Assessment of Iron Deficiency Anemia Among Patients Attending Kigali University Teaching Hospital

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Abstract

Anemia in general is characterized by a decrease in number of red blood cells or less the normal quantity of haemoglobin. Iron deficiency is defined as a condition in which there are no mobilization iron stores, resulting from a long-term negative iron balance and leading to a compromised supply of iron to the tissue.

Objectives: *The objective of this study was to assess iron deficiency anemia and to estimate its prevalence compared to other types of anemia in patients attending Kigali University Teaching Hospital from 1st September to 31st October 2017.*

Methods: *This was a cross section study on data from the clinical laboratory of this hospital located in Kigali city, with a representative sample of 68 patients from urban and rural areas. Anemia was diagnosed by means of hemoglobin assays (from CBC test). Further tests were performed for diagnosis of iron deficiency anemia (IDA) though red blood cells indices (MCV, MCH and MCHC), peripheral blood smear (PBS), reticulocytes count and ferritin test.*

Results*: The results showed that 33 patients had iron deficiency anemia with a prevalence of 51.5%. Among 33 IDA patients, 32 were female whereas 1 was male (97% and 3% respectively). All three red cell indices, and haematocrits count were reduced with the mean and standard deviation of 68.98±6.79, 20.73±3.00, 29.98±2.11 and 68.98±6.79 respectively; all PBS showed anisocytosis sometimes poikilocytosis with hypochromic RBCs. Thrombocytosis was observed in most of IDA patients. IDA was significantly associated with age and sex with the P-value of 0.006 and 0.016 respectively.*

Conclusion: *The factors associated with IDA that are presented here should be taken into consideration in planning effective measures for its control.*

Keywords: *Blood Count, Blood Smear, Iron Deficiency Anaemia.*

I. INTRODUCTION

Iron deficiency anemia (IDA) is the most common micronutrient disorder in the world, affecting the health and socio-economic wellbeing of millions of men, women, and children. It is highly prevalent in developing countries but also remains a problem in developed countries where other forms of malnutrition have already been virtually eliminated. It is common in children under five years in eastern Africa. [1] IDA result from a long term negative iron balance, culminating in decreased or exhausted iron stores. Iron, a component of every living cell, is intrinsically involved in numerous biochemical reactions in the body and is associated with oxygen transport and storage, energy production, DNA synthesis, and electron transport. [2] It is a pathological process in which hemoglobin (Hb) concentration in red cells is abnormally low, considering variations as to age, gender, sea-level altitude, as a result of several situations such as chronic infections, hereditary blood conditions, deficiency of one or more essential nutrients that are necessary for the formation of hemoglobin. Therefore, there is no doubt that iron deficiency is the cause of most anemias. [3] According to a recent region and country summary, iron deficiency anemia is widespread among children under five years of age. Children in south Asia and Africa are particularly affected, with over half of preschool aged children having IDA in most countries. The prevalence of IDA ranges from 22 to 66% worlwide. [4] Iron deficiency is considered to be one of most prevalent forms of malnutrition. Iron deficiency is considered to contribute to death and disability as a risk factor

for maternal and perinatal mortality, and also through its direct contributions to cognitive impairment, decreased work productivity, and death from severe anemia. However, even more important than anemia, itself, is the indication that the more common ID without anemia may also adversely affect long-term neurodevelopment and behaviour and that some of these effects may be irreversible [5] Few studies have been conducted in Rwanda and their results are limited to a group of persons or a specific region and they lack the factors that can be involved in such type of anemia. According to this, there is an urgent need to develop effective and sustainable interventions to control iron deficiency anemia.

MATERIAL & METHODS

Study design

The study was a cross-sectional study which was most appropriate to assess iron deficiency anemia. It was concerned with patients whom anemia was suspected in internal medicine department and out-patient department for confirming if they present IDA. This was done from 1st September to 31st October 2017.

Sampling area and study population

The target population in this research was all patients with anemia attended KUTH from 1st September to 31st October 2017. Data were collected on field during the research period, and it was conducted on 64 patients with anemia. For IDA patients, essential tests were performed.

