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# THE EFFECT OF CHEMOTHERAPY ON BLOOD CELL COUNTS IN POST-MASTECTOMY BREAST CANCER PATIENTS

**Article History**

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**Keywords**
Blood Cell, Breast Cancer, Chemotherapy

**Abstract**

**Background:** Post-mastectomy chemotherapy often causes myelosuppression, as do the numbers of erythrocytes, leukocytes, and platelets.

**Objective:** To determine the effect of chemotherapy on the number of blood cells in post-mastectomy breast cancer patients.

**Methods:** This study was a retrospective observational study. The population in the study was breast cancer patients who underwent chemotherapy 0 to 4 times after mastectomy at the NTB Provincial Hospital from January to December 2024. Sampling was done using non-probability sampling with a purposive sampling method, resulting in 68 samples.

**Results:** In the study, the average number of erythrocytes from session 0 to session 4 was 4,23; 3,80; 3,67; 3,59, and 3.6 million cells/µL. Then, the average number of leukocytes from session 0 to session 4 was 7.208, 5.024, 4.739, 3.690, and 3,281. Meanwhile, the average number of platelets from session 0 to session 4 was 386.251; 302.792; 275.760; 228.014, and 206.035. Based on the Friedman test data analysis, the results showed a significance value of 0.000 < 0.05.

**Conclusions:** There is an effect of chemotherapy on the number of blood cells in post-mastectomy breast cancer patients.

**Cite this Article**

## INTRODUCTION

Cancer is a term used to describe the uncontrolled and malignant growth of new tissue or cells (1). Breast cancer is one of the most common types of cancer in women worldwide. According to data from the World Health Organization (WHO) in 2020, it showed that around 2.3 million women were diagnosed with breast cancer, with a global death toll reaching 685,000. In Indonesia, breast cancer is one of the leading causes of death from cancer, after lung cancer. According to data from the Global Burden of Cancer (GLOBOCAN) in 2020, breast cancer cases in Indonesia were recorded at 68,858 cases or around 16.6% of the total 396,914 cancer cases. Meanwhile, the overall death toll from cancer reached 234,511 people. In the province of West Nusa Tenggara, based on data from the NTB Provincial Hospital in 2023, breast cancer ranks first out of the 10 most common diseases, with a total of 3,738 patients. Of that number, 126 people died from breast cancer. In addition, based on these data, breast cancer cases have increased by 336 cases from 2022, which was 3,402 cases with 89 deaths. This often involves delays in diagnosis and treatment, which causes the disease to be found at an advanced stage, reducing the chances of recovery (2).

Breast cancer patients have hope for recovery, so they breast cancer patients need to undergo recommended treatment. These treatments include chemotherapy, radiotherapy, hormonal therapy, and mastectomy. Mastectomy is a procedure to remove all or part of the breast tissue. Mastectomy is one of the treatment methods that is often recommended, due to the effectiveness of mastectomy in inhibiting the development of cancer cells because it directly removes cancerous tissue, thereby reducing the risk of cancer spread, and the chance of a cure rate can reach 85%-87% (3).

Besides mastectomy, chemotherapy is a treatment method that is widely used in breast cancer treatment. Chemotherapy is a therapy that uses special drugs in the treatment of tumors and cancer. Post-mastectomy chemotherapy aims to reduce the risk of cancer recurrence by destroying the remaining cancer cells. In cancer treatment, chemotherapy is done in cycles determined by the severity and chemotherapy regimen, with patients usually receiving 4-8 cycles or a series of chemotherapy. Early cycles (1 or 2) of chemotherapy may not give a complete picture of the cumulative effects of chemotherapy. In contrast, late cycles (5 and above) tend to be more influenced by chronic toxic effects. Thus, the 4th cycle is often the evaluation point to assess the effectiveness of ongoing chemotherapy regimens. At this point, changes in clinical response can be observed, thus helping in determining whether therapy should be continued, modified or discontinued (4).

