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Study of anemia and its correlation with Hematological parameters in patient of various age group

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Abstract: *Objective: The aims of this study is to analyze the prevalence of anemia and evaluate the hematological parameters of subjects involved and study the type of anemia in various age groups.*
Methods: *This study was carried out in Sir T Hospital Bhavnagar in January 2013 for a period of 1 month. Total 1350 cases were studied. The cases were indoor patient admitted in various wards in Sir T Hospital Bhavnagar. The sample for test were collected in EDTA tube. The slides were prepared and stained with field stain. The sample were run in hematology cell counter ABOTT CELL DYN 3700 and Abacus for hematology indices and other parameters. Microscopic examination of slides was done for peripheral smear examination and complete blood count estimation.*
Results: *The overall prevalence of anemia was 43.48%. Mild degree of Anemia was present in 46.34%, which was the most common followed by moderate degree which was present in 43.44% and severe anemia was present in 10.22%, which was the least common of degree of anemia. Anemia was present in 50.25% of men and in 49.74% of women. Microcytic hypochromic anemia is the most common type of anemia in overall age groups -46.50%. Normocytic normochromic anemia without anisocytosis was the most common type of anemia -42.25% in adult patient. Mild degree of anemia is more common in males -52.21% and moderate and severe anemia was more in females-50.98% and 51.67% respectively.*
Conclusion: *The prevalence of anemia increases with age and is associated with race, chronic diseases, nutritional deficienses and other conditions such as infection. In different age group the prevalence of various types of anemia is different, which is because of different etiology and severity in this age groups. As a result, a diagnosis of anemia warrants adequate clinical attention, to find out the cause,type, severity and this forms the basis for treatment of anemia..*
Keywords: *Anemia; Hematology indices; Iron deficiency; Chronic diseases*

I. Introduction

Anemia is defined as a reduction of the total circulating red cell mass below normal limits. Anemia reduces the oxygen-carrying capacity of the blood, leading to tissue hypoxia. In practice, the measurement of red cell mass is not easy, and anemia is usually diagnosed based on a reduction in the hematocrit (the ratio of packed red cells to total blood volume) and the hemoglobin concentration of the blood to levels that are below the normal range.[1]

There are many classifications of anemia. One is based on underlying mechanism and second is clinically useful approach classifies anemia according to alterations in red cell morphology, which often point to particular causes. Morphologic characteristics providing etiologic clues include red cell size (normocytic, microcytic, or macrocytic); degree of hemoglobinization, reflected in the color of red cells (normochromic or hypochromic); and shape. In general, microcytic hypochromic anemias are caused by disorders of hemoglobin synthesis (most often iron deficiency), while macrocytic anemias often stem from abnormalities that impair the maturation of erythroid precursors in the bone marrow. Normochromic, normocytic anemias have diverse etiologies; in some of these anemias, specific abnormalities of red cell shape (best appreciated through visual inspection of peripheral smears) provide an important clue as to the cause. The other indices can also be assessed qualitatively in smears, but precise measurement is carried out in clinical laboratories with special instrumentation. The most useful red cell indices are as follows:

- Mean cell volume: the average volume of a red cell expressed in femtoliters (fL)
- Mean cell hemoglobin: the average content (mass) of hemoglobin per red cell, expressed in pictograms
- Mean cell hemoglobin concentration: the average concentration of hemoglobin in a given volume of packed red cells, expressed in grams per deciliter
- Red cell distribution width: the coefficient of variation of red cell volume[1]

The clinical manifestations of the anemia are nonspecific and were detailed earlier. The dominating signs and symptoms frequently relate to the underlying cause of the anemia, for example, gastrointestinal or gynecologic disease, malnutrition, pregnancy, and malabsorption.[1]

The diagnosis of iron deficiency anemia ultimately rests on laboratory studies. Both the hemoglobin and hematocrit are depressed, usually to a moderate degree, in association with hypochromia, microcytosis, and modest poikilocytosis.[1]

Anemia of Chronic Disease [1]

Impaired red cell production associated with chronic diseases is perhaps the most common cause of anemia among hospitalized patients . It is associated with a reduction in the proliferation of erythroid progenitors and impaired iron utilization. The chronic illnesses associated with this form of anemia can be grouped into three categories:

1. Chronic microbial infections, such as osteomyelitis, bacterial endocarditis, and lung abscess
2. Chronic immune disorders, such as rheumatoid arthritis and regional enteritis
3. Neoplasms, such as carcinomas of the lung and breast, and Hodgkin lymphoma

The anemia of chronic disease occurs in the setting of persistent systemic inflammation and is associated with low serum iron, reduced total iron-binding capacity, and abundant stored iron in tissue macrophages. Several effects of inflammation contribute to the observed abnormalities. [1]

The anemia is usually mild, and the dominant symptoms are those of the underlying disease. The red cells can be normocytic and normochromic, or hypochromic and microcytic, as in anemia of iron deficiency. The presence of increased storage iron in marrow macrophages, a high serum ferritin level, and a reduced total iron-binding capacity readily rule out iron deficiency as the cause of anemia. Only successful treatment of the underlying condition reliably corrects the anemia. However, some patients, particularly those with cancer, benefit from administration of erythropoietin.[1]

According to the World Health Organization (WHO), there are two billion people with anemia in the world and half of the anemia is due to iron deficiency [2].Anemia is a late indicator of iron deficiency, so it is estimated that the prevalence of iron deficiency is 2.5 times that of anemia [2].Iron deficiency is the most common nutritional disorder in the developing world and the most common cause of nutritional anemia in young children and women of reproductive age. With 40 per cent prevalence of anemia in the world on an average for the general population, the prevalence in the developing countries tends to be three to four times higher than in the developed countries.

Anemia in the elderly is an extremely common problem that is associated with mortality and poorer health-related quality of life, regardless of the underlined cause of the low hemoglobin. However anemia should not be accepted as an inevitable consequence of ageing[5]. Studies indicate that the prevalence of anemia increases with advancing age and under age 75 years, anemia is more common in females, but over age 75 years it is more common in males[6]. Multiple pathophysiologic abnormalities in a single elderly patient with anemia are well known. Micronutrient deficiencies as cause of anemia have been repeatedly documented in the elderly. They are thought to be due, among other factors, to lower energy requirements of the elderly which lead to reduced food intake.[7]

According to the World Health Organization (WHO), anemia is defined as a condition in which the hemoglobin content is below normal. This situation occurs because of different pathophysiological mechanisms. The most prevalent types of anemia are due to nutritional deficiencies (malnutrition and iron, vitamin B12 and folic acid deficiencies) and chronic diseases (such as cancer, kidney disease and congestive heart failure)[8,10]. In order to characterize the type of anemia and formulate a differential diagnosis, the work-up should include physical exams and laboratory tests, such as evaluations of hematocrit, hemoglobin and red blood cell indices. The red blood cell indices should include the cell count, MCV, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and red cell distribution width (RDW)[11]. In fact, the hemoglobin concentration is the parameter that is most commonly used as an indicator of the pathophysiological consequences of anemia. However, this variable is not very specific or sensitive. Hemoglobin levels can be altered in different pathologic conditions, such as infectious and inflammatory processes, hemorrhage, protein-caloric malnutrition, associated to medications and smoking. The MCV guides the diagnosis of anemia and helps in its classification. However, the MCV value, that is, the mean size of the red cells (macrocytic, microcytic and normocytic), should be used together with the RDW, thus directing the interpretation of the variation in the size of red blood cells.

Aims: To evaluate the hematological parameters of subjects involved, analyze the prevalence, type and severity of spectrum of anemia in various age groups.

II. Methodology

The study was carried out in Sir T Hospital Bhavnagar, a Tertiary Care Hospital in Bhavnagar city. The patients of all age groups admitted in various wards of hospital were included in study. Outdoor patient were excluded from study. The selection was performed randomly. The blood samples were collected in ethylenediaminetetraacetic acid (EDTA) tubes and were immediately sent to the laboratory for hematological testing. The hematological testing was performed in the Hematology Sector of the Clinical Pathology Laboratory of Sir T. hospital, Bhavnagar, Gujarat, India. The equipment used included a Abott Cell Dyn 3700 and Abacus 5 part hematology analyzer. The evaluated parameters included the hemoglobin concentration and red blood cell indices- Mean Cell Volume(MCV) , Mean cell hemoglobin(MCH), Mean cell hemoglobin concentration(MCHC), hematocrit (PCV), Red blood cell count, total leucocyte count, differential count and platelet count.

