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Assessment of Iron Stores in Anaemia of Chronic Disorders

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ABSTRACT

Background: Anaemia refers to a state in which the level of hemoglobin in the blood is below the reference range appropriate for age and sex. Other factors including pregnancy and altitude, also affect hemoglobin level and must be taken into account when considering whether are individual is anaemic.

Objective: To asses and evaluate of iron stores in anaemia of chronic diseases.

Methods: a prospective study was done in Ibn Sina Hospital (Mosul – Iraq) from the first of January on 2017 to the last of December 2017 on (9) patients with mild, moderate to severe anaemia of normochromic normocytic type associated with chronic diseases.

Results: The result of this study reveals that anaemia in all these (9) cases of chronic disorders are of normocytic normochromic type and iron stores in bone marrow were normal except in one (1) case was depleted.**Conclusion:** Iron stores were normal in all of (9) nine cases of anaemia except in one case iron store was depleted.

Keywords: hemoglobin (HB), Systemic lupus, erythematosus (SLE), reticuloendothelial system (RE) system.

PREFACE

This a preliminary study and in the near future there will be extend study of iron status in chronic inflammatory disorder.

INTRODUCTION

This Anaemia refers to a state in which the level of hemoglobin in the blood is below the reference range appropriate for age and sex [1]. The normal adult body contains about (3-5 g) of iron, most of which is in hemoglobin, the reminder (0.4 g) is in myoglobin, and up to (1.5 g) in the storage compound ferritin and haemosiderin[3]. Only very small amount was present in plasma, bound to transferrin, and there were trace quantities present in all cells, incorporated in various enzyme systems. As shown in (Table 1).

Table 1: shows body iron distributions [2].

	Iron content, mg	
	Adult male, 80 kg	**Adult female, 60 kg**
Hemoglobin	2500	1700
Myoglobin	500	300
Transferrin-iron	3	3
Iron stores	600-1000	0 – 300

The major role of iron in mammals is to carry oxygen as part of hemoglobin (HB). O_2 is also bound to myoglobin in muscles [2]. If HB synthesis is impaired, resulting in anaemia and reduced O_2 delivery to tissue[2,3]. Iron absorption occurs mainly in duodenum and proximal jejunum[3,4]. As storage iron increase, iron absorption decrease, when stores were depleted, absorption increased [2,3,4].

Iron that enter mucosal cells is either bounded to transferrin and transport to portal circulation or remain in mucous cells and sloughed. Stores are mobilized by increased requirement [3,4,5].

Iron absorption from the diet or released from stores circulate in the plasma bound transferrin, the iron transport protein. Transferrin is a bilobed glycoprotein with two iron- binding sites. Transferrin that carries iron exist in the two forms – monoferric (one iron atom) or diferric (two iron atoms). The turnover (half-clearance time) of transferrin-bound iron is very rapid- typically (60-90 min. Because almost all of the iron transported by transferrin is delivered to the erythroid marrow, the clearance time of transferrin-bound iron from circulation is affected most by the plasma iron level and the erythroid marrow activity [2]. When erythropoiesis is markedly stimulated, the pool of erythroid cells requiring iron increases, and the clearance time of iron from the circulation decreases. The half-clearance time of iron in the presence of iron deficiency is a short as 10-15 min. With suppression of erythropoiesis, the plasma iron level typically increases, and the half-clearance time may be prolonged to several hours. Normally, the half-bound to transferrin turns over 6-8 times per day. Assuming a normal plasma iron level of 80-100 µg / dL, the amount of iron passing through the transferrin pool is 20-24 mg/d [2].

It is generally assumed that ferritin act as stores from which iron can mobilized to compensate for fluctuation in requirement due to blood loss, dietary changes. Serum ferritin concentrate is proportional to amount of storage in the body. [3,4]

A number of chronic diseases such as infection, malignant disease, renal and collagen diseases are accompanied by moderate fall in hemoglobin level resulting from moderate shortening of red cell life span and lack of compensator.

Bone marrow response to anaemia and defective transfer of iron from reticuloendothelial system (RE system) store to red blood cells precursors with impaired transferrin production and serum ferritin level are found normal indicating sufficient body iron store [2,3,4],, although serum iron may be decreased, with low to normal transferrin level, increased red cell protoporphyrin and reduced or absent marrow sideroblasts in the presence of RE system iron store.

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A representative evaluation of patients iron status is possible by examination of bone marrow smears stained for iron. Storage iron appears as very rounded dense blue-black siderotic granules in matrix of marrow spicules with experience iron can be judged to be increased normal or decreased visually Prussian blue reaction, Normally 20 % to 50 % of marrow nucleated red cells should contain from one to three siderotic granules. Storage iron is markedly decreased or absent in patient with iron deficiency anaemia with few or no sideroblast are present patients having anaemia associated with chronic diseases have normal amount of storage iron but no sideroblast in contrast patient with erythroblastic leukemia and with some form of myelodysplastic syndrome often show increased storage iron and ringed sideroblast contains numbers sideroticgranules.[3,4,5].

MATERIALS AND METHODS

Nine patients with chronic illness are selected to study of iron store in bone marrow. Five patients with different stages of chronic renal failure two patients with SLE, one patient with pulmonary T.B and one patient with hypothyroidism.

The hematocrit, hemoglobin level, and red blood cells morphology are taken, the patients of chronic Renal failure the duration and degree of renal impairment are assessed by measuring blood urea, serum creatinine, and creatinine clearance, and if the patient has any history of repeated blood transfusion or is on iron therapy (Table 2).

