THE EFFECTS OF IRON TREATMENT ON VISCOSITY IN CHILDREN WITH CYANOTIC CONGENITAL HEART DISEASE

Secondary erythrocytosis was seen in cyanotic congenital heart diseases due to low arterial oxygen saturation. This situation allows blood viscoelasticity to increase. Iron deficiency was observed in more than one third of patients with cyanotic congenital heart disease. Microcytosis caused by iron deficiency, though, increases viscoelasticity and thrombosis. Replacement of iron deficiency is frequently recommended in medical monitorings of patients with cyanotic congenital heart diseases. Nonetheless, while iron treatment restores microcytosis, it also increases hemoglobin level. Escalated hemoglobin and hematocrit values cause viscoelasticity to heighten. Given vicious cycle developed, advantage-disadvantage relation of iron treatment applied to cyanotic patients is unclear. How iron treatment affects viscoelasticity in cyanotic congenital heart diseases has been unidentified.

This study was planned to determine the effects of iron treatment on viscoelasticity in children with cyanotic congenital heart disease.

METHODS

Patients characteristics

Pediatric patients younger than 18 followed by Gazi University Medicine Faculty, diagnosed with cyanotic congenital heart disease were involved in the study. During evaluation; patients with bleeding findings that could lead to anemia, patients having blood transfusion in the last week and patients having iron treatment in the last three months were not included in the study.

Definitions

During the first evaluation; complete blood count, serum iron, iron binding capacity, ferritin level, viscoelasticity and transferrin saturation were examined in patients. Ferritin level was used for iron deficiency anemia in patients and patients with ferritin level lower than 12 ng/ml were diagnosed with iron deficiency anemia. Patients were divided into two groups according to their ferritin levels as with iron deficiency and non-iron deficiency. Iron deficiency treatment with two valences was orally initiated for patients with iron deficiency anemia as two doses, 4 mg/kg/day. Iron treatment was not applied to patients with no iron deficiency. Laboratory and clinical evaluations were repeated three months later in the groups that iron treatment was initiated and the treatment in question was not commenced.

RESULTS

A total of 39 patients were evaluated in the study. Of the patients, 20 (51%) were female, 19 (49%) were male; and it was established that their average age 9.9±6.2 years, average weight 33 ± 18.4 kg. Average oxygen saturation was identified as 73.5 ± 8.2 %.

Most frequently seen hyperviscosity symptom in patients was determined as headache. Of the hyperviscosity symptoms; headache was seen in 25 (64.1%) patients, complaint of having sinusitis frequently in 23 (59%), visual blurriness in 21 (53.8%), nose bleeding in 9 (23.1%), tinnitus in 5 (12.8%).

Laboratory Results

Iron deficiency was determined in 21 (53.8%) out of 39 patients. No statistically significant difference was identified in terms of incidence of hyperviscosity symptoms

between groups. No difference was established with respect to demographical features between groups with iron deficiency and non iron deficiency.

Average Hb, Hct values were measured respectively as : 14.8 ± 2.4 gr/dl and 45.8 ± 7.5% in the group with iron deficiency; 16.5 ± 2.5 gr/dl and 49.2 ± 8.3% in the group with non iron deficiency(Table 1). Other hematological parameters between groups with iron deficiency and non iron deficiency were shown in Table 2.

Initial hematologic values and those after three months were compared in patients who had been applied iron treatment. It was established that Hb value increased approximately from 14.8 ± 2.4 gr/dl to 16.0 ± 2.0'a($p=0.003$) three months later. Although there was an increase in hemoglobin and hematocrit values, viscosity value was approximately 5.6 ± 1.0 c poise initially, however, it was determined as 5.5 ± 1.0 c poise after three-month iron treatment ($p=0.741$). In addition, initial average oxygen saturation increased from 71.7 ± 6.8% to 75.0 ± 6.8% in the group that iron treatment had been applied; this increase was found statistically significant ($p<0.001$) (Table 2).

CONCLUSİONS

Iron deficiency is a frequently seen condition in patients with cyanotic congenital heart disease. Results obtained from the study indicated that iron treatment increased Hb and Hct levels without elevating viscosity in patients with cyanotic congenital heart disease and it caused improvement in clinical symptoms.

Table 1. *Comparison of two groups with and without iron deficiency in terms of their demographical and laboratory values*

