Profile of Reticulocyte Hemoglobin Equivalent (Ret-He) and Red Cell Distribution Width Coefficient of Variation (RDW-CV) in Patients with Hemoglobin Levels Below 8

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ABSTRACT

Background & Objective: Anemia is defined as a reduction in the concentration of hemoglobin within red blood cells (erythrocytes). It occurs when hemoglobin levels fall below 12 g/dL. Examination of Reticulocyte Hemoglobin Equivalent (Ret-He) and Red Cell Distribution Width Coefficient of Variation (RDW-CV) in patients with hemoglobin levels below 8 can assist in diagnosing and monitoring various medical conditions such as anemia and erythrocyte disorders. This study aimed to describe the Ret-He and RDW-CV profiles in patients with hemoglobin levels below 8 g/dL. **Method:** This research employed a descriptive design with purposive sampling, involving 30 samples. **Result:** The study revealed that among 30 samples, 1 patient (3%) had high Ret-He and high RDW-CV, 4 patients (13%) had normal Ret-He and high RDW-CV, 3 patients (10%) had low Ret-He and normal RDW-CV, 20 patients (67%) had low Ret-He and high RDW-CV, and 2 patients (7%) had normal Ret-He and normal RDW-CV. **Conclusion:** The highest proportion, 20 patients (67%), showed low Ret-He and high RDW-CV. This finding indicates that the bone marrow response was less active, resulting in immature red blood cells lacking sufficient iron content, thereby limiting normal hemoglobin synthesis in reticulocytes. Furthermore, the presence of increased RDW-CV reflects anisocytosis, or variation in red blood cell size.

Introduction

Anemia is defined as a decrease in hemoglobin concentration within red blood cells (erythrocytes) that is insufficient to meet the physiological needs of the body.

When a person experiences anemia, the body does not receive adequate oxygen, which can lead to various symptoms such as fatigue, weakness, dizziness, and shortness of breath. Anemia is diagnosed when hemoglobin levels fall below 12 g/dL (Novita Sari, 2020).

According to the World Health Organization (WHO), the prevalence of anemia among women is 30.7%. The highest prevalence occurs in Asia and Africa, where anemia affects up to 85% of the population, predominantly women. Indonesia is among the countries with the highest number of anemia cases, with prevalence rising from 37.1% in 2013 to 48.9% in 2018 (WHO, 2023).

Reticulocyte Hemoglobin Equivalent (Ret-He) is a measurement of hemoglobin content in reticulocytes, which are immature red blood cells that circulate in peripheral blood for 24 to 48 hours before maturing into erythrocytes released from the bone marrow into circulation. Ret-He provides valuable information on the bone marrow's ability to produce functional red blood cells. It is measured using flow cytometry technology integrated into automated hematology analyzers. This parameter reflects the functional capacity of the bone marrow to synthesize hemoglobin and is highly useful in diagnosing anemia or other disorders related to red blood cell production (Purnamasari, 2024).

Red Cell Distribution Width Coefficient of Variation (RDW-CV) is a parameter measured in complete blood count (CBC) tests that describes the variation in red blood cell size, known as anisocytosis, expressed as a percentage (%). RDW-CV is considered highly effective in assessing abnormalities in red blood cell size, although it is strongly influenced by the mean corpuscular volume (MCV) (Dian Sukma Hanggara, SpPK, 2019).

The Ret-He examination aims to evaluate the bone marrow's response in producing red blood cells (RBCs). A high Ret-He indicates active bone marrow response, while a low Ret-He suggests reduced activity. Meanwhile, RDW-CV assesses the variation in RBC size: a high RDW-CV indicates anisocytosis (unequal RBC sizes), whereas a low RDW-CV indicates uniformity. Therefore, these parameters are useful for evaluating bone marrow response in the diagnosis of anemia as well as assessing red blood cell conditions (Purnamasari, 2024; Putra & U. Y. Bintoro, 2019).

Based on this background, the researchers conducted a study titled "Overview of Reticulocyte Hemoglobin Equivalent (Ret-He) and Red Cell Distribution Width Coefficient of Variation (RDW-CV) in Patients with Hemoglobin Levels Below 8 g/dL" because these parameters are rarely used in routine diagnostics.

Objective

This study aimed to describe the Reticulocyte Hemoglobin Equivalent (Ret-He) and Red Cell Distribution Width Coefficient of Variation (RDW-CV) in patients with hemoglobin levels below 8 g/dL.

Method

This was a descriptive study designed to assess Ret-He and RDW-CV in patients with hemoglobin levels below 8 g/dL. The study population consisted of 44 patients with hemoglobin levels below 8 g/dL at QIM Hospital, Batang Regency. Using the Slovin formula with a margin of error of 10%, a total of 30 samples were obtained through purposive sampling. The study was conducted from March to May 2025 in

the clinical laboratory of QIM Hospital. Data obtained from the laboratory results were presented in tabular form and analyzed descriptively.