Sample collection

Patient samples were collected in EDTA and dry tubes for each study participant, at phlebotomy service and in internal medicine department. The blood collected in EDTA tubes were directly transported in hemetology department for complete blood count analysis and that in dry tubes were transported in biochemistry department for ferritin study. The samples were analyzed using the automated machines for haematological (Sysmex 500i) and biochemical (Coobas e411) studies.

Essential tests for iron deficiency anemia

These tests were done according to KUTH laboratory SOPs

Complete Blood Count

The hemetology section in this laboratory provide automated CBC analyses each day using a XS-sysmex 800i and 500i analyzers. Blood in EDTA tube for CBC were brought to the Hematology Analyzer area and placed on the roll mixer, for at least five minutes. Patients' blood were then run through the Hematology Analyzer. It means, all information of the patient are written in a machine connected to the analyzer and after click OK and dispose the sample to the needle of a sysmex and press the button behind the needle, then the sample is aspirated by a needle. After the specimens have been run, the results are printed out from a printer connected to the analyzer. The results recorded were hemoglobin, RBC, MCV, MCH, MCHC, Hct and platelets.

Reticulocyte count

Whole blood that is anticoagulated with EDTA were used for this test. 5 drops of cresyl blue solution were put in a test tube labeled with a patient name and ID, and 5 drops of well mixed EDTA anticoagulated blood were added in the labeled test tube. The contents were mixed by gently shaking and incubated at room temperature for 10 minutes. The smears were done using a wedge smear technique. The slides were labeled and allowed to air dry. Reticulocytes were visualized under microscope on an oil immersion objective. This stain causes the ribosomal and residual RNA to precipitate with the few remaining mitochondria and ferritin mosses in living young erythrocytes to form microscopically visible dark-blue dusters and filaments (reticulum). An erythrocyte still possessing RNA is referred to as a reticulocyte.

Peripheral blood smear (PBS)

PBS are made by placing a drop of blood on one end of a slide, by the help of another slide to disperse the blood over the slide's length. The aim is to get a region, called a monolayer, where the cells are spaced far enough apart to be counted and differentiated. The monolayer is found in the "feathered edge" created by the spreader slide as it draws the blood forward. The slide is left to air dry, after which the blood is fixed to the slide by immersing it briefly in methanol. The fixative is essential for good staining and presentation of cellular detail. After fixation, the slide is stained 20 minutes with Wright-Giemsa to distinguish the cells from each other. Slides were allowed to air dry. Helped by haematologist, the monolayer slides were viewed under a microscope using oil immersion objective. Individual cells are examined and their morphology is characterized and recorded.

Serum ferritin

Blood sample collected in dry tubes were centrifuged at 3,000 rpm for 5min to separate serum from blood cells. Serum of all patients were pipetted in the

sample cups to be tested for ferritin and analyzed by Cobas e411 full automated analyzer. The results were printed, recorded and interpreted according to the normal ranges.

Ethical consideration

The application letter for data collection permission was written to KUTH research department for being analyzed by KUTH research committee. Data were collected after getting the approval letter from KUTH research department. Data was recorded anonymously manipulated and information of patients was kept with high confidentiality and results were used for academic purpose only.

Data analysis

Results to assess iron deficiency anemia patients were analyzed by using Excel and Data was coded, and analyzed in statistical package for social sciences (SPSS) software for window 10. The assessment of iron deficiency anemia patients was analyzed statistically and presented as percentage.

RESULTS & DISCUSSION

Demographic and characteristics of study participants

In this study, the demographic characteristics of the population were established to characterize the population. Table 1 summarizes demographic characteristics of population which was in consideration.

Table 1: Demographic characteristics of study participants (N=64).

