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Analysis of blood cell parameters in predicting the diagnosis and differentiation of anaemias

Authors: Sarojini Raman [1], E S Rao [2], Kanaklata Dei [3]
[1]*Associate Professor, Department of Pathology, KIMS,BBSR*
[2]*Professor, Department of Pathology,MKCG Medical College,Brahmapur*
[3]*Professor, Department of Pathology,MKCG Medical College,Brahmapur*
Corresponding Author: Sarojini Raman

Abstract:
Introduction*: Anaemia is one of the most prevalent deficiency disorders in the world affecting all age groups . 1.62 billion people globally suffer from anemia , corresponding to 24.8% of population. Complete blood count is a cheap , commonly used test done for detection of anemias.The various parameters of CBC when analysed in conjunction with other tests can pinpoint the aetiology in most of the cases.*
Materials & methods : *This study was undertaken for a period of 3 years for all the cases advised for evaluation for anaemia at MKCG Medical College, Brahmapur.CBC parameters like HGB,TRBC,PCV,MCV,MCH,MCHC,RDW were used in different combinations to categorise and predict the aetiology of anaemia cases.*
Results: *Out of 350 cases maximum number of cases were of IDA 101(28.85%). Most of anaemia cases observed during second decade, i.e. 91(26%) and 71(20.28%) in first decade. Females suffer more than males, ratio was 1:1.05. Females of 20-40 yr age group affected more from microcytic anemias (44.9%).Adults of 20-40 year age group had more of normocytic normochromic anaemia. RDW raised in 68.31% of IDA as well as in 65.51% cases of ACD. MCV low in IDA mostly (77.22%). MCH low in all types of anaemia.*
Conclusion: *The results of this study can be used by public health programmes to design targeted interventions aimed at reducing the huge burden of anaemia in India. Further large scale prospective studies are needed with anciliary tests to clarify the aetiology of anaemia in all cases.*
Key Words: *Anaemia, Complete Blood Count, parameters*

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I. Introduction

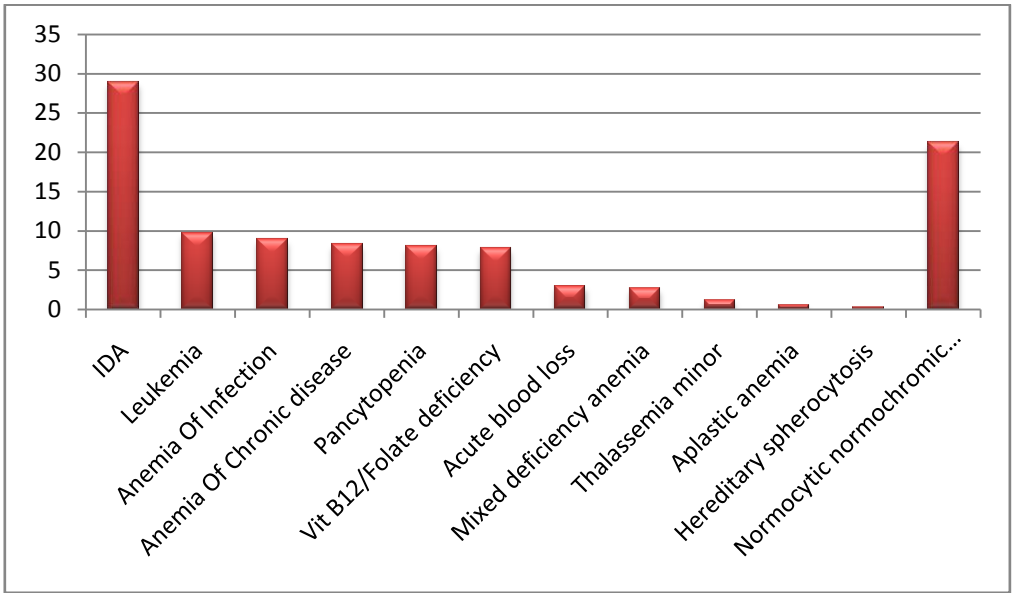
Anemia seems to hunt Indians since mythological ages exempting no age groups running as an undercurrent in many ailments.[1]It's a major public health hazard affecting two billion people worldwide.[2]Anemia is classified as per aetiology(e.g.hemolytic ,hemorrhagic etc), erythropoietic response (e.g. hypoproliferative , ineffective etc) or cell morphology(e.g.macrocytic ,microcytic hypochromic etc).[3]Complete blood count(CBC) is a time honoured laboratory test for detection of anemias.Its parameters provide important clues towards the aetiological factors when assessed together.

