The Frequency of Iron Deficiency and Iron Deficiency Anemia in Children with Cyanotic Heart Disease and Non-Cyanotic Heart Disease

Thesis

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Iron Deficiency Anemia

Hemoglobin

Ferritin

Transferrin receptor

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Abstract

Anaemia which occur from insufficient iron for synthesis of hemoglobin is the most frequent hematological disease of infancy and childhood. The incidence of IDA is related to multiple factors in its metabolism and nutrition. IDA is especially often present in children with CHD caused by multiple different factors. To determine the frequency of unrecognized anemia in pediatric patient with different CHD we carried out a cross sectional study including 80 Egyptian patients with congenital heart disease who were diagnosed and have been followed up at cardiology clinic, National Heart Institute from June, 2018 to January, 2019. These 80 patients had been divided into two group ; (1) CCHD group included 40 patients, 27 male (67.5%) and 13 female (32.5%). (2) ACHD group included 40 patients, 21 males (52.5%) and 19 females(47.5%). All of patients aged from 3 months to 3 years. Lab investigations, CBC and Iron profile have been performed to all patients and the results were analyzed. The frequency of anemia in cyanotic group was 60.0% and in acyanotic group was 42.5%. Patients that had ID in CCHD was (32.5 %) and that had IDA was (22.5%). But those of ACHD that had ID was (30 %) and that had IDA was (20%). This study detected that ID and IDA are commonly encountered in children with CHD Routine check up for ID is recommended for these children and those found to be deficient must to be treated.

List of Abbreviations

ACD	Anemia of chronic illness
ACHD	Acyanotic congenital heart disease

ALCAPA	Anomalous left coronary artery from the pulmonary artery
AS	Aortic stenosis
ASD	Atrial septal defect
AVSD	Atrioventricular septal defect
BAV	Bicuspid aortic valve
CCHD	Cyanotic congenital heart disease
CCVM	Congenital cardiovascular malformation
CHD	Congenital heart disease
CoA	Coarctation of the Aorta
CT	Computed tomography
DILV	Double inlet left ventricular
DORV	Double outlet right ventricle
ECG	Electrocardiogram
Hb	Hemoglobin
HCT	Hematocrit
HLHS	Hypoplastic left heart syndrome
ID	Iron Deficiency
IDA	Iron Deficiency Anemia
LV	Left ventricular
LVH	Left ventricular hypertrophy
MCH	Mean corpuscular hemoglobin
MCV	Mean corpuscular volume

MR	Mitral regurge
MRI	Magnetic resonance imaging
MVP	Mitral valve prolapse
PDA	patent ductus arteriosus
PPS	peripheral Pulmonary stenosis
PS	Pulmonary stenosis
SD	Standard deviation
sTfR	Soluble Transferrin Receptor
TGA	Transposition of great arteries
TIBC	Total iron binding capacity
TOF	Tetralogy of Fallot
VSD	Ventricular septal defect

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Introduction

IDA arises when disturbance occur between iron intake, stores, and the body's loss of iron and iron became insufficient to fully support production of erythrocytes. The impact on children is very significant. the definition of anaemia depends on hemoglobin values vary according to age, sex .race. Symptoms and signs are related to the degree of the anemia. Patient may complain of poor mental performance or cold intolerance

(*Rosenzweig and Volpe, *1999). Dyspnea and fatigue are regularly occured. Although rare, dysphagia or glossitis may be seen at presentation ***(*Cook, *2005).***

Iron deficiency anemia is associated with some rather striking neurological complication . Pica is another associated neurological manifestation . ID is also known to cause cognitive dysfunction. Neurological effect is particularly relevant during infancy brain development. Long-lasting cognitive effects occur despite therapy later in life. Therefore, iron deficiency anemia during infancy must be aggressively treated to avoid the potential for cognitive effects ***(*Lozoff *et al., 1991).***

Laboratory evaluation reveals characteristic changes in blood parameters for iron regulation storage, transport, and utilization. Currently, the central parameter for determination of significant ID as well as therapeutic response is ferritin ***(*Mei *et al. 2005).*** The ferritin protein complex structure acts as a cage to contain up to 4500 iron molecules ***(Harrison and Arosio, 1996).*** A serum ferritin level of 15 μg/L or less is diagnostic of ID , and correlates specifically with the absence of stainable bone marrow iron ***(*Baker, *2000).***

Even at higher ferritin levels, around 40 μg/L, erythropoiesis may be affected. ID also causes increased release of soluble transferrin from erythroblasts. Therefore, ratios of STRS and ferritin are used to detect iron-deficient erythropoiesis. Complete blood count and serum iron level are also essential for diagnosis ***(*Cable *et al., 2011)***.

Transferrin receptor is a membrane receptor involved in the control of iron supply to the cell through the binding of transferrin, the major iron-carrier protein. This receptor plays a major role in cell proliferation because iron is essential for sustaining ribonucleotide reductase activity, and is the enzyme that catalyzes the conversion of ribonucleotides to deoxyribonucleotide (**Crichton and Charloteaux-Wauters, 1987)**.

Transferrin receptors may be increased in persons with ID . Thereby aiding in the evaluation of ID and in the diagnosis of IDA . Its main function is to control the level of free iron. Unlike ferritin, the transferrin receptor level is not affected by infection or inflammation and is therefore useful in distinguishing IDA from ACI**(Weiner and Cairo, 2002)**.

Anemia is an important effect factor for morbidity and mortality in patients with CCHDand ACHD. There is high frequency of IDA among CHD patient, so routine check up for ID is recommended for these children .Those found to be deficient must to be treated ***(*Ootaki *et al., 2007).***

Heart failure may occur and worsens by anemia. In CCHD with a right to left flow , arterial oxygen saturation decreases and red blood cell count may reach a big level and hyperviscosity develops. In addition, in anemic patients especially those with microcytic IDA , permeability of microcytic erythrocytes decreases in comparison to normocytic cells, therefore thromboembolic and CVS events are more frequently encountered ***(*Broberg *et al., 2006).***