ROLE OF RBC COUNT AND RBC INDICES IN DIAGNOSING AND DIFFERENTIATING ANEMIAS CAUSED DUE TO VARIOUS CLINICAL SITUATIONS IN A TERTIARY CARE HOSPITAL IN VADODARA, GUJARAT

Sandeep Barve[1], Darshana Patel[2], K. K. Shiromani[3], Ashish Jawarkar[4]

[1]Associate Professor, Department of Pathology, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat.
[2]Assistant Professor, Department of Pathology, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat.
[3]Assistant Professor, Department of Pathology, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat.
[4]Assistant Professor, Department of Pathology, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat.

ABSTRACT: BACKGROUND: Latest technologies have made it easier for the pathologist and clinician to diagnose any case of anemia. Automated cell counters are widely used since last two decades that have further facilitated and made it easy for the clinicians to reach to the root cause of anemia. RBC count and entire RBC indices along with HB estimation gives a definite idea as to what could be the cause of anemia. The whole spectrum of RBC indices i.e. MCV, MCH and MCHC along with RBC count, PCV and Hemoglobin estimation plays a vital role to analyze the cause of anemia.

MATERIAL AND METHODS: A cross sectional study was carried out at Parul Institute of Medical Science and Research, Limda, Vadodara, Gujarat. Investigations of RBC count and RBC indices of patients were carried out on fully automated cell counter – by Merck diagnostics. Study included 700 patients with Hemoglobin <10gm% which included males and females of age group 15-50 years.

RESULTS: Total 700 anemic patients with Hemoglobin < 10gm% were enrolled in the study. Among them 569 were females which included pregnant females also and 131 were males. Patients were of age group 15-50 years. Data revealed that 45 % of patients had iron deficiency anemia, 14 % had megaloblastic anemia, 13% had hemolytic anemia, 6 % had anemia due to chronic illness whereas 10 % had dimorphic type of anemia. In iron deficiency anemia, blood picture showed relatively high to normal RBC count and PCV i.e. hematocrit, typically low MCV and MCH values and low to normal MCHC. In megaloblastic anemia, RBC count was very low due to premature destruction of RBC's and they had low PCV whereas high to very high MCV, MCH and MCHC values. In hemolytic anemia it is seen that RBC count is low and so is the PCV or hematocrit while such patients have normal to high MCV and normal MCH and MCHC. In anemia of chronic disease all parameters are relatively normal except low to normal MCV.

CONCLUSION: RBC indices vary in different types of anemia and are used routinely by clinicians to reach presumptive diagnosis and further investigate the case of anemia and reach final diagnosis.

KEYWORDS: RBC Indices, Hematocrit, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin, Mean Corpuscular Hemoglobin concentration.

INTRODUCTION: Anemia is usually defined as a decrease in the amount of red blood cells (RBCs) or hemoglobin in the blood. It can also be defined as a lowered ability of the blood to carry oxygen.[1]

There are three main types of anemia which may be classified as follows: Anemia due to blood loss, due to decreased red blood cell production, and due to increased red blood cell breakdown. Causes of blood loss include trauma and gastrointestinal bleeding among others. Causes of decreased production include iron deficiency, a lack of vitamin B12, thalassemia and a number of neoplasms of the bone marrow among others. Causes of increased breakdown include a number of genetic conditions such as sickle cell anemia, infections like malaria and some autoimmune diseases among others.[2,3] It can also be classified based on the size of red blood cells and amount of hemoglobin in each cell. Normal hemoglobin levels in males are 13-18gm% and in females were 12-16gm%. Diagnosis of anemia in males is based on hemoglobin of less than 11gm%, while in females less than 10gm%. Further testing is then required to confirm various types of anemia.[4,5]

The quantitation of blood cell(red blood cells, white blood cells and platelets) is well recognized tool used widely in the field of modern medicine. With availability of automated blood cell analysers, indices related to red blood cells are being estimated as a part of complete blood count as a primary investigation in almost every patient. Red blood cell count along with RBC indices play a vital role in getting a clue to the type of anemia.