Haemoglobin concentrations (g/dL) for the diagnosis of anaemia and assessment of severity according to the World Health Organization.			
Age	**Mild**	**Moderate**	**Severe**
6–59 months	10–10.9	7–9.9	<7
5–11 years	11–11.4	8–10.9	<8
12–14 years	11–11.9	8–10.9	<8
Female >14 years	11–11.9	8–10.9	<8
Male >14 years	11–12.9	8–10.9	<8

The reference range of Mean Cell Volume(MCV) was taken as 80-100fl, mean cell hemoglobin(MCH) was taken as 27-32pg, for mean cell hemoglobin concentration 32-36g/dl.
Microcytic anemia was taken as MCV value less than 80fl and MCH less than 27. Macrocytic was taken when MCV is greater than 100fl.
Normocytic Normochromic was taken when all hematological indices are within range.

III. Observation & Results

According to a UNICEF report 2 billion people suffer from anemia worldwide and most of them have IDA, especially in underdeveloped/developing countries. According to WHO, almost 20 % of [21] all women of the childbearing age in United States were suffering from iron deficiency anemia as compared to 2 % of adult males. According [22] to WHO, in the developing countries, about 50-60 % of young children and pregnant females and 20-30 % non-pregnant females were affected by iron deficiency anemia. In countries where little meat is in the diet, [22] iron deficiency anemia is 6-8 times more prevalent than in North America. Thus it is one of the global problems, mainly affecting the [23] developing countries. Pregnant and lactating females, growing children and elderly people with some underlying disease causing blood loss are at more risk as compared to other groups of population.

Anaemia is the most prevalent nutritional deficiency disorder in the world. It affects all age groups . Globally, anaemia affects 1.62 billion people, which corresponds to 24.8% of the population. The highest prevalence of anemia exists in the developing world where its causes are multi-factorial. National Family Health Survey statistics reveal that every second Indian woman is anaemic and one in every five maternal deaths is directly due to anaemia.

This study was carried out in Sir T Hospital Bhavnagar in January 2013 for a period of 1 month. Total 1350 cases were studied.The cases were indoor patient admitted in various wards in Sir T Hospital Bhavnagar.

Table 1 – Prevalence of Anemia

	Total number of Subjects	**Anemic Subjects**
Number of Subjects	1350	587
Percentage	100%	43.48%

Out of 1350 studied patient anemia was found 587 patient of different age group. Prevalance of anemia in indoor patient is 43.48%.

Table 2 Gender distribution of subjects

	Total Numbers	**Percentage**
Males	295	50.25
Females	292	49.74

In the study total number of males were 295 and female were 292. There was no statistical difference in both gender. Mild anemia was common in males 52.21% , while moderate and severe anemia was more common in females.

Table 3 – Grading of Anemia		
Severity of Anemia	**Numbers of subjects**	**Percentage**
Mild	272	46.34%
Moderate	255	43.44%
Severe	60	10.22%
Total	587	100%

In our study, Mild anemia was most common followed by moderate and severe anemia.

Table 4 – Gender wise Distribution of Grading of Anemia			
	Mild	**Moderate**	**Severe**
Male	**141 (52.21%)**	**125 (49.01%)**	**29 (48.33%)**
Female	**131 (47.79%)**	**130 (50.99%)**	**31 (51.67%)**
	272 (100%)	**255 (100%)**	**60 (100%)**

Table 5 – Age wise Distribution of Grading of Anemia					
Age in years	**Mild**	**Moderate**	**Severe**	**Total**	**Percentage**
>40	**130**	**100**	**23**	**253**	**43.10**
31 – 40	**52**	**50**	**10**	**112**	**19.08**
21 – 30	**37**	**53**	**13**	**103**	**17.54**
11 – 20	**41**	**26**	**6**	**77**	**12.43**
<10	**12**	**26**	**8**	**46**	**7.83**

Anemia is most common in adult population, 43.10%, second peak was seen in the age group 31-40(19.08%). In our study anemia was least common in age group <10 years.

