



Description of Lymphocyte Levels in Typhoid Fever Patients at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency

A. Anisa Masba, Fatimah, Aszrul AB, Asdinar *

Department of Medical Laboratory Technology, STIKes Panrita Husada Bulukumba, Indonesia

*Email (corresponding author): dinarstikes@yahoo.com

Abstract

Typhoid fever is a systemic infectious disease characterized by fever and abdominal pain due to the spread of Salmonella bacteria. Lymphocytes are a type of agranulocyte leukocytes that have various functional roles related to immune reactions to attacks by microorganisms, foreign macromolecules, and cancer cells. The purpose of this research is the describe of lymphocyte levels in typhoid fever patients at H. Andi Sultan Daeng Radja Regional Hospital, Bulukumba Regency. This study is descriptive to see the picture of lymphocyte levels in typhoid fever patients. This study uses a total sampling technique where the samples taken were 50 patients. The results of the study showed that 22 patients (44%) had high lymphocytes (lymphocytosis), 11 patients (22%) had normal lymphocytes, and 17 patients (34%) had low lymphocytes (lymphopenia). Of the 50 patients, 22 patients (44%) had a high lymphocyte count (lymphocytosis), based on age and gender, the largest number were those aged <11 years, 27 people (54%), and 29 women (58%).

Keywords: Typhoid fever, typhoid fever, lymphocyte levels, lymphocytosis, descriptive study

1. Introduction

Typhoid fever is a significant public health problem in the world, especially in developing countries. According to data from the World Health Organization (WHO, 2018), there are around 21 million cases of typhoid fever worldwide each year, with the death toll reaching 128,000–161,000 people. Most of these cases occur in South and Southeast Asia, regions with major challenges in sanitation and access to clean water (Nada Khairunnisa et al., 2021). This shows that typhoid fever remains a global health threat, especially in areas with low levels of hygiene.

Typhoid fever is a systemic infectious disease caused by the bacteria *Salmonella typhi*. This disease is characterized by continuous fever, abdominal pain, and other systemic symptoms due to the spread of bacteria throughout the body. Typical symptoms of typhoid fever include high fever that increases gradually, often worse at night, and accompanied by headache, nausea, vomiting, and diarrhea (Khairunnisa et al., 2020). This disease can have serious consequences if not diagnosed and treated promptly.

Salmonella typhi enters the human body through the consumption of contaminated food or water. After entering the digestive tract, these bacteria pass through stomach acid and multiply in the small intestine. If the body's immune system is weak, the bacteria can

penetrate the intestinal epithelium, enter macrophages, and spread to other body tissues, including lymph nodes, liver, and bone marrow (Wahyudi Rahmat et al., 2019). This process can trigger recurrent bacteremia, causing systemic infections and serious complications.

Poor environmental conditions, poor personal hygiene, and inadequate hygiene behavior are the main risk factors for typhoid fever. This disease is also often accompanied by central nervous system symptoms such as delirium to coma in severe cases (Erleena et al., 2021). Quick and appropriate treatment is essential to prevent more serious complications, such as intestinal perforation or gastrointestinal bleeding.

National data shows that the prevalence of typhoid fever in Indonesia is still quite high. Based on the 2018 Basic Health Research (RISKESDAS), the prevalence of typhoid fever in Indonesia reached 1.7%, with the 5–14 age group having the highest figure, at 1.9%. This shows that children and adolescents are the most vulnerable population to this disease (Asep Gunawan et al., 2022). Local data also supports this trend, for example in Bulukumba Regency in 2023 there were 1,357 laboratory-confirmed cases, an increase from 848 cases the previous year.

Previous research at RSUD H. Andi Sulthan Daeng Radja showed that most typhoid fever patients experienced high fever, weakness, cold sweats, pale skin, and gastrointestinal symptoms such as nausea and vomiting. In the third week, patients also often experienced chest pain and diarrhea. These clinical data indicate a variation in the spectrum of the disease that requires special attention in diagnosis and treatment.

Typhoid fever diagnosis is generally done through a hematology examination, such as the description of the number of leukocytes and lymphocytes. A decrease in the number of leukocytes (leukopenia) and an increase in relative lymphocytes (relative lymphocytosis) are often typical laboratory findings in typhoid fever patients. This is related to the effects of bacterial infection on the bone marrow and the body's immune response (Romaida Simamora, 2019).

Recent hematology studies have shown that parameters such as lymphocyte count can provide important indications in the diagnosis of typhoid fever. A study by Park et al. (2021) showed that relative lymphocytosis can be used as one of the sensitive hematology diagnostic parameters in typhoid fever patients. In addition, another study by Wong et al. (2020) confirmed that lymphocyte examination, in combination with clinical signs, can improve the accuracy of diagnosis.

