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An Overview of The Total Leukocyte Count in Pulmonary Tuberculosis Patients At RSUD Gambiran Kediri City

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Abstract. The leukocyte count examination in tuberculosis infection serves to monitor the inflammation caused by *Mycobacterium tuberculosis*. An increasing leukocyte count can lead to complications such as pleuritis. The purpose of this study was to determine the total leukocyte count of pulmonary tuberculosis patients at RSUD Gambiran, Kediri City, based on gender and age. This research was a descriptive retrospective study. Data analysis was conducted using Microsoft Excel and presented in the form of tables and diagrams. The results of this study showed that pulmonary tuberculosis infection was more prevalent in males, with 26 individuals (62%) affected. In terms of age groups, the highest infection rate was in the 21-60 years age range, with 30 individuals (71%) affected. As for leukocyte count elevation (leukocytosis), it was more commonly observed in males with a count of 14.57 μ L. In terms of age groups, leukocytosis was frequently observed in the 21-60 years age range, with a count of 48.66 μ L. Out of the 42 samples, 19 individuals had a normal leukocyte count, while the remaining 23 individuals experienced leukocytosis. From the results of the study, it can be concluded that not all pulmonary tuberculosis patients experience leukocytosis; some patients maintain a normal leukocyte count.

Keywords: Total Leukocyte Count, Pulmonary Tuberculosis, RSUD Gambiran

Abbreviations: Tuberculosis (TB), helper T cells (Th1), interferon-gamma (IFN γ)

Running title: An Overview of The Total Leukocyte Count in Pulmonary Tuberculosis

INTRODUCTION

Tuberculosis (TB) is a chronic and contagious infection caused by *Mycobacterium tuberculosis* (Mutiar, 2020). The transmission of TB bacteria occurs through the air, as it is an airborne disease. It spreads from an infected person to another person through droplets of saliva or mucus when the infected person coughs, sneezes, speaks, or laughs (Mursyaf, 2018). TB is the leading cause of abnormalities in the lungs and extrapulmonary organs and has been one of the deadliest diseases in history compared to other illnesses (Nurkumalasari et al., 2016).

The diagnosis of TB is based on physical examination, bacteriological tests, and hematological examinations (Hasnawati, 2018). Hematological examinations include the examination of red blood cells (erythrocytes), platelets (thrombocytes), total leukocyte count (white blood cells), and the differential count of leukocytes (neutrophils, lymphocytes, monocytes, basophils, and eosinophils) using a hematology analyzer (Sundari, 2017).

When *M. tuberculosis* enters the body, it causes inflammation. This is due to the body's natural response to trauma, allergies, and bacterial infections, leading to the release of proinflammatory cytokines, which is marked by an increase in leukocyte count (leukocytosis) (Bili, 2017). Leukocytes play a role in the body's defense system or immunity against infectious diseases by phagocytosis and antibody production (Niagita, 2019). Leukocyte count tends to increase in patients with pulmonary TB due to inflammation, while a normal leukocyte count indicates that the patient has a good immune system and adequate nutrition to fight TB bacterial infections.

The total leukocyte count examination aims to detect increases or decreases in leukocyte numbers in the blood (Rosita, 2019). Additionally, this examination can help diagnose organ damage caused by bacterial or viral pathogens and provide information about the progression of immune deficiency diseases. In severe cases of pulmonary TB infection, complications may arise if not promptly treated, and one common complication is pleuritis or pleural effusion (Pratiwi, 2018). However, not all patients with pulmonary TB experience leukocytosis.

Based on previous research conducted by Dicky & Ahmad (2019), where 20 patients with pulmonary TB showed increased leukocyte count while 30 patients had a normal leukocyte count, the researchers wanted to investigate and conduct a study with the title "Overview of Total Leukocyte Count in Pulmonary Tuberculosis Patients at RSUD Gambiran Kediri City."