		Total	Percentages
Age-group	Below 17	7	10.9%
	[17-37[	25	39.1%
	[37-57[	24	37.5%
	57 and above	8	12.5%
Sex	Male	9	14.1%
	Female	55	85.9%

Mean Age: 36.53±20.36 years
Range: 92.8

As shown in table 1, in the present study, the total number of participants was 64 anemia patients and from them the demographic characteristics of the population were determined where the population was categorized into 4 groups of ages (<17, 17-37, 37-57 and 57 years and above). The participants below 17 years were 7(10.9%), 17-37 were 25(39.1%), 37-57 were 24(37.5) and in patients of 57 and above were 8(14.1%). Basing on gender, 9(14.1%) and 55(85.9%) were males and females respectively. Anemia is dominant in females than in males and is most frequent in adolescent and adults people compared to younger and seniors. This study agrees with that conducted in India, saying that the prevalence of anemia was more than 60% among adolescent girls and young women, [6] and another of one conducted in Atlanta, where the high prevalence of anemia was observed in pre-menopausal women. This may be due to the increased loss of blood during this period of age. [7]

Prevalence of iron deficiency anemia among other types of anemia

Table and figure below show how prevalent is iron deficiency anemia among other types of anemia, of all 64 participants of this study. This classification is based on hemoglobin and ferritin findings.

Table 2: Prevalence of iron deficiency among all patients

	Numbers of patients	Hb (g/dl)	Ferritin (µg/l)
Iron deficiency anemia	33	<12	<15
Other causes of anemia	31	<12	>15

Based on ferritin and hemoglobin, anemia was classified into 2 categories: iron deficiency without anemia, and other kinds of anemia were classified into the 2nd category of other cause of anemia. In this study, among 64 anemia patients, 33(51.5%) had iron deficiency anemia, and 31(48.5%) had other types of anemia. This study agree with the study conducted, said that iron deficiency anemia occupy approximately 50% of all anemias and that iron deficiency is the main micronutrient disorder that cause anemia. [8] In this study also, iron deficiency anemia is dominant compared to other types of anemia.

Distribution of iron deficiency anemia according to age and sex

During this study the distribution of iron deficiency anemia patients was determined. The table 5 shows the distribution of iron deficiency anemia patients according to the sex-age group.

Table 3: Distribution of iron deficiency anemia according to age and sex

		Number of participants	Iron-deficiency anemia	Tests		
				X^2	Degree of freedom	P value
Age-group	Below 17	7	0(0%)	12.539	3	0.006*
	[17-37[	25	15(23.43%)			
	[37-57[	24	16(25%)			
	57 and above	8	2(3.12%)			
	Total	**64**	**33(51.5%)**			
Sex	Male	9	1(1.56%)	5.814	1	0.016*
	Female	55	32(50%)			
	Total	**64**	**33(51.5%)**			

P value <0.05 is statistically significant (*)

The overall prevalence of iron deficiency anemia patients observed in the present study was 51.5%. In the age group of 17-37 and 37-57 was where iron deficiency anemia is mostly prevalent compared to other age with the prevalence of 23.43% and 25% respectively. Among them, 50% were female and 1.56% was male. This is due to the fact that, as a woman is in reproductive age, there is the increase of blood loss. This occurs during menstruation, pregnancy, breast feeding and pre-menopause period. This finding agrees with a study conducted; reported that menstruation, pregnancy, breast feeding and pre-menopause period are the causes of iron deficiency anemia due to the incresed blood loss during this period. The association between iron deficiency anemia with age and sex, is likely to be the cause in this study with the P-value of 0.006 and 0.016 respectively. [9]

Level of main blood cells function parameters among IDA patients

During this study the level of main blood function test for iron deficiency anemia patients were determined. The table below summarizes those parameters.

Table 4: Level of main blood cells function for IDA patients. SD stand for standard deviation.