Results

After conducting the study on Ret-He and RDW-CV in patients with hemoglobin levels below 8 g/dL, the following results were obtained:

TABLE 1. Results of Ret-He and RDW-CV Examination in Patients with Hemoglobin Levels Below 8 g/dL

Sample Code	Hemoglobin g/dl	Ret-he (pg)	Description	RDW-CV (%)	Description
S1	7.7	30.3	Normal	12.6	Normal
S2	6.8	13.2	Low	20.2	High
S3	7.5	23.8	Low	15.5	High
S4	2.5	32.9	Normal	22.5	High
S5	6.5	18.0	Low	19.5	High
S6	7.8	16.5	Low	23.5	High
S7	6.8	27.2	Low	15.5	High
S8	2.5	14.7	Low	22.9	High
S9	6.8	29.7	Normal	16.3	High
S10	7.0	27.2	Low	15.8	High
S11	7.7	28.9	Normal	14.1	Normal
S12	7.8	23.5	Low	14.5	Normal
S13	7.3	22.4	Low	14.8	High
S14	4.8	22.4	Low	16.4	High
S15	6.8	21.4	Low	20.1	High
S16	4.9	36.9	High	18.0	High
S17	6.8	14.1	Low	34.4	High
S18	6.1	28.1	Normal	15.3	High
S19	6.8	23.8	Low	16.2	High
S20	6.7	13.9	Low	34.4	High
S21	7.4	13.7	Low	34.2	High
S22	7.4	25.9	Low	13.4	Normal
S23	6.7	27.0	Low	14.2	Normal
S24	6.8	27.6	Low	15.0	High
S25	7.5	24.1	Low	16.3	High
S26	7.8	35.4	Normal	14.6	High
S27	7.9	21.0	Low	16.2	High
S28	5.3	27.7	Low	16.8	High
S29	5.8	17.4	Low	20.9	High
S30	5.2	27.4	Low	15.7	High

TABLE 2. Percentage of Ret-He and RDW-CV in Patients with Hemoglobin Levels Below 8 g/dL

NO	Ret-he	RDW-CV	Jumlah	Persentage%
1	High	High	1	3%
2	Normal	High	4	13%
3	Low	Normal	3	10%
4	Low	High	20	67%
5	Normal	Normal	2	7%
Total			**30**	**100%**

Discussion

Based on the percentage results of Ret-He and RDW-CV examinations in inpatients with hemoglobin levels below 8 g/dL at QIM Hospital, Batang Regency, from 30 samples the findings were as follows: high Ret-He and high RDW-CV in 1 case (3%), normal Ret-He and high RDW-CV in 4 cases (13%), low Ret-He and normal RDW-CV in 3 cases (10%), low Ret-He and high RDW-CV in 20 cases (67%), and normal Ret-He and normal RDW-CV in 2 cases (7%).

In the 3% of cases with high Ret-He and high RDW-CV, this indicates the presence of many young red blood cells with sufficient iron content, reflecting an active bone marrow response in producing new erythrocytes under anemic conditions. The high RDW-CV is due to low MCV values, leading to variation in red blood cell size (anisocytosis).

In the 13% of cases with normal Ret-He and high RDW-CV, normal Ret-He indicates that hemoglobin production in reticulocytes is adequate for the body's needs, even under severe anemia. However, the high RDW-CV is associated with low MCV values, causing heterogeneity in red blood cell size.

In the 10% of cases with low Ret-He and normal RDW-CV, this condition reflects insufficient iron content in reticulocytes, resulting in reduced production of new reticulocytes by the bone marrow. Meanwhile, normal RDW-CV indicates relatively uniform red blood cell size with proper maturation.

In the 67% of cases with low Ret-He and high RDW-CV, which was the most frequent finding, low Ret-He demonstrates that reticulocytes lack sufficient iron content, limiting the bone marrow's ability to produce hemoglobin within reticulocytes. The high RDW-CV is associated with low MCV values, indicating marked variability in red blood cell size (anisocytosis).

In the 7% of cases with normal Ret-He and normal RDW-CV, hemoglobin production in reticulocytes was adequate for physiological needs, and the red blood cells were relatively uniform in size.

Conclusion

This study shows that among inpatients with hemoglobin levels below 8 g/dL at QIM Hospital, Batang, the most frequent result was low Ret-He and high RDW-CV in 20 cases (67%). This finding indicates a less active bone marrow response, where reticulocytes lack sufficient iron to produce hemoglobin adequately. The high RDW-CV is explained by low MCV values, resulting in variability in red blood cell size (anisocytosis). Other findings included normal Ret-He and high RDW-CV in 4 cases (13%), low Ret-He and normal RDW-CV in 3 cases (10%), high Ret-He and high RDW-CV in 1 case (3%), and normal Ret-He and normal RDW-CV in 2 cases (7%).

Acknowledgement

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