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Analysis of Complete Blood Count (Cbc) and Erythrocyte Sedimentation Rate (Esr) Results in Multidrug Resistant Tuberculosis (Mdr-Tb) Patients

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ABSTRACT

Tuberculosis (TB) is a contagious infectious disease caused by the bacterium M. tuberculosis. The emergence of drug-resistant strains of Mycobacterium tuberculosis causing MDR-TB is one of the public health problems to date. Globally, it is estimated that there will be 450,000 incident cases of MDR-TB in 2021, up 3.1% from 437,000. The danger of side effects that can arise in tuberculosis patients during MDR-TB treatment is that one of them is a decrease in the number of erythrocytes, the number of leukocytes and platelets. The purpose of this study was to analyze the results of Complete Blood Count (CBC) and ESR in Multidrug Resitant Tuberculosis (MDR-TB) patients at the University Hospital of Muhammadiyah Malang. This study is an observational descriptive study with data sourced from primary data collection. The samples of this study were positive MDR-TB patients from TB-RO clinic of RSU Universitas Muhammadiyah Malang as many as 25 samples, examined in October-November 2023, male and female. The data were analyzed descriptively using tables and graphs. The results of the study averaged more than 50% in the components of hemoglobin, hematocrit, and erythrocyte count decreased. In the platelet count examination component, 32% on average decreased. The average leukocyte count component of 92% tends to be normal. The examination of ESR is not specific for MDR-TB patients, namely the female gender has increased (elongated) while the male gender tends to be normal.

KEYWORDS *CBC, ESR, MDR-TB Patients*

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INTRODUCTION

Tuberculosis (TB) is a contagious chronic infectious disease that is still a public health problem in the world. *M. tuberculosis* can be transmitted when people with BTA positive pulmonary *tuberculosis* speak, sneeze and cough which indirectly releases dopleth nuclei containing *M. tuberculosis* microorganisms and falls to the floor, ground, or other places (Mar'iyah & Zulkarnain, 2021).

The World Health Organization (WHO) reports that Indonesia has the third highest number of tuberculosis cases in the world. The first and second positions are India and China. In 2019, the estimated number of TB cases in Indonesia was 845,000 people. This number increased from the previous 843,000 people (Riyandhi, 2020).

Indonesia is currently ranked second only to India, with 969,000 cases and 93,000 deaths per year, equivalent to 11 deaths per hour. In 2022, the Ministry of Health together with all health workers succeeded in detecting more than 700,000 cases of tuberculosis (TB). This is the highest number since TB became a national priority program (DHO, 2023).

There are new challenges that need attention, one of which is drug-resistant TB. Drug resistance is one of the main threats to the treatment of TB patients. In 2018, a total of 186,772 cases of MDR-TB and rifampicin-resistant TB were diagnosed, and 157,071 patients started treatment worldwide. Approximately 3.4% of new TB patients and 20% of patients with previous TB treatment history were diagnosed with MDR-TB worldwide (Jang & Chung, 2020).

Multidrug Resistant Tuberculosis (MDR-TB) is a type of *tuberculosis* disease caused by *Mycobacterium tuberculosis* bacteria that cannot respond to at least two types of drugs such as Rifampicin and Isoniasid. The danger of side effects that can arise in tuberculosis patients during MDR-TB treatment is that one of them is a decrease in the number of red blood cells (erythrocytes), the number of white blood cells (leukocytes) and blood clots (platelets). Based on previous research that has been conducted, it is stated that the number of leukocytes, platelets and hemoglobin levels in pulmonary TB patients can decrease if the patient follows serious therapy using Anti-Tuberculosis Drugs (OAT) such as Isoniazid and Rifampicin. (Rampa et al, 2020).

There are several examinations for the diagnosis of pulmonary TB infection, namely microscopic sputum examination / BTA, routine blood tests, and blood sedimentation rate *Complete Blood Count* (CBC) or complete blood examination includes hemoglobin, hematocrit, white blood cell count (leukocytes), red blood cell count (erythrocytes) and blood clots (platelets) is an examination to evaluate the presence of infection in a person's health, especially in patients with MDR-TB. (Komariah & Anita K, 2022).

