all patients retained left ventricular function.

TDI is an effective method for evaluating cardiac function, the TDI evaluation in this study showed the normal range of Sam, Eam, and Aam. And myocardial relaxation disorder was observed in 27% of patients. In patients with sickle cell disease, chronic volume overload has been associated with prolonged anemia, which is indicative of existing disorders. Endothelial dysfunction and blood vessel stiffness also play a role, but it is less important to increase the iron deposition in the heart in patients with sickle cell disease.

Iron deposition in the heart can be considered as one of the causes of heart problems in patients with sickle cell disease. T2-based MRI imaging studies have shown that iron deposition in the heart, despite the iron deposition in the liver, is rarely seen in the history of clear blood transfusions and systemic iron overload. In this study, iron deposition in the heart was not present in any of the patients, but iron deposition in the liver was observed in 32% of patients. Serum ferritin was high in 34% of patients, with higher levels of it correlated with higher iron deposition in the liver, but this association was not associated with iron deposition in the hear.

Conclusion

The results of our studies showed that in most sickle cell disease patients, systolic and diastolic function of left ventricular was maintained, and the malfunction of the heart cavities was mild. Also, pulmonary hypertension is a common echocardiographic finding and cardiac abnormalities have not been associated with iron deposition in the heart.

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