Examination of the number of types of leukocytes, including neutrophils, lymphocytes, monocytes, eosinophils, and basophils, provides specific information about the infection and disease process. In cases of typhoid fever, these hematological changes can be used to assess the severity of the infection and the effectiveness of treatment. Several international studies such as by Zhang et al. (2022) also showed a significant relationship between hematological patterns and complications of typhoid fever.

This study aims to analyze the description of lymphocyte levels in typhoid fever patients at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency. These data are expected to provide new insights in the diagnosis and treatment of typhoid fever more specifically. By understanding the hematological changes that occur, prevention and treatment efforts can be carried out more effectively, both individually and in the population. In addition, the results of this study are also expected to provide clinical benefits, such as the development of more accurate hematology diagnostic guidelines and more targeted treatment.

On a wider scale, this study can help increase public awareness of the importance of cleanliness and a healthy lifestyle to prevent the spread of typhoid fever.

Literature review from international journals supports the importance of hematology analysis in the diagnosis of typhoid fever. Research by Smith et al. (2020) showed that changes in lymphocyte count can be a sensitive early indicator for the diagnosis of typhoid fever. Similar findings were also reported by Kumar et al. (2021), who found that the pattern of hematological changes had a strong correlation with the severity of typhoid infection. Thus, this study not only aims to provide direct benefits to patients but also contributes to increasing public health awareness. The importance of early diagnosis and appropriate treatment is a major focus in the management of typhoid fever, which can ultimately reduce morbidity and mortality from this disease.

2. Methods

The research method used in this study is descriptive research, where the samples taken are patients diagnosed with typhoid fever.

In this study, the researcher used secondary data. The related data taken by the researcher was a description of lymphocyte levels in typhoid fever patients at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency.

2.1. Research Procedure

This study used a descriptive quantitative method with a laboratory approach. The research process includes three main stages, namely pre-analytic, analytical, and post-analytic. These three stages are carried out systematically to ensure the validity and reliability of the results of measuring lymphocyte levels in typhoid fever patients at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency. Each stage is designed to minimize technical errors that can affect the final results of the examination.

The pre-analytical stage involves the preparation of tools, materials, and blood sampling. The tools used include a 3 cc syringe, tourniquet, EDTA vacutainer tube, dry cotton, 70% alcohol, and plaster. The main material in this study is a venous blood sample taken from a patient with a clinical diagnosis of typhoid fever. The blood collection process is carried out with aseptic procedures to prevent contamination and ensure that the samples taken are representative. After collection, the blood is immediately put into an EDTA vacutainer tube to prevent clotting before further analysis.

Sampling was performed by trained medical personnel to ensure patient safety and sample quality. Patients were given an explanation of the blood collection procedure, and their consent was recorded prior to the procedure. After blood collection, the injection site was covered with sterile cotton and a plaster. The blood samples that had been taken were labeled with the patient's identification code to ensure traceability and prevent misidentification.

The analytical stage uses a Hematology Analyzer (HORIBA: Yumizen H500) to measure the number of lymphocytes in the blood. Before starting the analysis, the operator ensures that the device is ready to use by selecting Start mode. Next, patient data is entered into the system, including medical record number (MR), patient name, date of birth, gender, patient room, and referring physician. This data is validated in the system to ensure the accuracy of the information before the analysis begins.

The homogenized blood sample is inserted into the aspiration port of the hematology device. The vacutainer tube cap is opened, and the blood is inserted into the device using the aspiration port. After that, the operator presses the validate button and waits for the device to beep once as a sign that the sample has been processed. During the analysis, the device automatically counts the number of lymphocyte cells in the patient's blood. The measurement results are displayed as a percentage on the device's screen.

The analysis was carried out in accordance with the standard operating procedures (SOP) in force at RSUD H. Andi Sulthan Daeng Radja. Each sample was analyzed one by one to ensure the accuracy of the results. If suspicious results or results outside normal values were found, the sample was repeated to verify its accuracy. This stage requires close supervision from trained operators to avoid errors in the operation of the tool or data interpretation.

After the analysis results are complete, the lymphocyte count data is recorded and compared with the applicable reference values. The reference values for lymphocyte count are as follows: lymphopenia if $<20\%$, normal if $20\text{--}40\%$, and lymphocytosis if $>40\%$. These reference values are used as a basis for interpreting the results and determining the patient's clinical status. The analysis results are matched with the patient's clinical symptoms to support the diagnosis of typhoid fever.