MATERIALS AND METHODS

In this study, a descriptive retrospective method was used. The sampling technique employed was purposive sampling, which included all pulmonary tuberculosis patients at RSUD Gambiran, Kediri City, during the period of January to December 2021, based on inclusion and exclusion criteria. The inclusion criteria were patients with pulmonary tuberculosis who underwent leukocyte count examination at RSUD Gambiran, Kediri City. The exclusion criteria were patients with pulmonary tuberculosis at RSUD Gambiran, Kediri City, who had a history of HIV/AIDS and Diabetes Mellitus. Data were collected as secondary data from the leukocyte count examination results of pulmonary tuberculosis patients at RSUD Gambiran, Kediri City.

The collected data underwent several processing steps. Firstly, the data obtained from the study were carefully reviewed to ensure completeness and accuracy during the editing phase. Subsequently, the meticulously collected data was entered into the Microsoft Excel computer program, enabling efficient data management during the processing phase. To gain valuable insights into the leukocyte profile of pulmonary tuberculosis patients at RSUD Gambiran, Kediri City, a comprehensive data analysis was carried out using Microsoft Excel during the data analysis phase. The results were then visually represented through tables and diagrams for better understanding and interpretation. Throughout this analysis, various aspects were explored, such as the distribution of pulmonary tuberculosis patients based on gender and age groups. Additionally, diagrams were created to showcase the increase in leukocyte count based on gender and age. These visual representations helped to identify the highest and lowest increases in leukocyte count among male and female patients, as well as within specific age groups. Furthermore, the diagrams allowed the determination of whether the leukocyte count fell within the normal range for each age group. By utilizing Microsoft Excel and conducting a comprehensive data analysis, the study successfully provided valuable insights into the leukocyte profile of pulmonary tuberculosis patients, contributing to a better understanding of the disease's manifestation and progression in the specified setting.

RESULTS AND DISCUSSION

Tuberculosis (TB) infection is a chronic infectious disease caused by the bacterium *Mycobacterium tuberculosis*, a rod-shaped acid-fast aerobic bacterium. Based on the research conducted at RSUD Gambiran, Kediri City, there were 42 patients diagnosed with pulmonary tuberculosis.

Table 1. Percentage of Pulmonary Tuberculosis Patients Based on Gender

Gender	Number of Patients	Percentage (%)	Gender
1	Male	26	62%
2	Female	16	38%
Total		42	100%

Table 1 shows the percentage of pulmonary tuberculosis patients based on gender at RSUD Gambiran, Kediri City. Out of 42 patients diagnosed with pulmonary tuberculosis, there were 26 male patients (62%) and 16 female patients (38%). This indicates that pulmonary tuberculosis cases are more prevalent in males compared to females. The difference is largely attributed to the distinct immune systems between males and females. Females have stronger immune systems due to the significant role of the X chromosome and sex hormones in the pathogenesis of infectious diseases. Endogenous hormones and androgens play a pivotal role in antibody production and the immune response, contributing to females' greater resistance against infectious diseases.

On the other hand, testosterone hormone in males can hinder the immune system, making them more vulnerable to infections, including pulmonary tuberculosis. Furthermore, it is essential to understand the distribution of pulmonary tuberculosis patients based on age to determine the age range with a higher incidence of pulmonary tuberculosis cases. This information allows for targeted and effective prevention and management strategies for pulmonary tuberculosis.

Table 2. Percentage of Pulmonary Tuberculosis Patients at RSUD Gambiran, Kediri City, Based on Age Groups

No.	Age Group	Number of Patients	Percentage (%)
1	2- 10 years	2	5%
2	11 - 20 years	1	2%

3	21 - 60 years	30	71%
4	61 + years	9	21%
Total		42	100%

Table 2 shows the percentage of pulmonary tuberculosis patients at RSUD Gambiran, Kediri City, based on different age groups. The data indicates that the highest number of patients with pulmonary tuberculosis falls within the age group of 21-60 years. This can be attributed to the fact that individuals in this age range are in their productive years, and they are more exposed to various factors that can lead to infections. According to the research conducted by Gita & Mardina (2019), some factors contributing to pulmonary tuberculosis infections include exposure to vehicle emissions, cigarette smoke, and dust containing *M. tuberculosis*.

