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Original Research Article

Comparison between Automated Hematology Analyzer and Peripheral Blood Smear Examination for Assessment of Morphological Types of Anemia

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ABSTRACT

Background
Anemia represents a major healthcare burden in developing country like India. Since decades peripheral blood smear has been used for diagnosis of anemia. Cell counter has been introduced with increasing efficacy and a decreasing cost all over the world. Aim of this study was to correlate morphological typing of anemia based on RBC indices and RDW obtained from automated hematology analyzer with PBS (Peripheral Blood Smear) and to give better approach in diagnosis of anemia and analyze their limitations.

Materials and Methods
This prospective study was undertaken at Sir T hospital, Bhavnagar comprising of total 300 cases of anemia over a period of 4 months between July to October, 2021. Anemia typing was done by NIHONKODEN 9100 hematology analyzer and peripheral blood smear.

Results
Out of 300 cases, 265 cases of anemia typed by RBC indices and RDW obtained from hematology analyzer were correct. 35 cases needed blood smear examination for correct typing of anemia. Microcytic hypochromic anemia was the most common morphological type of anemia followed by normocytic normochromic anemia. Anemia was found to be more common in females. Microcytic hypochromic anemia and normocytic normochromic anemia was the most common type in females and males respectively.

Conclusions
PBS examination remains the gold standard test for morphological typing of anemia. With new advances in hematology analyzer typing of anemia can be done with indices and RDW but PBS confirmation is must. Both the methods should be used complementary to each other for better diagnostic accuracy.

Keywords: Anemia, Hemoglobin, Microcytic hypochromic anemia, Normocytic anemia

INTRODUCTION

The word anemia is derived from Greek word 'anaimi' meaning lack of blood which is either due to decrease in normal number of RBCs or less than normal quantity of hemoglobin in blood.[1,2] Anemia is functionally defined as insufficient RBC mass to adequately deliver oxygen to peripheral tissues. Anemia refers to reduction in oxygen carrying capacity and is defined as a clinicopathological condition, which is present when hemoglobin level of the body is below the normal range for the age and sex of the individual.[3]

Once anemia is established, a morphological typing of anemia helps the clinician to approach the cause of anemia. Morphological typing of anemia is based on RBC indices – MCV, MCH and PCV. The manual methods of measuring RBC indices are tedious and show large coefficient of variation. The automated hematology analyzers give more accurate (< 1% coefficient of variation) RBC indices. Thus,

we can definitely conclude that the hematology analyzers have a potential to replace peripheral blood smear examination. Cell counting with these instruments is rapid, objective, statistically significant and not subject to the distributional bias of the manual count.

MATERIALS AND METHODS

This prospective study was undertaken at hematology laboratory, Sir T hospital, Bhavnagar. A total 300 cases of anemia were studied over a period of 4 month between July 2021 to October 2021. Study was undertaken after approval from ethics committee of the institute, Bhavnagar and EC approval No. was 1054/2021 & CTRI No. is CTRI/2021/07/035060. All samples received during the study period and showing anemia were included in the study. Samples of patients less than 16 years, more than 65 years and antenatal females were excluded. Also, hemolyzed and clotted samples were excluded. Anemia typing was done by two methods; firstly, using RBC indices and RDW only and then on peripheral blood smear examination. Chi square statistics was applied and p value calculated.

RESULTS

Out of the 300 cases, 46.66% samples showed microcytic hypochromic anemia with raised RDW followed by normocytic normochromic anemia with normal RDW (33.33%) using RBC indices and RDW (Table-1a). With PBS, microcytic hypochromic anemia was most common (54%) followed by normocytic normochromic anemia (33.33%) (Table-1b)

Table-1a: Morphological typing of anemia based on RBC indices and RDW

Morphological type of anaemia	Male	Female	Total
Microcytic Hypochromic Anaemia with normal RDW	02	10	12
Microcytic Hypochromic Anaemia with raised RDW	20	120	140
Normocytic Normochromic Anaemia with normal RDW	51	49	100
Normocytic Normochromic anaemia with raised RDW	13	22	35
Macrocytic Anaemia	09	04	13
Total	95	205	300

Out of total 300 cases, 265 cases typed concordant by both methods. 35 cases showed non concordant typing of Anemia. Out of these, 10 cases were typed as normocytic normochromic Anemia with raised RDW using RBC indices alone which on PBS showed microcytic hypochromic Anemia with polychromasia. The polychromatic cells (reticulocytes) being larger are responsible for increasing the MCV to fall within normal range.

Table-1b: Morphological typing of anemia based on peripheral blood smear examination

Morphological Type ofAnemia	Male	Female	Total
Microcytic HypochromicAnemia	29	133	162
Normocytic Normochromic Anemia	51	49	100
Macrocytic Anemia	9	4	13
Dimorphic Anemia	6	19	25
Total	95	205	300

25 cases were typed as normocytic normochromic Anemia with raised RDW using RBC indices alone which on peripheral blood smear examination showed presence of mixed red cell population with microcytic hypochromic cells and macrocytic cells and hence having a normal MCV and raised RDW and hence typed correctly on peripheral blood smear examination as dimorphic Anemia (Table-2).