II. Materials & Methods

The study was undertaken for a duration of 3 years.The cases included all clinically diagnosed anemias from indoor & outdoor wards, advised for evaluation of anemia by CBC method in automated coulter counter. Consent was taken in all cases. Cases were subjected to detail history taking ,physical examination and after CBC, further confirmation by bone marrow aspiration, trephine biopsy, special stains(Myeloperoxidase,Per iodic Schiff, New methylene blue), specific tests like electrophoresis,G-6PD(glucose-6 phosphate dehydrogenase) were done whenever required. The automated hematology analyzer was calibrated using stable calibrant (either preserved blood or a substitute) or commercial calibrant with assigned value .Quality control(QC) was regularly checked. Hemoglobin (HGB) concentration was measured by photometry, total RBC count (TRBC) measured by electronic counter . Mean corpuscular volume (MCV), Packed cell volume (PCV) , Mean corpuscular haemoglobin (MCH) & Mean corpuscular haemoglobin concentration (MCHC) were calculated parameters. Though the results of automated counter was precise, manual review by peripheral blood smear examination was done in all cases to identify any abnormal cells that the instrument could not recognise.

III. Results

Table-1: Distribution of cases of anemia



Out of 350 cases maximum number of 101(28.85%) cases encountered were iron deficiency anemias (IDA) followed by leukemia 34 (9.17%),infections of various causes 31(8.85%), anemia of chronic disease (ACD) 29(8.28%), pancytopenia 28(8%),vit B12/Folate deficiency 27(7.71%),acute blood loss 10 (2.85%), thalassemia minor 4(1.17%),aplastic anemia 2 (0.57%) & 1 case of hereditary spherocytosis(HS) . Good number of cases were normocytic normochromic anemias (NCNC) 74(21.14%),in which the exact etiology could not be identified. Out of 350 anemic cases ranging from age group 1-80 yrs, maximum 91(26%) cases observed during second decade and 71(20.285%) cases seen in first decade.

Table-2: Sex distribution of anemias

Types of anemia	Males No(%)	Females No(%)
IDA	50(29.4%)	51(28.3%)
NCNC	35(20.5%)	39(21.6%)
Leukemia	17(10%)	15(8.3%)
Infection	14(8.2%)	17(9.4%)
ACD	16(9.4%)	15(8.3%)
Pancytopenia	13(7.6%)	15(8.3%)
Vit B12/Folate deficiency	18(10.5%)	9(5%)
Acute blood loss	2(1.1%)	8(4.4%)
Thalassemia minor	4(2.2%)	0
Aplastic anemia	0	2(1.1%)
HS	1(0.5%)	0
Total	170	180

Male to female ratio was 1:1.05.

Table-3: Morphometric classification of anemias in different age groups & gender

Age in years	Microcytic ,No(%)		Normocytic, No(%)		Macrocytic, No(%)	
	Male	Female	Male	Female	Male	Female
0-10	10(12%)	6(7.6%)	09(11.6%)	10(11.2%)	0	3(18.7%)
11-20	14(16.8%)	18(23%)	11(14.2%)	25(28%)	4(66%)	7(43.7%)
21-30	24(28.9%)	17(21.7%)	27(35%)	22(24.7%)	1(16.6%)	2(12.5%)
31-40	14(16.8%)	23(29.4%)	13(16.8%)	18(20.2%)	1(16.6%)	1(6.2%)
41-50	08(9.6%)	9(11.5%)	09(11.6%)	10(11.2%)	0	1(6.2%)
51-60	05(6%)	3(3.8%)	03(3.8%)	1(1.1%)	0	1(6.2%)
61-70	06(7.2%)	2(2.5%)	03(3.8%)	2(2.2%)	0	0
71-80	02(2.4%)	0	02(2.5%)	1(1.1%)	0	1(6.2%)
Total	83	78	77	89	6	16

Among children normocytic normochromic anemia 19 (11.4%) was most common followed by microcytic anemia 16(9.9%) due to various causes. In contrast adults had more of microcytic anemia cases(48.4%). Females of 20-40 yr age group suffered more from microcytic anemias (44.9%). 23% Adolescent females affected by deficiency anemia.Adults of 20-40 year age group had more of normocytic normochromic anemia.