ESR is the speed of erythrocyte *sedimentation* in blood that has not coagulated with units of mm/hour. ESR is a type of examination that is not specific, meaning that ESR can increase in all diseases or in pathology when there is inflammation, degeneration, or tissue necrosis (Artha et al., 2019). ESR is needed because it is a marker of infection and an indicator of the level of stability to assess the response of patients with MDR-TB. (Pratiwi et al., 2019).

RESEARCH METHOD

This research is a quantitative research, the method used in this research is descriptive observational research that will describe a situation through observation. The researcher analyzed the examination of Complete Blood Count (CBC) and ESR on Multidrug Resistant Tuberculosis (MDR-TB) patients at RSU Muhammadiyah Malang. The research design used in the study was a cross sectional approach where primary data collection by researchers was carried out once observation at a certain time.

RESULT AND DISCUSSION

Based on the data of Complete Blood Count (CBC) and ESR in MDR-TB patients with Hematology Analyzer method in RSU Universitas Muhammadiyah Malang as many as 25 patients, the following research results were obtained:

Tabel 1 Percentage of Hematology Test Results in MDR-TB Patients

No.	Inspection Result	Number (n)	Percentage (%)
1	Hemoglobin Level		
	Normal	12	48,0 %
	Low	13	52,0 %
	Increased	-	-
2	Hematocrit Level		
	Normal	7	28,0 %
	Low	18	72,0 %
	Increased	-	-
3	Leukocyte Count		
	Normal	23	92,0 %
	Low	2	8,0 %
	Increased	-	-
4	Erythrocyte Count		
	Normal	9	36,0 %
	Low	16	64,0 %
	Increased	-	-
5	Platelet Count		
	Normal	15	60,0 %
	Low	8	32,0 %
	Increased	2	8,0 %
6	Blood Suction Rate		
	Normal	11	44,0 %
	Increased	14	56,0 %

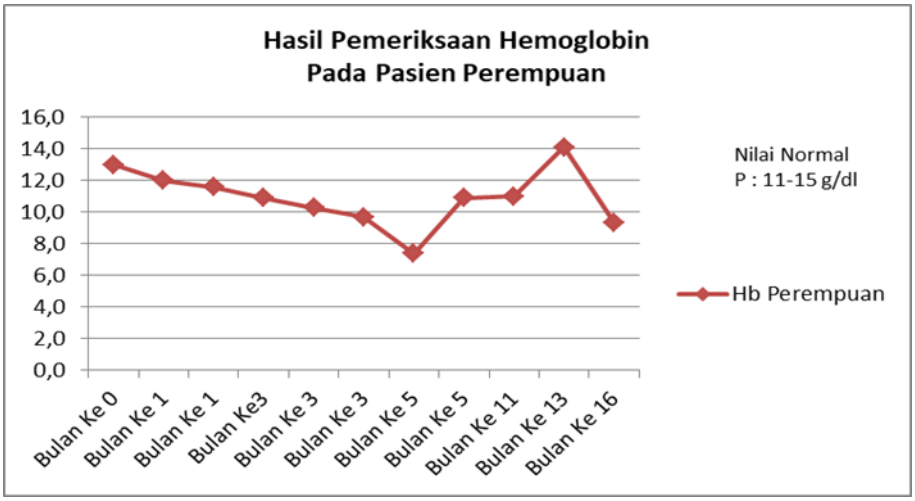

Figure 1. results of hemoglobin examination in female patients

Graph showing the results of hemoglobin examination based on the length of treatment in MDR-TB patients with female gender