Bone marrow aspiration are obtained or from posterior iliac or from sternum by special needle for evaluation of cellularity Erythroid Granulocyte, erythroid morphology and marrow iron store are assessed visually using Prussian blue reaction after dry marrow smears are fixed in absolute methanol for -15 and staining fresh prepared staining solution for 20 minutes and rinse the slide in gentle wash of tap water for 20 minutes and counterstain with 0.5 % safranin for 15-30 seconds, air dry and mount with coverslip and then iron store are assessed visually.

This technique is subjective measure of iron stores and can be judged with experience to be increased, normal or decreased and the number of sideroblast cell are counted with siderotic granules in each cell and if there is any ringed sideroblasts containing numerous siderotic granules[3,4,5].

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RESULT

The As shown in (Table 2, 3) the anaemia in all these selected cases of chronic disorders are of normocytic normochromic type and bone marrow cellularity are normal cellular with normal maturation of all hemopoietic cellular elements with no any abnormal cell apart from hyperreactive erythropoiesis in three of five patients with chronic Renal failure, and in one of two patients with SLE and the patient with pulmonary tuberculosis. The patient with hypothyroidism, the erythroid series shows micro normoblast cell with defective hemoglobinization.

The iron stains showed normal iron stores in all selected patients with anaemia of chronic disorder except the patient with hypothyroidism where the iron stain shows depleted iron store in bone marrow.

Table 2: The patients with anaemia due to chronic renal failure

Patient No./sex age	1/Female 25 years	2/ Male 50 years	3/Female 50 years	4/ Male 60 years	5/Female 27 years
Duration of illness	2 Months	4 years	5 Months	2 years	3 years
Blood urea mg/dl	168	204	234	145	80
Serum creatinine mg/dl	6.6	7.7	13.0	6.3	4.8
Creatinine clearance ml/minut	14	9	8	27.6	23.5
History blood transfusion n in units	2 units	Nil	nil	3 units	2 units
Drug history and iron therapy	No	No	No	No	No
Hbhldl	6.8	11.0	7.6	7.9	4.5
PCV%	19%	32%	22%	28%	14%
Red blood cell morphology	Normochromic normocytic	Normochromic normocytic	Normochromic normocytic	Normochromic normocytic	Normochromic normocytic
Bone marrow cellularity	Normocellular with normal erythropoiesis	Normocellular with normal erythropoiesis	Normocellular with normal erythropoiesis	Normocellular with normal erythropoiesis	Normocellular with normal erythropoiesis
Iron store	Normal	Normal	normal	Normal	normal

Table 3: The patients with anaemia of chronic disorders

Patient no./ sex age	Diagnosis	Hb. g/dl	PCV%	RCB morphology	Bone marrowcellularity	Iron store
1/ female 25 years	Chronic renal failure	6.8	19%	Normochromic normocytic	Normocellular with normal erythropoiesis	normal
2/ male 50 years	Chronic renal failure	11.0	32%	=	=	normal
3/female 50 years	Chronic renal failure	7.6	22%	=	=	normal
4/ male 60 years	Chronic renal failure	7.9	28%	=	=	normal
5/ female 27 years	=	4.5	14%	=	=	normal
6/ male 50 years	Pulmonary T.B	12.5	35%	=	=	normal
7/ female 27 years gldl	SLE	12.0	39%	=	Normocellular with normal erthropiesis	normal
8/ female 21 years	SLE	6.0	18%	=	Normocellular with erythroid hyperplasia	normal
9/ female 28 years	hypothyrodism	6.8	20%	=	Normocellular with detective haemoglobinization	Depleted iron store

DISCUSSION

In this study, iron stores in bone marrow of these nine selected patients with anaemia of chronic diseases (8) casesfrom the total number (9) patients, these patients there was no compensatory bone marrow respond to anaemia and there was defect transfer of iron from(RE) system stores to red cell precursors. Except in the female patients with hypothyroidism with severe anaemia of normochromic normocytic red cell morphology whose iron store in bone marrow showed depleted store.

In patients with anaemia of chronic renal failure it is expected to have normal iron store in uncomplicated cases without history of repeated blood transmission, in the later case iron store is increased due to iron overload because of large numbers of blood transfusion and secondary hemochromatosis. The anaemia in patient with SLE usually normochromic normocytic of mild to moderate severity, although some patients with SLE developed positive coombstest (auto immune hemolytic anaemia) so usually iron store is not affected unless there is history of blood loss in which probably iron store will be depleted.

In patients with pulmonary tuberculosis may developed mild to moderate anaemia of normochromic normocytic and severe anaemia is rare in those patients in the absence of complications, such as amyloidosis, the content of iron in (RE) systemis generally increased [3,4,5].

It is known that iron deficiency anaemia will not occur before the iron store is completely depleted and the earliest changes in the red cell morphology is normochromic normocytic and when the hemoglobin level further decreased, the red blood cells became hypochromic and the last changes in peripheral red blood cells morphology is microcytic when hemoglobin levels decreased less than 8 g / dL. [3,4,5].

CONCLUSION

Iron stores were normal in all nine cases of anaemia except in one case iron store was depleted

RECOMMONDATION

Encouraging more studies should be done on a more number of patients in other hospitals to confirm or disconfirm the outcome of the results of the study which done in Ibn Sina Hospital.

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