	Group with iron deficiency (n:21)					Group with non-iron deficiency (n:18)					p
	x ± SS			median	(min – max)	x ± SS			median	(min – max)	
Age (yrs)	9.2	±	7.0	8.0	1.5-19.0	10.8	±	5.2	12.0	1.5-18.0	0.553
Weight (kg)	29.5	±	19.1	20.0	7.5-58.0	37.1	±	17.1	37.0	13.0-63.0	0.117
Height (cm)	120.7	±	36.9	118.0	70.0-173.0	134.7	±	29.2	141.5	76.0-175.0	0.254
Hb (gr/dl)	14.8	±	2.4	14.7	11.5-20.1	16.5	±	2.5	16.4	12.7-20.1	0.063
Hematocrit (%)	45.8	±	7.5	45.1	35.3-64.6	49.2	±	8.3	48.5	33.0-63.5	0.242
MCH (pg)	24.5	±	3.6	25.0	17.4-31.3	28.8	±	2.7	29.5	22.3-31.2	**0.001**
MCHC (gr/dl)	32.4	±	1.4	32.4	29.6-35.3	33.2	±	0.8	33.4	31.2-34.3	**0.019**
MCV fl	75.6	±	9.3	76.4	58.9-95.8	87.2	±	6.5	87.5	72.1-94.3	**<0.001**
RDW (%)	18.5	±	3.7	17.3	12.7-25.9	14.7	±	1.7	14.4	12.7-19.9	**<0.001**
Fe (ug/dl)	26.6	±	19.3	21.0	11.0-96.0	84.1	±	53.4	61.0	28.0-180.0	**<0.001**
IBC (ug/dl)	433.4	±	54.1	438.0	348.0-513.0	363.4	±	57.1	352.5	296.0-495.0	**0.001**
Ferritin (ng/ml)	5.6	±	2.8	4.9	2.2-11.0	50.6	±	48.7	34.7	14.0-220.0	**<0.001**
TS (%)	6.2	±	5.3	5.0	2.0-25.0	22.9	±	14.8	19.5	7.0-53.0	**<0.001**
sTfR (mg/L)	7.0	±	3.8	6.0	3.0-19.4	2.8	±	0.6	2.6	1.9-4.2	**<0.001**
O2sat (%)	71.7	±	6.8	70.0	62.0-85.0	75.6	±	9.2	75.0	62.0-90.0	0.189
Viscosity (c poise)	5.6	±	1.0	5.8	(4.0-7.3)	5.8	±	1.8	5.3	(4.0-9.2)	0.899

Hb: *Hemoglobin,* ***Hematocrit:*** *Hematocrit,* ***MCV:*** *Mean corpuscular volume,* ***MCH:*** *Mean corpuscular hemoglobin,* ***MCHC:*** *Mean corpuscular hemoglobin concentration,* ***RDW:*** *Red blood cell distrubution width,* ***Fe:*** *Iron,* ***IBC:*** *Iron binding capacity,* ***TS:*** *Transferrin saturation,* ***sTfR:*** *soluble transferrin receptor*

Table 2. *Evaluation of iron treatment effects on viscosity and other hematologic parametres*

	Beginning				After three-month iron treatment				p
	x ± SS		median	(min – max)	x ± SS		median	(min– max)	
Hb (gr/dl)	14.8	± 2.4	14.7	(11.5-20,1)	16.0	± 2.0	15.9	(12.3-9.4)	**0.003**
Hematocrit (%)	45.8	± 7.5	45.1	(35.3-64,6)	47.6	± 7.2	48.0	(32.0-63.1)	0.052
MCH (pg)	24.5	± 3.6	25.0	(17.4-31.3)	26.8	± 2.6	26.9	(19.8-30.4)	**0.007**
MCHC (gr/dl)	32.4	± 1.4	32.4	(29.6-35.3)	33.1	± 1.3	33.1	(30.2-36.0)	**0.020**
MCV(fl)	75.6	± 9.3	76.4	(58.9-95.8)	80.1	± 6.9	81.0	(66.0-91.4)	**0.014**
RDW(%)	18.5	± 3.7	17.3	(12.7-25.9)	16.0	± 2.2	15.6	(13.3-20.4)	**0.002**
Fe (ug/dl)	26.6	± 19.3	21.0	(11.0-96.0)	59.6	± 22.0	60.0	(20.0-22.0)	**<0.001**
IBC (ug/dl)	433.4	± 54.1	438.0	(348.0-513.0)	371.4	± 51.2	360	(288.0-80)	**0.002**
Ferritin (ng/ml)	5.6	± 2.8	4.9	(2.2-11.0)	40.5	± 41.1	24.4	(3.2-179.0)	**<0.001**
TS (%)	6.2	± 5.3	5.0	(2.0-25.0)	16.0	± 6.3	16.0	(5.0-29.0)	**<0.001**
sTfR (mg/L)	7.0	± 3.8	6.0	(3.0-19.4)	4.6	± 1.9	4.6	(2.2-10.8)	**<0.001**
Viscosity (c poise)	5.6	± 1.0	5.8	(4.0-7.3)	5.5	± 1.0	5.5	(2.9-7.3)	0.741
O2sat (%)	71.7	± 6.8	70.0	(62.0-85.0)	75.0	± 6.8	72.0	(66.0-90.0)	**<0.001**

Hb: *Hemoglobin,* ***Hematocrit:*** *Hematocrit,* ***MCV:*** *Mean corpuscular volume,* ***MCH:*** *Mean corpuscular hemoglobin,* ***MCHC:*** *Mean corpuscular hemoglobin concentration,* ***RDW:*** *Red blood cell distrubution width,* ***Fe:*** *Iron,* ***IBC:*** *Iron binding capacity,* ***TS:*** *Transferrin saturation,* ***sTfR:*** *soluble transferrin receptor*