RBCs parameters (unit)	Value (Mean±SD) of RBCs parameter	Normal Range
RBC counts	4.21±0.75	Men: 4.5-6.2×10^6/mm^3 Women: 4.0-5.5×10^6/mm^3
Reticulocytes counts	0.64±0.57	Men and women 0.5-2.5%
Hemoglobin	8.76±1.94	Men: 13-18 g/dl Women: 12-15 g/dl
Haematocrit	28.95±5.29	Men: 40%-54% Women: 36%-46%
MCV	68.98±6.79	Men and women:80-100fl
MCH	20.73±3.00	Men and women: 28-32pg
MCHC	29.98±2.11	Men and women: 32-37g/dl
Serum Ferritin	7.22±2.75	Men: 15-300 µg/l Women: 15-200 µg/l
Platelets count	521.03±174.7	Men and women:150-450×10^6/mm^3

As shown in table 4, hemoglobin level were significantly decreased in iron deficiency anemia, of course as said the definition of anemia, being 8.76±1.94 as compared to the reference range. This is due to the reduction of iron supply in hemoglobin synthesis. [10] The same results have been reported where red blood cell indices; MCV, MCH, MCHC and haematocrit were significantly decreased in patients with iron deficiency anemia, being 68.98±6.79, 20.73±3.00, 29.98±2.11 and 68.98±6.79 respectively. Red blood cells and reticulocyte were normal, being 4.21±0.75 and 0.64±0.57. [11] Iron deficiency, survival of circulating erythrocytes and reticulocytes are normal or somewhat shortened due to that anemia is not severe. The table continues showing that the platelets levels were raised in some iron deficiency anemia patients as the mean and standard deviation being 521.03±174.7, to mean that iron deficiency anemia can cause thrombocytosis in some patients. It is said that in IDA, the most important factor affecting platelet counts is iron saturation. These changes in the platelet parameter may be due to low levels of tissue iron. They suggest that decreased iron saturation might stimulate megakaryopoiesis. Moreover, iron may have an inhibitor effect on platelet counts. [12]

Morphological types of anemia

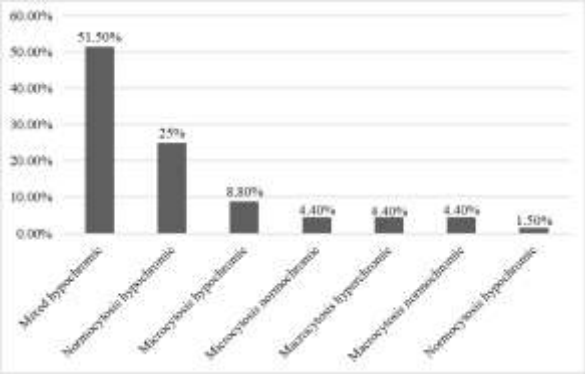

Figure 2: Morphological types of anemia

The morphological classification of anemia in the screened patients showed that anisocytosis with hypochromic anemia was the most predominant type, occuring in 51 .5% of this population. It is assumed that iron depletion is the main factor responsible for the high proportion of anisocytosis with hypochromic anemia. This is due to the supply of iron to the marrow which is inadequate to meet basal requirements for hemoglobin production. As a result of this defect, the amount of free erythrocyte protoporphyrin increases, reflecting the excess of protoporphyrin over iron in heme synthesis and each cell produced contains less hemoglobin, resulting in microcytosis and hypochromia. [13] A similar finding was reported in Tanzania. [14]

CONCLUSION AND RECOMMENDATIONS

Conclusion

In the present study, iron deficiency anemia among patients attending KUTH was assessed. The high frequency of anemia was observed in females than in males with the prevalence of 85.9% and 14.1% respectively. Among all types of anemia, iron deficiency anemia was found to occupy 51.5% which make it more prevalent. According to age, adolescents and adults were significantly observed to have iron deficiency anemia in this study.

Recommendations

We recommend routine screening for iron deficiency anemia patients for all gender and age, for control and preventing IDA complications, to sensitize IDA patients for improving their lifestyle such as taking a complete daily dietary food, and continuous hospital follow up.

The Ministry of Health should help people to emphasize on sensitizations about IDA prevention to prevent disabilities and death. We recommend researchers to investigate about other types of anemia that are more frequent, and search for how people could manage for not being IDA victims. Further studies are needed also to identify factors to address this issue.

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