Table-6 Peripheral smear examination in Mild anemia		
Peripheral smear examination	**Total subjects**	**Percentage**
Normocytic normochromic	**200**	**73.52%**
Microcytic hypochromic	**64**	**23.53**
Normocytic normochromic, few Macrocytes	**8**	**2.94**

Table-7 Peripheral smear examination in Moderate anemia		
Peripheral smear examination	**Total subjects**	**Percentage**
Normocytic normochromic	**48**	**18.82**
Microcytic hypochromic	**167**	**65.49**
Macrocytic normochromic	**40**	**15.68**

Table-8 Peripheral smear examination in Severe anemia		
Peripheral smear examination	**Total subjects**	**Percentage**
Normocytic normochromic	**2**	**3.33**
Microcytic hypochromic	**40**	**66.66**
Macrocytic normochromic	**10**	**16.66**
Dimorphic	**8**	**13.33**

Table-9 Prevalance of anemia in population		
Peripheral smear examination	**Total subjects**	**Percentage**
Normocytic normochromic	**248**	**42.25**
Microcytic hypochromic	**273**	**46.50**
Macrocytic normochromic	**58**	**9.88**
Dimorphic	**8**	**1.36**

Microcytic Hypochromic Group:

Out of 1350 patients 273 had microcytic hypochromic anemia (46.50%). This is the most common type of anemia in the study. Majority of the subjects (167) had moderate degree of anemia and 64 had mild type followed by severe type of anemia, which is seen in 42 subjects.

Normocytic Normochromic Group:

Out of 1350 patients 248 had normocytic normochromic anemia accounting for 42.25% of anemic patients. 73.52% of Normocytic group had mild anemia. Majority in this group were adult males.

Macrocytic Normochromic Group:

Out of 1350 patients 58 had macrocytic normochromic anemia accounting for 9.88% of anemic patients. of Normocytic group had mild anemia. 40 patient in this group (15.68%) had moderate anemia, 10 had severe anemia, and 8 had mild anemia.

Dimorphic group:

Out of 1350 patients had 8 dimorphic anemia. All in this group had severe anemia (100%).

IV. Discussion

In this study using routine clinical data from a large number of patients, anaemia was present in the majority of adults and young children.

The high proportion of microcytic anaemia and the fact that gender differences were only seen after the menarche period in women indicate that iron deficiency was the main cause of anaemia. In a study of children aged 12–23 months in two rural districts in India, 72% of children with anaemia had low ferritin levels .[8] Other Indian studies have also shown high prevalence of iron deficiency anaemia among young women [9, 10]. The high prevalence of iron deficiency anaemia among women in childbearing age has important public health implications. It is estimated that anaemia accounts for 12.8% of maternal mortality in Asia [11]. Iron requirements are greater in pregnancy, and iron deficiency is associated with maternal death, preterm delivery, and low birth-weight [12, 13]. In India, only 28% of women consume meat, fish, or eggs on a weekly basis [4] and the iron bioavailability of the vegetarian diet is poor. [10, 14] Effective public health programmes aimed at reducing iron deficiency among young women could have a major impact in reducing maternal and infant mortality. [15]

Literature has revealed that ageing does have an effect on blood production with reduced ratio of bone marrow to fat cells and reduced marrow response when stimulated with erythropoietin. [7] However, the decline of hemoglobin and resulting increase in anemia with age should not be presumed to be a result of "normal aging" and blanket treatment with hematinics should be avoided. Literature has revealed that ageing does have an effect on blood production with reduced ratio of bone marrow to fat cells and reduced marrow response when stimulated with erythropoietin. MCV increases slightly with increasing age but usually not enough to produce significant macrocytosis. Although there is a paradoxical feedback in renal production of erythropoietin, since the levels of this hormone actually increase over time, it has also been reported that the erythroid marrow may become less sensitive to erythropoietin stimulation, a key factor contributing along with possible nutritional deficits and comorbidities to the development of anaemia in the elderly. Even distinguishing anemia of chronic inflammation from anemia of chronic kidney disease is somewhat challenging considering the fact that increased inflammation is seen in older adults even without chronic kidney disease and there are coexisting morbidities in this age group. [16] Anemia algorithms used for evaluation of younger adults are based on the mean corpuscular volume. Such algorithms may be less helpful in the elderly because the classic changes in erythrocyte size do not often accompany anemia in this age group. In most elderly patients with anemia, red cell indices disclose normocytic, normochromic anemia. Clinicians therefore might begin the evaluation of anemia as they would in younger adults, but, if they do not find one of the classic causes of microcytosis or macrocytosis, the search for a cause might need to be enlarged. [17]