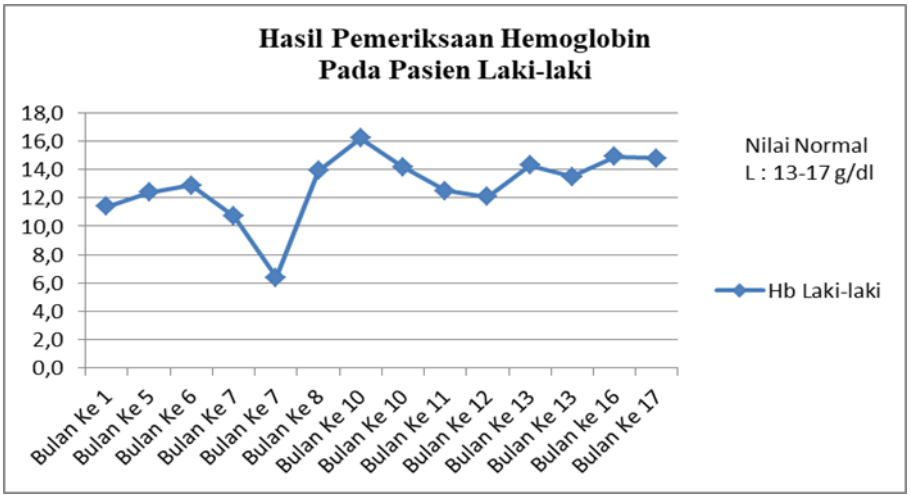

Figure 2. Hemoglobin Test Results in Male Patients

Graph showing the results of hemoglobin examination based on the length of treatment in MDR-TB patients with male gender

Figure 3. Results of Hematocrit Examination in Female Patients

Graph showing the results of hematocrit examination based on the length of treatment in MDR-TB patients with female gender

Figure 4. Results of Hematocrit Examination in Male Patients

Graph showing the results of hematocrit examination based on the length of treatment in MDR-TB patients with male gender

Figure 5. Leukocyte Examination Results in Female Patients

5 Graph showing the results of leukocyte examination based on the length of treatment in MDR-TB patients with female gender

Figure 6. Leukocyte Examination Results in Male Patients

Graph showing the results of leukocyte examination based on the length of treatment in MDR-TB patients with male gender

Figure 7. Results of Erythrocyte Examination in Female Patients

Graph showing the results of erythrocyte examination based on the length of treatment in MDR-TB patients with female gender

Figure 8. Results of Erythrocyte Examination in Male Patients

Graph showing the results of erythrocyte examination based on the length of treatment in MDR-TB patients with male gender

Figure 9. Results of Platelet Examination in Female Patients

Graph showing the results of platelet examination based on the length of treatment in MDR-TB patients with female gender.

Figure 10. Platelet Examination Results in Male Patients

10 Graph showing the results of platelet examination based on the length of treatment in MDR-TB patients with male gender.