One side effect that often occurs due to chemotherapy is myelosuppression, which is the suppression of the bone marrow that can cause blood cell production to be disrupted. This happens because chemotherapy drugs are toxic to organs that produce blood, such as the bone marrow. Chemotherapy works by stopping or slowing down the

growth of rapidly growing cancer cells. However, because the drugs cannot distinguish between cancer cells and rapidly increasing normal cells, cells such as blood cells, hair cells, and the digestive tract can also be affected (5).

In this study, although previous studies have discussed the comparison of pre- and post-chemotherapy hematological profiles, previous studies focused on the general population of cancer patients without considering the specific conditions of post-mastectomy patients, and only compared one cycle of chemotherapy. Thus, this study aims to explore in depth the effect of chemotherapy on blood cell counts in post-mastectomy breast cancer patients, so that it can provide significant efforts to manage therapy and plan further therapy more effectively.

## MATERIALS AND METHODS

This research is a retrospective observation study, namely by tracing the data on the results of examining the number of blood cells, including the number of erythrocytes, leukocytes, and platelets, in breast cancer patients who underwent chemotherapy 0 to 4 times after mastectomy in 2024.

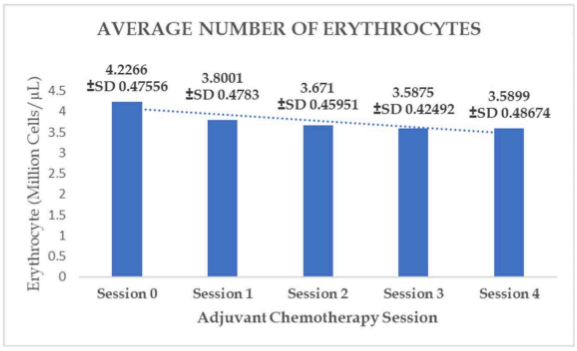
The sampling technique used was non-probability sampling with the purposive sampling method. The inclusion criteria in the study included breast cancer patients who underwent mastectomy at the NTB Provincial Hospital, breast cancer patients who underwent four chemotherapy sessions after mastectomy, had complete identity data and hematology examination results during four chemotherapy sessions (0, 1, 2, 3, 4), and breast cancer patients aged 30-65 years. The sample exclusion criteria were cancer patients with other comorbidities affecting cell production and patients taking other drugs that could affect blood cell counts.

Data analysis for the normality test was performed with the Kolmogorov-Smirnov test. A repeated measures ANOVA test was performed if the results were normally distributed. Conversely, the Friedman test was a non-parametric alternative if the data were not normally distributed.

## RESULTS AND DISCUSSIONS

This study was conducted from January 1, 2025, to March 31, 2025, at the Surgical Oncology Clinic of the NTB Provincial Hospital. The total population of breast cancer patients in 2024 was 4958 patients, and 68 samples were selected based on the criteria in the study.

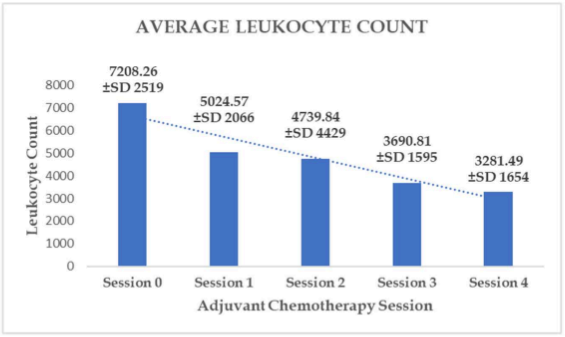
The average number of erythrocytes, leukocytes, and platelets in 68 patients in each chemotherapy session after undergoing mastectomy (adjuvant chemotherapy) can be seen in the following graphs.