Table-2: Correlation between morphological typing of anemia using RBC indices and RDW with morphological typing of anemia using peripheral blood smear examination

Morphological typing of anemia using RBC indices & RDW (Number of Cases)	Morphological typing of anemia using PBS examination (Number of Cases)
Microcytic Hypochromic Anemia with normal RDW (12)	Microcytic Hypochromic Anemia (162)
Microcytic Hypochromic Anemia with raised RDW (140)	
Normocytic Normochromic Anemia with raised RDW (10)	
Normocytic Normochromic Anemia with raised RDW (25)	Dimorphic Anemia (25)
Normocytic Normochromic Anemia with normal RDW (100)	Normocytic Normochromic Anemia (100)
Macrocytic Anemia (13)	Macrocytic Anemia (13)
Total: 300	**Total: 300**

Out of the total 300 cases of anemia, mean age of anemia predominance in males was found to be 41.49 years and in female 37.51 years (Figures 1 & 2).

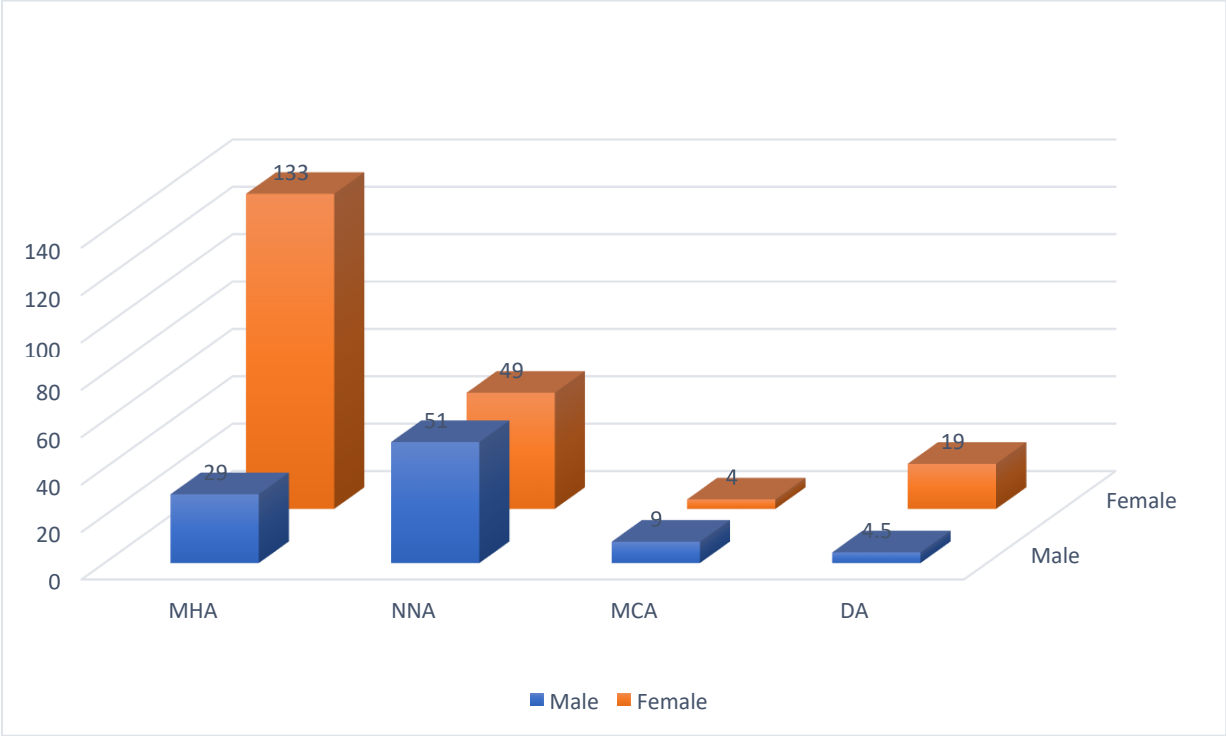

Figure-1: Gender wise distribution of different morphological types of anemia

Table-3: Distribution of cases correctly typed by RBC indices and peripheral blood smear examination

Method	Correct Typing	Wrong Typing	Total
RBC indices with RDW	265 (88.33%)	35 (11.67%)	300
PBS with RBC indices	300 (100%)	0 (0%)	300

The chi-square statistic is 34.16. The p value is <0.00001, significant at p< 0.01.