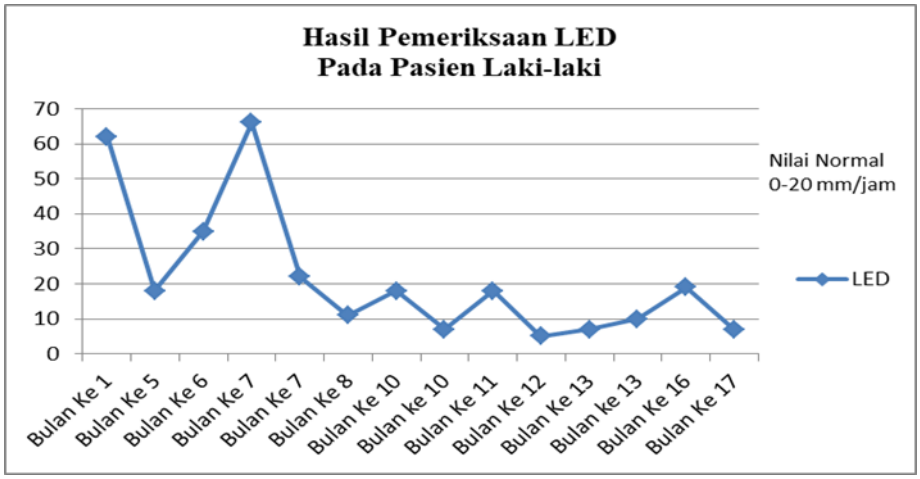

Figure 9. LED Examination Results in Male Patients

12 Graph showing the results of ESRD examination based on the length of treatment in MDR-TB patients with male gender

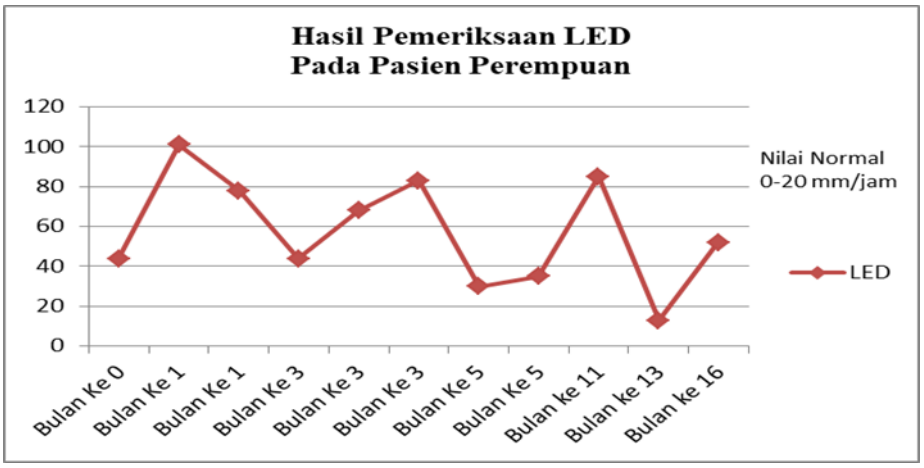

Figure 9. LED Examination Results in Female Patients

11 Graph showing the results of ESRD examination based on the length of treatment in MDR-TB patients with female gender

The results showed that of the 25 samples in Multidrug Resistant tuberculosis (MDR-TB) patients had Complete Blood Count (CBC) results on the components of hemoglobin, hematocrit, erythrocyte count on average more than 50% decreased in months 1 to 8 and will improve after month 8. In the platelet count examination component, 32% decreased in months 6 to 13. In the leukocyte count examination component, the results with an average of 92% tended to be normal during the treatment. In the examination of ESR, an increase of 56% occurred mostly in women during treatment.

Venous blood sampling on respondents was carried out when the respondents carried out treatment control at the General Hospital of Muhammadiyah University

of Malang which was located in a special and open room. At the time of taking venous blood samples, the respondent is informed consent first whether the patient is willing to become a research respondent or not. If the patient is willing to become a research respondent and signs an informed consent, the researcher immediately carries out venous blood sampling with the correct procedure, after obtaining the sample, it is immediately transported to the laboratory for Complete Blood Count (CBC) and LED examination.

In the examination components of hemoglobin, hematocrit, the number of erythrocytes with an average of more than 50% decreased in months 1 to 8 and will improve after month 8, but there is one patient with female gender who has decreased in month 16, this may be caused by other factors that can affect the results. There is a decrease in hemoglobin and hematocrit levels which indicates the prevalence of anemia in MDR-TB patients. This study supports the report of Olaniyi et al (2016) that this study may indicate similar anemia in Multidrug Resistant tuberculosis (MDR-TB) patients. One of the hematological abnormalities that can occur in patients with TB is anemia. This is due to the suppression of the erythropoiesis process by inflammatory mediators. Thus the formation of hemoglobin is inhibited and iron bound as heme increases its level in the blood (Putra, 2018).

The high proportion of Multidrug Resistant tuberculosis (MDR-TB) patients with decreased hemoglobin and hematocrit levels may indicate anemia due to the drugs consumed by patients. This study shows that hematocrit levels were normal as many as 7 samples (28.0%) and 18 samples (72.0%) had decreased hematocrit levels, this is in line with research conducted by Syahriana (2021) of 24 samples, 16 samples (66.7%) had low hematocrit levels and 8 samples (33.3%) had normal hematocrit levels. Low hematocrit levels in patients with pulmonary tuberculosis are one of the side effects of taking anti-tuberculosis drugs. Drugs can cause various hematologic abnormalities that affect red blood cells, white blood cells, and platelets. Drug-induced syndromes include hemolytic anemia, methemoglobinemia, red blood cell aplasia, sideroblastic anemia, megaloblastic anemia, polycythemia and aplastic anemia (Kassa et al., 2016).