**Graph 1**. Average Erythrocyte Count of Breast Cancer Patients

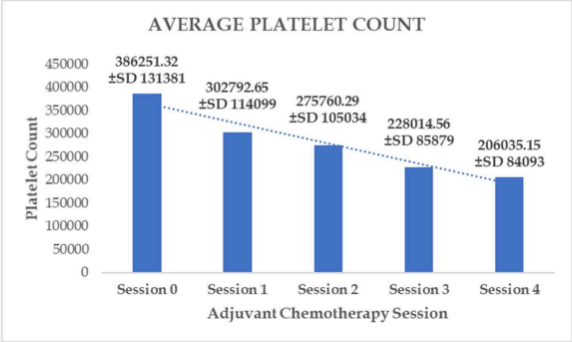
Based on the graph above (Graph 1), the average erythrocyte count decreased as the chemotherapy sessions increased, especially from session 0 to session 3. Although there was a slight increase in session 4, the erythrocyte count did not return to the initial value. The relatively stable standard deviation (ranging from 0.42 to 0.48) indicates that the variation in erythrocyte counts between patients is not too significant, so this downward trend can be considered consistent.

The average number of erythrocytes, leukocytes, and platelets in 68 patients in each chemotherapy session after undergoing mastectomy (adjuvant chemotherapy) can be seen in the following graphs.




**Graph 2**. Average Leukocyte Count of Breast Cancer Patients

Based on the graph above (Graph 2), the average leukocyte count showed a significant decrease from the initial to the final chemotherapy session. The standard deviation from sessions 0 to 4 ranged from 1,595 to 4,429, indicating a significant patient variation.




**Graph 3**. Average Platelet Count of Breast Cancer Patients

Based on the graph above (Graph 3), the average platelet count of patients experienced a consistent decrease during the four chemotherapy sessions. The highest reduction in the average platelet count occurred from session 0 to session 1, which was 83,458. This decrease was quite significant compared to the other sessions. The standard deviation from session 0 to session 4 ranged from 84,093 to 131,381, which showed that the variation of platelet count was quite significant. In addition, the graph also shows that although platelets have decreased, they are still within the range of expected values. Based on data analysis using the Friedman test on the three groups of data, namely the number of erythrocytes, leukocytes, and platelets, the significance value obtained is a P value of 0.000 < 0.05, so it can be stated that there is a significant difference in the three groups of data, namely the number of erythrocytes, leukocytes, and platelets in each chemotherapy cycle. Thus, chemotherapy has a significant effect on the number of blood cells in post-mastectomy breast cancer patients.

A decrease in blood cell count during the chemotherapy stage is a common phenomenon caused by several factors. The reduction in the number of blood cells in 68 subjects was shown by the change in the average number of blood cells from session 0 to session 4. The decrease in erythrocytes, leukocytes, and platelets in chemotherapy patients manifests as myelosuppression (5). Kaur et al.'s (6) research stated that the more

often chemotherapy is given, the more cancer cells are damaged and die. However, this effect also affects healthy cells in the body. The anthracycline group of drugs used in chemotherapy has a mechanism of action as an antiproliferative agent due to its ability to prevent microtubule depolymerization of tubulin. This inhibits the cell division process, ultimately leading to a decrease in the number of blood cells (7). Meanwhile, the taxane class also functions as an inhibitor of cell proliferation by suppressing the depolymerization of tubulin microtubules so that the cell division process can stop (8). In addition, in cancer management, more aggressive chemotherapy regimens also play a role in reducing blood cell counts, such as AC or CAF (Cyclophosphamide, Adriamycin, 5-fluorouracil) regimens, which are more likely to cause a decrease in the number of erythrocytes, leukocytes, and platelets (9).

The decrease in the number of blood cells in chemotherapy patients is significant, especially in erythrocytes, essential in carrying oxygen throughout the body. A decrease in the number of erythrocytes can cause anemia, which is characterized by a decrease in hemoglobin levels. Research by Raza et al. (10) and Aynalem et al. (11) found that hemoglobin concentration decreased significantly after chemotherapy cycles in breast cancer patients. In addition, a decrease in leukocyte count, or leukopenia, also occurs in chemotherapy patients. Variations in leukocyte counts in each chemotherapy cycle reflect the body's response to the cytotoxic effects of chemotherapy drugs (8). Pullakanam et al.'s (12) research reported that the number of neutrophils and lymphocytes decreased significantly during chemotherapy in breast cancer patients. This decrease can lead to neutropenia, which increases the risk of severe infection in patients. Chemotherapy involving anthracyclines such as doxorubicin and epirubicin, as well as alkylating agents such as cyclophosphamide, is more at risk of causing severe neutropenia, which is dangerous for patients as it increases their susceptibility to infection (13).