Anemia is a critical clinical problem in the elderly population with a significant public health impact. Data on the prevalence of anemia are varied and depend on the location and the population. The present study demonstrated a prevalence of anemia of 43.48%. This high percentage of prevalence is similar to the S.Patel et al study.[17] The prevalence of anemia in the highest in adults (>40 years) which is 42.9%.The similarities in prevalence may be associated with a greater concern with the aging population and the greater emphasis on their health. The increase in the frequency of anemia in older individuals is sometimes regarded as inherent to the aging process. Nevertheless, further investigations of the cause of anemia and the completion of treatment may help to improve clinical conditions in the elderly population. It is important to remember that anemia is multifactorial, and its occurrence may be due to the presence of cancer, inflammatory diseases, kidney disease (due to diabetes and hypertension), and the use of several drugs commonly required in the elderly population.[18] Our findings demonstrate a higher prevalence of anemia in women than in men considering all the age groups. These results are in similar to those of a study that evaluated 284 elderly participants in the Family Health Program of Pernambuco, Brazil. The study found that the average prevalence of anemia in women was 12.6% versus 118 Sgnaolin V, Engroff P, Ely LS, Schneider RH, Schwanke CH, Gomes I, Morrone FB, de Carli GA Rev Bras Hematol Hemoter. 2013;35(2):115-8 10.9% in men. In contrast, a study performed by Olivares et al.[19] enrolled 274 elderly outpatients in Chile and found a low prevalence of overall anemia, but a higher prevalence among men (5.4%) compared to women (4.4%). This increase in the prevalence of anemia in men was also described in the NHANES III study, with men accounting for 11.6% of the cases of anemia versus 10.2% for women. [5] In an attempt to explain the different prevalence rates of anemia for men and women, some authors have argued that estrogens act as inhibitors of erythropoiesis and make women more vulnerable to the development of anemia. However, while postmenopausal estrogen levels decrease, there is an increase in red cell mass to levels that are similar to those in males, which makes it unreasonable to use different criteria for anemia in each gender. [20,21]

In our study 295(50.25%) were males and 292(49.74%)were females, which was similar to the Kaur et al[24] in which 37% were males and 33% were females, and in contrast to the Chul won choi et al study in which 11.4% were males and 2.1% were females.[25]

In our study Microcytic hypochromic anemia 46.50% is the predominant type of anemia as seen in Gerardo et al studies[26] and S Patel et al [27] study in which microcytic hypochromic anemia was seen in 72%.This finding was in contrast to the Kaur et al [24] in which normocytic normochromic anemia is the predominant type 56%.

In our study normocytic normochromic anemia was found in 42.25%, majority of which had mild type of anemia 73.52%. The predominant age group in this category was elderly.

In our study the majority of the subjects were adults (42.91%), followed by the patient in the third decade (19.08%), this was similar to the Kaur et al study[24] in which 55% were found in the age group 60-69 years, and in contrast to the S. Patel et al study[27] in which peak age group was 21-30 years,46%.

V. Conclusion

The prevalence of anemia in patients admitted in our hospital was higher than community based studies.Hematological parameters guiding the type of anemia differ in various age groups involved which reflects the varying etiologies behind this. In younger age group the predominant type is microcytic hypochromic which is due to iron deficiency. In adults the type most prevalent is normocytic normochromic which may be because of chronic diseases,inflammation,blood loss,malignancies or aging process. However, anemia is not a condition that should only be associated with the aging process. Anemia is not a condition, it is a manifestation of a variety of pathologies which deserves adequate medical attention.

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