The situation of decreasing the number of erythrocytes in patients with pulmonary tuberculosis can be caused by the influence of OAT consumed by patients, linezolid is a drug that can suppress proliferation and cellular metabolite activity and interfere with mitochondrial function. Linezolid can also block mitochondrial protein biosynthesis and reduce ATP production in bone marrow precursor cells. The mechanism underlying linezolid-induced anemia is currently unclear. However, vacuolated pronormoblasts suggest that the mechanism of anemia is identical to that of chloramphenicol-induced myelosuppression. Suppression of mitochondrial respiration through inhibition of mitochondrial protein synthesis is the likely mechanism. Pure red blood cell aplasia has also been reported as one of the mechanisms of linezolid-induced anemia (Oehadian et al., 2022).

The number of platelets of Multidrug Resistant tuberculosis (MDR-TB) patients in this study obtained results as many as 15 samples (60.0%) normal platelet counts, 8 samples (32.0%) low platelet counts and as many as 2 samples (8.0%) increased platelet counts. This is not in line with the results of research conducted by Sari (2022) where out of 30 samples with as many as 20 samples (66.6%) normal

platelet counts, 2 samples (6.7%) with low platelet counts and 8 samples (28.7%) experienced an increase in platelet counts (Sari, 2022).

Thrombocytopenia can occur as a result of severe bacterial infection in Multidrug Resistant tuberculosis (MDR-TB) patients, or because they have taken various drugs for too long during the treatment period undertaken by Multidrug Resistant tuberculosis (MDR-TB) patients. As previously reported, various drugs can cause platelet destruction mediated by the immune system by working as a hapten or participating in the formation of immune complexes that settle on the platelet membrane (Astuti, 2018).

A decrease in platelets can be caused by the effects of medication and immune destruction of platelets. An increased platelet count indicates platelet activation and signaling will cause platelet and monocyte adhesion which triggers macrophage activation (Sitanggang & Sihombing, 2023).

The low leukocyte count is caused by the anti-tuberculosis drug rifampicin. Rifampicin can bind to plasma macromolecular proteins, promote antibody formation, and form antigen antibody complexes. When these complexes are absorbed on leukocytes, they can cause leukocyte lysis and target cell damage, leading to leukopenia. Multidrug Resistant tuberculosis (MDR-TB), where there is resistance to anti-tuberculosis drugs that are no longer sensitive to Mycobacterium tuberculosis bacteria due to gene mutations of Mycobacterium tuberculosis bacteria, so that bacteria can survive and can reduce the body's defense system which results in the body being more easily exposed to Mycobacterium tuberculosis bacteria that cause pulmonary tuberculosis disease (Aprilia, 2017).

Based on the data from the examination of the ESR value, it is in line with the research conducted by Ningrum (2017) who experienced an increase in ESR value of 94.3% or 99 patients out of 105 patients. Research subjects with male gender in the results of ESR examination experienced an increase who underwent treatment ≤ 7 months. This can be caused by an acute phase infection which will trigger an immune response and will activate macrophage cells and increase acute phase proteins which can trigger the formation of reouleux which will affect the mass of red blood cells which will affect the value of ESR (Asmauliyana, 2019).

Protein activation can increase acute phase proteins which cause increased erythrocyte aggregation to form reouleux accompanied by erythrocyte reouleux deposition so that abnormal blood sedimentation rate levels are obtained at the end of the slow deposition phase (Nurmawan et al., 2020). ESR values in patients with Multidrug Resistant Tuberculosis (MDR-TB) with female gender increased during treatment. This can be influenced by the fact that women need more iron in their body and the lack of proper diet during treatment for patients with Multidrug Resistant Tuberculosis (MDR-TB). The ESR rises faster for women than men due to the increase in fibrinogen levels that occurs during pregnancy, diabetes mellitus, and infection. Routine ESR checks can show the progress of whether the disease is healing, such as in rheumatic fever pulmonary TB. ESR is a non-specific reaction from the body, because ESR can increase in all infections (Nirwanto, 2021).

CONCLUSION

Hemoglobin, hematocrit and erythrocyte levels of TB patients decreased after the first to 8th month of treatment, while variations in platelet values showed 32% decreased after the 6th month. Most normal results were obtained in the value of lekocyte results and variations in ESR results were obtained differently based on gender where women experienced a tendency to increase ESR levels compared to men who mostly showed normal results. Hematologic values based on cell blood count (CBC) due to the effect of treatment should be assessed continuously during TB treatment.

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