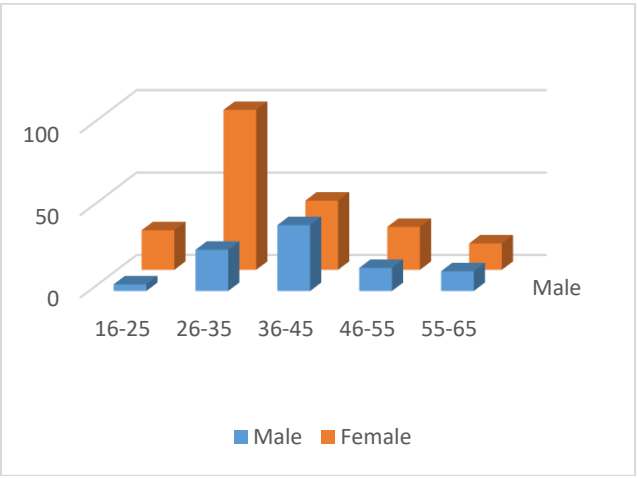

Figure-2: Age wise distribution of anemia

DISCUSSION

Table-4a shows the number of cases needing PBS for correct diagnosis in previous studies and comparison with our study.

Table-4a: Number of cases needing peripheral blood smear review for correct diagnosis

	Present Study	Meenu Venukumar et al[4]	Novis et al[5]
Total number of cases	300	400	95,141
Number of cases needing peripheral blood smear review	35 (11.66%)	49 (12.25%)	6147 (6.4%)

In our study, microcytic hypochromic anemia was the most common morphological type of anemia comprising of 54% of cases which is concordant with the other studies named Japheth E Mukaya et al[6] (54.5%), Singh M et al[7] (60%), Garg et al[8] (50.86%) and Phukan et al[9] (50.58%) (Table-4b).

Table-4b: Comparison of distribution of morphological type of anemia with other studies

Morphological type of anemia	Present Study	Japheth E Mukaya et al[6]	Singh M et al[7]	Garg et al[8]	Phukan et al[9]
Microcytic Hypochromic Anemia	54%	54.5%	60%	50.86%	50.58%
Normocytic Normochromic Anemia	33.33%	31%	14.86%	25.14%	21.92%
Macrocytic Anemia	4.33%	5.9%	2.85%	2.29%	7.29%
Dimorphic Anemia	8.33%	8.6%	20.86%	15.43%	12.98%

CONCLUSIONS

RBC indices and RDW obtained from hematology analyzer are useful in the diagnosis of various morphological types of anemia and can aid but cannot replace peripheral blood smear examination. Both methods should be used as complementary to each other as it increases diagnostic accuracy. Peripheral blood smear examination is still the gold standard for confirmation of diagnosis.

REFERENCES

1. Anemia Definition and Meaning. Retrieved from https://www.merriam-webster.com/dictionary/anemia (Accessed on 01.07.2023)

2. Chronic Anemia: Practice Essentials, Etiology, Epidemiology. Retrieved from https://emedicine.medscape.com/article/780176-overview (Accessed on 01.07.2023)

3. Isselbacher KJ, Braunwald E, Petersdorf RG, Wilson JD, Martin JB, Fauci AS. Harrison's principles of internal medicine. In: Harrison's principles of internal medicine. 1987. McGraw-Hill.

4. Venukumar M, Suma MT. Comparison between Morphological Typing of Anemia based on RBC Indices Obtained from an Automated Haematology Analyzer with Peripheral Blood Smear Examination. Saudi J Pathol Microbiol 2019; 4(3): 226-232.

5. Novis DA, Walsh M, Wilkinson D, St Louis M, Ben-Ezra J. Laboratory productivity and the rate of manual peripheral blood smear review: a College of American Pathologists Q-Probes study of 95,141 complete blood count determinations performed in 263 institutions. Arch Pathol Lab Med. 2006 May;130(5):596-601. doi: 10.5858/2006-130-596-LPATRO. PMID: 16683868.

6. Mukaya JE, Ddungu H, Ssali F, O'Shea T, Crowther MA. Prevalence and morphological types of anaemia and hookworm infestation in the medical emergency ward, Mulago Hospital, Uganda. S Afr Med J. 2009 Dec 7;99(12):881-6. PMID: 20459999.

7. Singh M, Kafle SU, Shaukin SH, Pokhrel S. Study of Peripheral Blood Smear Findings in Paents of Anemia and to Compare it with Automated Hematology Analyzer Generated Red Cell Parameters. BJHS 2020;5(3)13. 1231-1235.

8. Garg Monika, Gitika, Sangwan Karuna. Comparison of Automated Analyzer Generated Red Blood Cell Parameters and Histogram with Peripheral Smear in the Diagnosis of Anaemia. International Journal of Contemporary Medical Research. 2019 Aug; 6(8): h1-h6.

9. Phukan, Jyoti Prakash; Kawsar, Hena; Banerjee, Jayashree; Sinha, Anuradha1,. A comparative study of anemia in peripheral blood smear and automated cell counter generated red cell parameters. Iraqi Journal of Hematology 11(1):p 51-55, Jan–Jun 2022. | DOI: 10.4103/ijh.ijh_3_22.

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