RBC indices are blood tests that provide information about the hemoglobin content and size of red blood cells.[6] Abnormal values indicate the presence of anemia and type

of anemia. Mean corpuscular volume (MCV) is the average volume of a red blood cell and is calculated by dividing the hematocrit (Hct) by the red blood cells. Normal range in 75-95 fl. Mean corpuscular hemoglobin (MCH) is the average amount of hemoglobin (Hb) per red blood cell and is calculated by dividing the hemoglobin by the red blood cells. Normal range in 27-31 pg. Mean corpuscular hemoglobin concentration (MCHC) is the average concentration of hemoglobin per unit volume of red blood cells and is calculated by dividing the hemoglobin by the hematocrit. Normal range: 32-36 g/dL.[7,8,9] Various clinical situations leading to anemia produce changes in red cell count, hematocrit and RBC indices. Automated cell counters estimate these indices with high level of accuracy and are used in diagnosing and differentiating various types of anemia.

AIMS AND OBJECTIVES: To study RBC count and RBC indices in various clinical situations.

MATERIAL AND METHODS: An observational study was carried out in year 2015 at PIMSR, Vadodara, Gujarat. Ethical clearance was sought from organizational ethical committee. Information like age, sex, clinical diagnosis and lab parameters were collected which include complete blood count and red cell indices. Data was entered in Microsoft excel and mean, standard deviation and proportion were calculated.

RESULTS: Laboratory record of total 700 patients with anemia (hemoglobin less than 10 gm %) was studied. These included 131 males and 569 females varying from age group 15-50 years.

In the above table it is observed that iron deficiency anemia predominate in our set up which accounted for 45 %, which included 27 % pregnant females. Further it was observed that megaloblastic anemia accounted for 14 % of cases and dimorphic type i.e. both iron deficiency and megaloblastic was seen in 10 % cases. Hemolytic causes were seen in 13 % cases and anemia due to chronic illness in 6 % patients.

Anemias due to blood loss were seen in 11 % patients.

Once we get clue as to what is the type of anemia further confirmatory investigations were carried out such as Serum Iron, TIBC and S. Ferritin in iron deficiency anemia, S. Folic acid and S. Vitamin B12 in Megaloblastic anemia, Hb electrophoresis, autoantibody detection in hemolytic type and so on, to reach final diagnosis.

DISCUSSION: With the advent of automated cell counters precise results are obtained. Their use is increased worldwide. Present study was carried out with studying of RBC count and RBC indices in various clinical conditions. Patients were categorized in five main categories: Anemias due to increased blood loss, anemia due to increased RBC breakdown, Anemia due to reduced RBC synthesis, Anemias due to chronic illness and other causes of anemia. In present study it was observed that

there was decrease in all parameters i.e. RBC count, MCV and MCH while MCHC was reduced or normal in iron deficiency anemia. Similar observations were made in his study by Carmel et al. In megaloblastic anemia RBC count and PCV decreased whereas MCV, MCH and MCHC increased, these observations coincide with the observations made by Savage et al in his studies. In hemolytic anemia RBC count and PCV decreased while MCV, MCH and MCHC were normal or variable, these values of indices along with high reticulocyte count and peripheral smear study are diagnostic of hemolytic anemia which coincides with study by Paul Schick et al. In chronic illness RBC indices were variable. Low MCV is an immediate indicator of iron deficiency anemia with the exception of thalesemia minor. High MCV and MCH almost instantly gives a clue towards megaloblastic anemia especially if MCV > 105 or hemolytic anemia if there are other evidences of hemolytic like increased reticulocyte count. Normal MCV and MCH in patients with anemia usually indicates anemia due to chronic illness or due to rare causes.

In our study, in cases of iron deficiency anemias a direct relationship was observed between severity of anemia i.e. low hemoglobin and reduced indices which means lower the Hb, the RBC indices were highly reduced whereas in cases of megaloblastic anemias inverse relationship was found between Hb levels and MCH, MCH and MCHC.

CONCLUSION: Apart from RBC count, other parameters PCV, MCV, MCH and MCHC differ in various clinical forms of anemia. In patients of iron deficiency anemia which predominantly included pregnant females, low value of MCV and MCH was observed. Raised MCV and MCH indicate mainly megaloblastic cause or sometimes hemolytic. Anemias due to chronic diseases usually do not affect RBC indices. Findings of present study indicate that RBC count and RBC indices play a primary role in diagnosing and differentiating different types of anemia. Thus by performing RBC indices along with proper clinical history of patients a clinician immediately gets a clue to diagnosis of the type of anemia. Whether facilities are available or not they should be used as routine investigatory measures.

REFERENCES:
1. Bunn HF. Approach to the anemias. In: Goldman L, Schafer AI, eds.Goldman's Cecil Medicine, 24th ed. Philadelphia, Pa: Elsevier Saunders; 2011: chap 161.
2. Aslan D, Gumruk F, Gurgey A, Altay C. Importance of RDW value in differential diagnosis of hypochromic anemias. Am J Hematol. 2002, 69: 31-33.
3. Brugnara C. Iron deficiency and erythropoiesis: new diagnostic approaches. Clin Chem. 2003, 49: 1573-1578.

4. Brugnara C. Use of reticulocyte cellular indices in the diagnosis and treatment of hematological disorders. Int J Clin Lab Res. 1998, 28: 1-11.

5. Carmel R, Cassileth PA. A focused approach to anemia. Hosp Pract. 1999; 34: 71–91 Diagnosis of Anemia 15 t1.9.

6. Gehrs BC, Friedberg RC. Autoimmune hemolytic anemia. Am J Hematol. 2002, 69: 258-271.

7. Glader, B. Anemia: general aspects. In:Greer JP, Foerster J, Lukens JN, et al, eds. Wintrobe's Clinical Hematology. 11th ed. Baltimore, Md: Williams & Wilkins; 2004:947-978. Irwin JJ, Kirchner JT. Anemia in children. Am Fam Physician. 2001, 64: 1379-1386.

8. Savage DG, Ogundipe A, Allen RH et al. Etiology and diagnostic evaluation of macrocytosis. Am J Med Sci. 2000, 319: 343-352.

9. Spivak JL. The blood in systemic disorders. Lancet 2000, 355: 1707-1712.

Age	Males	Females	Total	Percentage of total %
15-25 years	22	134	156	22.1
25-35 years	40	256	296	42.1
35-45 years	45	129	174	24.6
45-50 years	24	50	74	10.3
Total	**131**	**569**	**700**	**100 %**
Table 1: Age-wise and gender-wise distribution of anemia in study group				

Clinical Conditions	N=700	Frequency %
Anemia due to blood loss either intrinsic or extrinsic due to trauma	77	11%
Anemia due to decreased production 1. Iron deficiency in pregnancy. 2. Iron deficiency due to other causes. 3. Megaloblastic anemia.	189 126 98	27 % 18 % 14 %
Anemia due to increased breakdown of RBC(hemolytic)	91	13 %
Anemia due to chronic illness	42	6 %
Any other rare causes like bone marrow suppression, fanconi's anemia, etc	7	1 %
Dimorphic anemia	70	10 %
Table 2: Clinical diagnosis of the studied subjects and % frequency		

Type of Anemia	HB %	RBC COUNT	PCV	MCV	MCH	MCHC
Iron deficiency	↓	↓	↓	↓	↓	N
Megaloblastic	↓	↓	↓	↑	↑	↑
Hemolytic	↓	↓	↓	N or raised except Thal. Minor- reduced	N	N
Chronic illnesses	↓	N	N	N	N	N
Others	↓	V	V	V	V	V
Table 3: RBC count and RBC indices varied in different types of anemia and following data was observed in these 700 patients enrolled in the study						

↓ - Decreased ↑ - Increased N – Normal V – Variable.