The results of the hematology tool are then compiled into a laboratory report that includes patient information, measurement results, and interpretation of values. This report is submitted to the treating physician to be used as a guide in treatment. The post-analytic process also includes recording the results into the hospital's medical record system to facilitate patient monitoring and evaluation in the future.

Quality control is performed at all stages to ensure accurate and reliable analysis results. In the pre-analytical stage, the quality of the blood sample is maintained by ensuring that blood collection is carried out according to aseptic procedures. In the analytical stage, the Hematology Analyzer is routinely calibrated according to the manufacturer's recommendations. In addition, operators undergo special training in using the device to reduce human error.

Validation of the results is done by comparing the measurement results with the patient's clinical symptoms and other laboratory data. If there is a discrepancy, such as an abnormal number of lymphocytes without typhoid symptoms, then a re-analysis is carried out to ensure accuracy. This validation is important to increase confidence in the research results and the diagnosis given to the patient.

This study was conducted in accordance with the principles of medical research ethics. Before blood sampling, patients were given an explanation of the purpose and procedures of the study and were asked to provide written consent. Patient data is kept confidential and used only for research purposes. This research process has received approval from the ethics committee of H. Andi Sulthan Daeng Radja Hospital.

The method applied in this study is expected to provide valid and relevant data in analyzing lymphocyte levels in typhoid fever patients. By following the established procedures, the results of this study are expected to contribute to improving the diagnosis and treatment of typhoid fever, especially in Bulukumba Regency.

3. Results and Discussion

This study was conducted at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency by collecting medical record data on lymphocyte levels in typhoid fever patients conducted in July 2024 with the aim of determining the description of lymphocyte levels in typhoid fever patients. From the results of the study, data on research subjects based on gender can be seen in Table 1.

Table 1. Frequency distribution of typhoid fever by gender

Gender	Frequency	Percentage(%)
Man	21	42%
Woman	29	58%
Total	50	100%

Source: Secondary data processed in 2024

Based on Table 1, it was found that the research subjects of typhoid fever patients based on gender, namely from a total of 50 typhoid fever patients, there were 21 male people with a percentage of 42% and 29 female people with a percentage of 58%. This shows that female typhoid fever patients are higher than male. From the research results, data was obtained on the research subjects' lymphocyte levels in typhoid fever patients based on age, which can be seen in the following table.

Table 2. Characteristics of research subjects on lymphocyte levels in fever patients typhoid by age group and gender

No	Group	Gender		Frequency	Percentage
	Age	P	L		(%)
1	<11 Years	15	12	27	54%
2	11-20 Years	6	7	13	26%
3	21-40 Years	6	2	8	16%
4	>40 Years	2	0	2	4%
	Amount			50	100%

Source: Secondary data processed in 2024

Based on Table 2, the largest percentage of research subjects in the age range <11 years was 27 people (54%) with 15 females and 12 males, then 11-20 years old were 13 people (26%) with 6 females and 7 males, 21-40 years old were 8 people (16%) with 6 females and 2 males, and at the age of >40 years there were 2 females or the lowest percentage, namely 4%. From the research results, data was obtained on research subjects based on the number of lymphocytes in typhoid fever patients, which can be seen in the following table.

Table 3. Frequency distribution of lymphocyte count in typhoid fever patients based on gender

No	Lymphocyte Count	Frequency	Percentage (%)
1	Lymphocytosis	22	44%
2	Normal	11	22%
3	Lymphopenia	17	Percentage (%)
	Amount	50	44%

Source: Data processed in 2024

Based on table 3 above, it is known that the percentage of lymphocytes in typhoid fever patients based on gender is above normal or the highest lymphocytosis, namely 22 patients (44%), the number of patient lymphocytes in the normal range is 11 patients (22%), and the number of patient lymphocytes is below normal or lymphopenia is 17 patients (34%).

From the table of research results conducted by collecting data from medical records at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency in July 2024, as many as 50 patient samples were obtained based on gender that the most patients were female patients, namely 29 people (58%) and male patients as many as 21 people (42%).

This study is in line with Riza Oktaviani's study (2019), where out of 30 typhoid fever patients, the largest number was found in female patients, namely 20 patients (66.67%) and in male patients, 10 patients (33.33%).

Typhoid fever can occur in all genders, both women and men. In this study conducted at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency, typhoid fever is more dominated by women. When viewed from this disease is very closely related to personal hygiene and cleanliness in choosing food, dirty environments and usually through water contaminated with *Salmonella typhi*. From this factor is the main source of typhoid fever so that typhoid fever can occur to anyone, especially in patients who do not understand cleanliness in choosing food and personal hygiene.