On the other hand, in the age group of children, the factors causing tuberculosis infection in children, as mentioned by Rizky et al. (2020), are related to the immature immune system at a young age, leading to a lower ability to eradicate pathogens causing infections. Additionally, as stated by Wijaya et al. (2021), malnutrition, especially in the form of severe malnutrition, can increase children's vulnerability to diseases and cause secondary immunodeficiency.

Next, the distribution of pulmonary tuberculosis patients who experienced an increase in leukocyte count based on gender was analyzed. The objective was to determine the average increase in leukocyte count based on gender. Below is the diagram illustrating the increase in leukocyte count based on gender in patients with pulmonary tuberculosis at RSUD Gambiran, Kediri City.

Discussion

Male patients experienced a higher increase in leukocyte count compared to females, with an average of 14.57 μ L. Leukocytosis indicates the severity of a disease, especially in infectious diseases. According to Ruggieri (2016), this section presents the obtained results briefly and may be supported by illustrations such as tables, graphs, or qualitative descriptions. The discussion emphasizes the cause-and-effect relationship, the connection between theory and results, and similar previous research. Leukocytosis can be influenced by several factors, including the innate immune system in both males and females, which is related to sex hormones and genetic contributions from chromosomes. Hormones and chromosomes in females lead to different responses to bacteria, viruses, and parasites, resulting in a lower risk of infection and a tendency for leukocyte counts to remain within the normal range compared to males. After determining the average increase in leukocyte count based on gender, the next step was to determine the average increase in leukocyte count based on age groups of pulmonary tuberculosis patients. The purpose of this was to identify the age range where patients experienced leukocytosis. Below is the diagram illustrating the leukocyte count increase based on age in patients with pulmonary tuberculosis at RSUD Gambiran, Kediri City, as shown in the table below.

The increase in leukocyte count in the 21-60 years age group can be attributed to the fact that this age range represents the productive years of individuals, where they engage in learning, working, and striving for personal and communal achievements. These activities require significant energy expenditure, and inadequate rest can lead to a weakened immune system and susceptibility to diseases (Nurjana, 2015). Additionally, individuals in this age group often experience stress due to their work and daily physical activities, which can trigger pathological and physiological changes. Glucocorticoids released during stress suppress the immune response and block helper T cells (Th1) that produce interferon-gamma (IFN γ), which is crucial for activating immunoglobulins. A decrease in immunoglobulins leads to a weakened immune system and a higher risk of infection (Setyarsih, 2020). Furthermore, the distribution of pulmonary tuberculosis patients with leukocytosis was analyzed based on age groups, including children, adolescents, adults, and the elderly at RSUD Gambiran, Kediri City. The purpose was to determine the number of individuals experiencing leukocytosis within each age group.

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CONCLUSIONS

Based on the research conducted on pulmonary tuberculosis patients at RSUD Gambiran, Kediri City, it was found that males were more affected by tuberculosis compared to females, accounting for 62% (26 individuals) of the total cases. Additionally, there was an increase in cases within the age group of 21-60 years, which constituted 71% of the total cases. Leukocytosis, indicated by an increase in leukocyte count, was predominantly observed in male patients, with an average increase of $14.57 \mu\text{L}$ compared to females. Moreover, within the age group of 21-60 years, there was a significant leukocytosis with an average increase of $48.66 \mu\text{L}$. However, it is noteworthy that not all pulmonary tuberculosis patients experienced leukocytosis. Out of the 42 sampled patients, 19 individuals had normal leukocyte counts, while the remaining 23 individuals showed leukocytosis. Based on the research findings, the author recommends adding variables to the leukocyte profile before and after treatment to compare changes in leukocyte count over time. This suggestion is aimed at enriching the research by considering more variables since the current study only focused on a single variable. Additionally, extending the research period is advised to gather more comprehensive data.

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AUTHORS' CONTRIBUTIONS

¹ Devi Nor Fitri designed the study. Lisa Savitri analyzed the data. Rochmad Krissanjaya and Elfred Rinaldo Kasimo wrote the manuscript. All authors read and approved the final version of the article.

COMPETING INTERESTS

The authors declare that there are no competing interests.

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