Table-4: Types of anemia based on MCV & RDW

MCV(fl)	RDW (CV)	Type of anemia	No of cases	Causes of anemia
<76	>14	HTMI	94	IDA, ACD, NCNC, HS, Thalassemia minor, Pancytopenia
<76	11.6-14	HMMI	26	
76-98	>14	HTN	99	Early IDA ,Vit B12/Folate def on therapy,NCNC
76-98	11.6-14	HMN	117	Acute blood loss, ACD, Infections, Leukemia, NCNC
>98	> 14	HTMA	12	Megaloblastic anemia, Infections, Aplastic anemia , Alcoholism, Pancytopenia
>98	11.6-14	HMMA	2	

HTMI- Heterogeneous microcytic HMMI-Homogenous microcytic
HTN- Heterogeneous normocytic HMN- Homogenous normocytic
HTMA- Heterogeneous macrocytic HMMA- Homogenous macrocytic
There was overlap of cases among HTN & HTMA,HTMI & HMN and HMN & HMMA groups. The RDW value was high in iron deficiency anemia , anemia of chronic disease, early macrocytic anemia , anemia with dimorphic picture as well as dual deficiency anemia on therapy.

Table-5: RBC indices in anemias

Type of anemia		IDA	ACD	Infection	Leukemia	Pancytopenia	Vit B12/ Folate def	Acute blood loss
HGB	<11	71(70.29%)	16(55.17%)	16(51.61%)	27(79.41%)	20(71.42%)	16(59.25%)	5(50%)
	>11	30(29.7%)	13(44.82%)	15(48.38%)	7(20.58%)	8(28.57%)	11(40.74%)	5(50%)
RDW*	11.6-14	32(31.68%)	10(34.48%)	22(70.96%)	24(70.58%)	13(46.42%)	19(70.37%)	7(70%)
	>14	69(68.31%)	19(65.51%)	9(29.03%)	10(29.41%)	15(53.57%)	8(29.62%)	3(30%)
MCV	<76	78(77.22%)	17(58.62%)	11(35.48%)	8(23.52%)	12(42.85%)	8(29.62%)	3(30%)
	76-98	2(1.98%)	10(34.48%)	19(61.29%)	26(76.47%)	16(57.14%)	19(70.37%)	7(70%)
	>98	23(22.77%)	2(6.89%)	1(3.22%)	0	0	0	0
MCH	<28	62(61.38%)	19(65.51%)	21(67.74%)	28(82.35%)	18(64.28%)	21(77.77%)	4(40%)
	>28	39(38.61%)	10(34.48%)	9(29.03%)	6(17.64%)	10(35.71%)	6(22.22%)	6(60%)
PCV	<35	76(75.24%)	20(68.96%)	21(67.74%)	15(44.11%)	15(53.57%)	12(44.45%)	4(40%)
	>35	26(25.74%)	9(31.03%)	10(32.25%)	19(55.88%)	13(46.42%)	15(55.55%)	6(60%)

*Red cell distribution width
Table 5 shows RDW raised in IDA(68.31%) as well as ACD(65.51%).MCV low in 77.22% of IDA.MCH low in all types of anemia.Low PCV seen in IDA,ACD,infections.

IV. Discussion

Anemia is an under diagnosed condition with serious negative consequences affecting productivity & quality of life. Women & children are vulnerable to malnutrition & anemia for both biological and social reasons. By conducting more systematic laboratory tests physicians can greatly improve the recognition, diagnosis and management of anemic patients.[1,4]