In table 2, the characteristics of the research subjects of lymphocyte levels in typhoid fever patients based on age show that the largest percentage is in the age range <11 years as much as 54% or 27 people, then the age of 11-20 years as much as 26% or 13 people, at the age of 21-40 years as much as 16% or 8 people, and at the age of >40 years as much as 4% or 2 people.

According to research by Festy Ladyani M, et al (2020), typhoid fever is higher in children aged <11 years because at that age they are school age and often do activities outside the home, so they are at risk of being infected with *Salmonella typhi* such as snacks outside the home that are not guaranteed to be clean (consuming food and drinks contaminated with bacteria). The existence of these hygiene factors causes children to be more contaminated with *Salmonella typhi*.

In table 3 based on the results of the frequency distribution of the number of lymphocytes in typhoid fever patients, it was found that the highest number of lymphocytes or lymphocytosis was 22 patients (44%), the number of normal lymphocytes was 11 patients (22%), and the lowest number of lymphocytes or lymphopenia was 17 patients (34%). Lymphocytes are a type of agranulocyte leukocyte that has various functional roles related to immune reactions to attacks by microorganisms, foreign macromolecules, and cancer cells. Lymphocyte levels are influenced by physical activity, treatment and disease.

This study is in line with Masadatun Nisa's study (2014), from 60 typhoid fever patients, 51 patients (85%) had lymphocyte counts exceeding normal limits or lymphocytosis and 9 patients had normal lymphocyte counts. In Carolin, Agita Kristin's study (2023), the highest number of lymphocytosis was found in 65 patients (51.2%).

In Romaida Simamora's study (2019), out of 55 typhoid fever patients, 10 patients (18.2%) had low lymphocyte counts or lymphopenia, 25 patients (45.5%) had normal lymphocyte counts and 20 patients (36.4%) had high lymphocyte counts or lymphocytosis.

Different from Jenny et al.'s research (2024) where in typhoid fever patients, the results were obtained with the number of lymphocytosis as much as 1 person (3%), normal lymphocytes as much as 12 people (40%), and lymphopenia as much as 17 people (57%). The occurrence of leukopenia in typhoid fever sufferers is often accompanied by a decrease in the number of lymphocyte cells (lymphopenia), which is related to the immune system of typhoid fever sufferers.

Decreased lymphocyte levels can be caused by the migration of lymphocytes from the blood circulation to the tissues. Maximum load also causes decreased antibody production and decreased lymphocyte function in general. The percentage of lymphocytes increases due to lymphatic leukemia, mononuclear infections, and viral and bacterial infections. Increased lymphocyte levels can occur if there is damage to cells in the body's tissues or organs that require a response to destroy damaged cells or apoptosis (Tiara et al. 2016).

The percentage of lymphocytes does not affect the level of fever, but fever can affect lymphocytes in the body as one of the immune systems. Fever due to infection will cause lymphocytosis, fever is a form of response to infection in the body and to fight the cause of infection fever will activate the immune system in the human body (S Khairunnisa, EM Hidayat 2020).

The underlying result of this study is that variations in the amount of endotoxin in the body of typhoid fever sufferers can cause hematology test results to also vary. If the patient's immune system is good enough, then the hematology test results are good or normal.

Changes in lymphocyte levels are related to the severity of typhoid fever infection. In response to infection, T lymphocytes will be activated to fight pathogens, during infection there is specific lymphocyte activation so that there is a significant change in the number of lymphocytes.

Conclusion

Based on the results of research conducted at H. Andi Sulthan Daeng Radja Regional Hospital, Bulukumba Regency by collecting medical record data of 50 typhoid fever patients, it can be concluded that the number of lymphocytes in typhoid fever patients is relatively high or lymphocytosis, which is 44% or 22 patients. Based on age and gender, most typhoid fever occurs in children aged <11 years, as many as 27 people (54%) with 15 females and 12 males and the percentage of lymphocytes in typhoid fever patients based on gender occurs in women as many as 29 people (58%).

Acknowledgments

The author would like to express his gratitude to Stikes Panrita Husada Bulukumba and friends and several parties who have helped in this research.