Meanwhile, although there was a decrease in platelets, this decrease was still within normal limits and did not indicate a significant risk of bleeding in the patient. The patient's clinical condition can influence variations in platelet counts at each session. Early in the cycle, thrombocytosis (high counts) may still occur as the body's response to inflammation or systemic stress due to cancer. However, as time passes, the toxic effects of chemotherapy dominate, so the platelet count decreases. Low platelet counts in breast cancer are mostly related to cancer cells, causing frequent activation of the coagulation system, which can manifest as thrombocytopenia (14).

Although a significant decrease in blood cell counts occurred from session 0 to session 4 in most patients, some patients still showed normal blood cell counts at the 4th session of chemotherapy. Some factors that could account for this are individual genetic variability that affects the body's ability to compensate for the effects of myelosuppression and maintain a normal blood cell count despite chemotherapy. These genetic factors, including variants that influence the capacity of the bone marrow to

produce blood cells, play an essential role in an individual's response to chemotherapy (15).

In addition, some patients still have above-normal blood cell counts by the 4th session of chemotherapy, such as platelets. An increase in platelet count, or thrombocytosis, can occur in response to anemia or wider body inflammation. Sometimes, the body tries to compensate for the decrease in red blood cells by increasing platelet production, a compensation mechanism for red blood cell loss (16). In addition to changes in blood cells during chemotherapy, at session 0, or before chemotherapy begins, some patients already show lower blood cell counts, especially in erythrocytes and leukocytes. This decrease can be due to several factors, including the cancer itself, which can affect blood cell counts by invading the bone marrow or through the secretion of cytokines that inhibit hematopoiesis. Breast cancer that has spread to the bone marrow can directly interfere with the body's ability to produce blood cells efficiently (17).

## CLINICAL IMPLICATION

Based on the results of the study, the gradual and consistent decrease in the three types of blood cells, namely eritrocytes, leukocytes, and platelets, indicates that chemotherapy, although effective in suppressing the growth of cancer cells, also has a toxic effect on the bone marrow as the center of blood cell production. Thus, this study provides the basis for a more personalized and evidence-based management strategy for breast cancer patients that accommodates the physiological differences between patients in response to chemotherapy. In addition, regular monitoring of hematological parameters is essential throughout therapy, as well as supportive strategies such as administration of hematopoietic growth factors or adjustments to chemotherapy regimens to minimize the negative impact on the patient's hematological condition.

## LIMITATIONS

Data collection was done retrospectively from medical records. It did not consider other factors such as nutritional status, comorbidities, and type of chemotherapy regimen, all of which may affect the validity and generalizability of the study results. This study also did not differentiate the type of chemotherapy drugs used by each patient, which may allow each regimen to have different myelosuppressive potential.

## CONCLUSIONS

Based on the results of research that has been conducted on the number of erythrocytes, leukocytes, and platelets in 68 breast cancer patients who underwent post-mastectomy chemotherapy in five observation sessions, it can be concluded that

chemotherapy has a significant effect on reducing the number of blood cells (erythrocytes, leukocytes, and platelets) in post-mastectomy breast cancer patients.

## CONFLICT OF INTEREST

The authors declare that there were no conflicts of interest during this research process that could affect the results and objectivity of the research. All stages of the study, from planning, data collection, analysis, to report preparation, were carried out independently without any influence from outside parties, either financially, academically, or personally. This research was prepared solely for scientific purposes and the development of knowledge in medical laboratory technology.

## AUTOR CONTRIBUTIONS

The first author played a full role in designing the research, conducting data collection and analysis, and preparing the final report. The second author provided scientific guidance and methodological direction throughout the research process. The third author was a supervisor, providing input to improve the research design and data analysis. The fourth author objectively evaluated the results and overall content of this scientific work.

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