IDA is considered the most prevalent anemia worldwide .In our study IDA was the most common type (28.85%).This is consistent with Joseph J et al & S Bhandare et al who found the incidence of IDA to be 30% & 27% respectively.[5, 6] IDA affects all age groups with poverty, illiteracy & ignorance acting as compounding factors for malnutrition. WHO estimate shows 2.1 billion people are globally affected with anemia mainly because of iron deficiency.[7,8]Vitamin B 12/ Folate deficiency incidence was observed to be 7.71% & the peak age group was 11-30 years which are in accordance with Uma Khanduri et al with incidence of 12.16% & age group at 10-30 years. The cause of macrocytosis should be further determined by reticulocyte count, peripheral smear examination, serum folate & vit B12 level and bone marrow aspiration study.[9, 10]

In our study females outnumbered males in all types of anemia , the ratio 1.05:1.This is close to findings by Goel S et al that females have higher prevalence of anemia than males.[11] Malhotra P et al also have reported male & female prevalence at 44.3% & 50% respectively with ratio of 1.13:1.[12,13] 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. The reasons being food habits, low socioeconomic status, social practices, regular loss of blood through menstruation, repeated childbirths, smaller muscle mass and bone density in females. The incidence of anemia among females can be decreased significantly by maternal health education & widespread awareness.[14,15,16]

Microcytic anemia in children was second most common (8.84%) in the present study, which is in accordance with Joseph J Irwin et al where the incidence was 3-10%. Besides IDA, hemoglobinopathies can cause microcytosis which should be proved by laboratory tests.[5,7]Macrocytic anemia was less common in adults and similar findings were also reported by Joseph J et al.Mild macrocytosis ,easily missed on blood smears by technician or haematologists, is frequently detected by coulter counter, facilitating early discovery of megaloblastic states,in which the MCV elevation typically precedes the development of anemia,often by months or years.[10,17] Our study revealed females of 20-40 yr age group suffered more from microcytic anemias (44.9%)

echoing alvarez –uria et al & Kaur k. 23% Adolescent females affected by microcytic anemia .Adolescent girls are particularly prone to iron deficiency anemia because of increased demand of iron due to growth spurt , loss of iron during menstruation and poor dietary habits .Adults of 20-40 year age group had more of normocytic normochromic anemia as noticed by alvarez –uria et al suggesting that causes other than iron deficiency might have contributed to the high prevalence of anaemia in this group.[18,19]

RDW values were raised both in IDA(68.31%) & ACD (65.52%).It was normal in anemia due to infections, in leukemias & in acute blood loss. Similar observations were made by Wians et al,so a single parameter i.e. RDW value was not of much help in differentiating between IDA & ACD. Persons with chronic disease, acute haemorrhage and aplastic anemia with no transfusion have normal RDW. On contrary persons with haemolytic anemia, hereditary spherocytosis, acute and chronic leukemia ,lymphoma, chronic hepatobiliary disease, solid tumors have high RDWs. In transfused patients with various diseases no significant difference between pre & post transfusion states seen.[20, 21,22]

MCV was low in 77.22% of IDA in our study, similar to Christensen et al corroborating with the fact that MCV has strong predictive value for IDA.[21]Vit B12/folate deficiency cases had normal MCV in 70.37% ,same as Saxena et al .[23] In patients with either cobalamin or folate deficiency, the MCV tends to increase before the haemoglobin value falls significantly. However, when concurrent iron deficiency or thalassemia is present, MCV often remains within reference range, even with biochemical evidence of vitamin deficiency.[10] MCH was low in all cases of microcytic anemias in our study. Hershko et al also observed similar findings (97-100%) in their study.[24]

Iron deficiency anemia cases were differentiated from ACD & other types of anemia by using a combination of different parameters like HGB, MCV, MCH, RDW & PCV. Similar observations were made by Mahu JL et al and Laffarty et al. Diagnostic utility of of RDW in relation to the MCV was evaluated like Monzon et al .Six different groups of erythrocyte disorders by MCV & RDW values were predicted. This combination established a useful differential diagnosis of erythrocyte disorders. The RDW may find its best use as a guide in differential diagnosis of anemia,rather than a definitive test per se.[17,25,26]

V. Conclusion

CBC is a powerful diagnostic tool. Appropriate evaluation of all aspects of CBC can lead to specific diagnosis or assist in ruling out many diseases. To gain full benefit of CBC, it must be used in conjunction with a good history, physical examination ,peripheral smear & bone marrow study as well as biochemistry panel.

CONFLICT OF INTEREST: None .

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