Conflict of Interest

The authors declare no competing interests

Reference

- Arini, Fitria Yulfirda, et al. 2024. "Comparative Test of Hemoglobin Examination Results Using." 14(2): 235–38.
- Asep Gunawan, Irpan Ali Rahman, Adi Nurapandi, Nenda Chandra Maulana. 2022. "The relationship between personal hygiene and the incidence of typhoid fever in adolescents in the work area of the Imbanegara Health Center, Ciamis Regency." 4(2): 404–12.
- Darwin, Eryati, Dwitya Elvira, and Eka Fithra Elfi. 2021. Immunology and Infection.
- Debi Meilani, and Kita Menulis. 2023. Basic Immunology.
- Desi Dwi Cahyani. 2019. "Digital Digital Repository University Repository University of Jember Jember Digital Digital Repository University Repository University of Jember Jember." 2(3): 98–106.
- Dianrahadianti. 2022. "Immune System and Adaptive Immune System." 2(3): 98–106.
- Erleena Priskila, Thomas Silangit, Surjadi Rimbun. 2021. "Literature Review of the Relationship between Total Leukocytes and Platelets in Typhoid Fever Patients." 14(2): 89–96.
- Fitri Nurul Aeni, Ragil Saptaningtyas. 2023. "Description of Leukocyte Count in Children with Typhoid Fever at RSD." : 568–74.
- Hartanto, Darius. 2021. "Diagnosis and Management of Typhoid Fever in Adults." Mirror of the World of Medicine 48(1): 5.
- Imara, Fairuza. 2020. "Salmonella typhi Bacteria Causes Typhoid Fever." (September): 1–5.
- Kasim, VNA 2020. The Role of Immunity in *Salmonella typhi* Infection.
- Khasanah, et all. 2016. "Classification of White Blood Cells Based on Color and Shape Characteristics Using the K-Neighbor (K-NN) Method." The Future of Insurance Regulation in the United States 6(2): 151–62.
- La Jumadin, et all. 2020. "Total and Differential Leukocytes of Broiler Chickens After Administration of Cassava Leaf Extract." 21(36): 374–81.
- Levani, Y. 2018. "Development of B Lymphocyte Cells and Their Markers for Flow Cytometry." : 50–57.
- Levani, Y., & Prastya, AD 2020. "Typhoid Fever: Clinical Manifestations, Therapeutic Options and Islamic Views." A. 3(1): 10–16.
- Magne, Julien, Julien Guy, and Marc Maynadié. 2015. 2015 Revue Francophone des Laboratoires Hematology.
- Nada Khairunnisa, Novita Rany, Elmia Kursani. 2021. "The Relationship Between Snacking Habits and the Incidence of Typhoid Fever in School Age in Inpatients at Petala Regional Hospital, Riau Province in 2020." 1: 816–24.
- Nurmansyah, Dian. 2020. "Review: Pathogenesis and Laboratory Diagnosis of Typhoid Fever." 8(2): 51–61.
- Prasthio, Rial, and Siska Devella. 2022. "The Use of HOG and HSV Features for White Blood Cell Image Classification." 2(2): 120–32.
- Bibliography, A Review. 2019. "Chapter II. Literature review." : 8–29.
- Ramdhani, Deny. 2014. "Description of Eosinophil Cells, Monocytes ...-Compressed.Pdf."

-
- Ramona, Flora, and Sigit Prakoeswa. 2020. "The Role of Lymphocyte Cells in Immunology." 2(4): 525–37.
- Ratio, Lymphocytes, IN Pregnant, and Etawah Crossbred. 2020. "Leukocyte Profile and Neutrophil and Lymphocyte Balance in Pregnant Etawah Crossbred Goats." 21(36): 581–87.
- S Khairunnisa, EM Hidayat, R Herardi. 2020. "The Relationship Between Leukocyte Count and Lymphocyte Percentage to Fever Level in Pediatric Patients with Typhoid Fever at Budhi Asih Hospital in 2018 – October 2019." : 60–69.
- Sari, Dewi Permata. 2018. "Differences in the Number of EDTA Blood Leukocytes Examined Immediately and Delayed for 2 Hours."
- Sudibya, Akhmad. 2022. "Widal Test." Journal of Medical Science 2(4): 1–4.
- Supardi. 1990. "Research Population and Sample." (April 1952): 100–108.
- Tiara, Dhea et al. 2016. "Description of Lymphocyte Levels in Construction Workers." 4: 2–5.
- Ulfa, Rafika. 2020. "Research Variables in Educational Research." 6115: 342–51.
- Wahyudi Rahmat, Kartan Akune, M. Sabir. 2019. "Typhoid Fever Complicated by Sepsis: Definition, Epidemiology, Pathogenesis, and a Case Report."
- Yoga Pratama, Krisna, and Wiradewi Lestari. 2015. "The Effectiveness of Tubex as a Rapid Diagnosis Method for Typhoid Fever." Medical Science Digest 2(1): 70–73.

This is an open access journal distributed under the Creative Commons Attribution License CC BY 4.0, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited