

Evaluation of Hematological Parameters Pre and Post Chemotherapy in Breast Cancer patients at the National Cancer Institute in Sudan at Khartoum state, Sudan

Abstract:

Introduction: Breast cancer is the most common malignancy among women worldwide, including in Sudan. Chemotherapy, a primary treatment modality, often results in hematological toxicity, impacting patients' overall health and treatment efficacy. This study aims to evaluate the changes in hematological parameters in breast cancer patients before and after chemotherapy in the Sudanese population.

Materials and methods: A case control study was conducted at the National Cancer Institute in Sudan at Khartoum state, Sudan. During the period of June 2022 to December 2022. A total of one hundred (N=100) female breast cancer patients scheduled for chemotherapy were enrolled. 50 sample before initiation chemotherapy, and fifty (50) samples after first cycle of chemotherapy from same patients. And fifty (50) samples from the healthy individuals as control group. Venous blood was obtained, then CBC determined using hematology analyzer (Sysmex: XP-300). Hematological parameters, including Red blood cell count (RBC), white blood cell (WBC) count, and platelet count, and differential counts, were measured before the initiation of chemotherapy and after the completion of the first cycle. Data were analyzed using paired t-tests to determine the significance of changes in these parameters.

Results: Significant reductions were observed in RBC levels (mean pre-chemotherapy: 3.8 ± 1.1 g/dL, mean post-chemotherapy: 2.1 ± 1.1 ; $p < 0.001$) and WBC counts (mean pre-chemotherapy: $13.9 \pm 1.9 \times 10^3/\mu\text{L}$, mean post-chemotherapy: $4.1 \pm 1.9 \times 10^3/\mu\text{L}$; $p < 0.001$). Platelet counts also decreased significantly (mean pre-chemotherapy: $661.8 \pm 128.5 \times 10^3/\mu\text{L}$, mean post-chemotherapy: $182.4 \pm 125.5 \times 10^3/\mu\text{L}$; $p < 0.01$). Breast cancer patients before initiation the first cycle of chemotherapy show significant low in RBCs count (3.8 ± 1.1) when compared with control group (4.8 ± 0.4) ($p = 0.000$). Also, significant high in WBCS count (13.9 ± 1.9) when compared with control group (5.9 ± 1.3) ($p = 0.000$) and high PLTs count (661.8 ± 128.5) when compared with control group (262.7 ± 73.4) ($p = 0.000$). And decrease in three parameters (pancytopenia) RBCs, WBCS, and PLTs count (2.7 ± 0.7) (4.1 ± 2.3) (182.4 ± 102.4) respectively when compared with control group (4.8 ± 0.4) (5.9 ± 1.3) (262.7 ± 73.4) ($p = 0.000$) to all, when start the first cycle of chemotherapy.

Conclusion: Chemotherapy in breast cancer patients leads to significant hematological changes, predominantly anemia, leukopenia, and thrombocytopenia. These findings underscore the need for close monitoring of hematological parameters during chemotherapy to manage potential toxicities and optimize treatment outcomes for breast cancer patients in Sudan.

Keywords: Breast cancer, chemotherapy, hematological parameters, anemia, leukopenia, thrombocytopenia, Sudan.

1 Introduction:

Out of all cancers, breast cancer is the second most frequent type, affecting 500,000 people each worldwide each year [1]. Men also are affected, but in small rate, make up less than 1% compared with women [2]. In 2022 approximately 287.850 cases were diagnosed, and the mortality rate reached 43.250 cases [3]. Breast cancer mortality and morbidity burden in African countries is higher compared to western countries due to late diagnosis, thus, are more likely to die from it [4]. So, in Sudan, breast cancer ranks fifteenth among the leading cause of death, so the mortality rate in Sudan reached 9.077 according to WHO data published in 2022 [5]. The complete blood count is a prerequisite investigation for breast cancer patients before and during uses any treatment [6]. Chemotherapy and other breast cancer therapies typically result in the body's malignant cells being destroyed. Nevertheless, some normal cells are also sensitive to chemotherapy and get damage in the process. That is mean chemotherapy interfere with blood cells production and can affect the bone marrow's ability to make blood cells. So, blood counts must be checked before each cycle of chemotherapy [7]. CBC test measures the levels of the three basic blood cells: red blood cells, white blood cells, and platelets. Chemotherapy medications can significantly reduce the levels of blood cells. This reduction increases the risk of infection, fatigue and bleeding [7].

This study aims to evaluate the changes in hematological parameters before and after chemotherapy in breast cancer patients among the Sudanese population. By identifying the specific hematological alterations induced by chemotherapy, health care providers can better manage treatment-related toxicities and improve the quality of care for breast cancer patients in Sudan.

2 Materials and Methods:

2-1 study design and setting

This was a case control study designed to evaluate hematological parameters pre and post-chemotherapy in breast cancer patients among Sudanese patients attending Khartoum oncology Hospital -Sudan.

2-2 participants

The study participants were 100 Sudanese women divided to test groups which was consisted of 50 women before initiation chemotherapy, and 50 samples after first cycle of chemotherapy from same participant, and 50 women were control group.

2-3 Data collection

Blood samples were collected before starting chemotherapy and after completing the treatment regimen. Venous blood was obtained; each patient had 1.5 ml of blood drawn from them. Blood

samples were collected aseptically into tubes containing the anticoagulant tri-potassium ethylene diamine tetra acetic acid. The blood sample was well mixed by gently inverting the tubes several times, then CBC determined using hematology analyzer (Sysmex: XP-300).The automated analysis was carried out in accordance with the manufacturer's operational instructions The following parameters were evaluated, RBCs count, WBCs count, and Platelet count.

2-4 statistical analysis

The collected data was analyzed by Statistical package for Social Science (SPSS) version 12 Statistical Software was used for statistical analysis.

3 Results

Table 1. a significant reduction in three parameters (pancytopenia) in RBCs, WBCS, and PLTs count (2.7 ± 0.7) (4.1 ± 2.3) (182.4 ± 102.4) respectively when compared with control group (4.8 ± 0.4) (5.9 ± 1.3) (262.7 ± 73.4) ($p = 0.000$) to all, when start the first cycle of chemotherapy.

Breast cancer patients before initiation of the first cycle of chemotherapy showed a significant reduction in RBCs count (3.8 ± 1.1) compared with control group (4.8 ± 0.4) ($p = 0.000$). Also, a significant increases in WBCS count (13.9 ± 1.9) when compared with control group (5.9 ± 1.3) ($p = 0.000$), and a significant increases in PLTs count (661.8 ± 128.5) when compared with control group (262.7 ± 73.4) ($p = 0.000$)

Table 2 showed a significant reduction in RBCs count, WBCs count, and PLTs count Post-chemotherapy (2.7 ± 0.7) (4.1 ± 2.3) (182.4 ± 102.4) when compared with Pre- chemotherapy (3.8 ± 1.1), (13.9 ± 1.9) and (661.8 ± 128.5), ($p = 0.000$), respectively, as seen in **Figure 1** and **Figure 2. Table 3.**

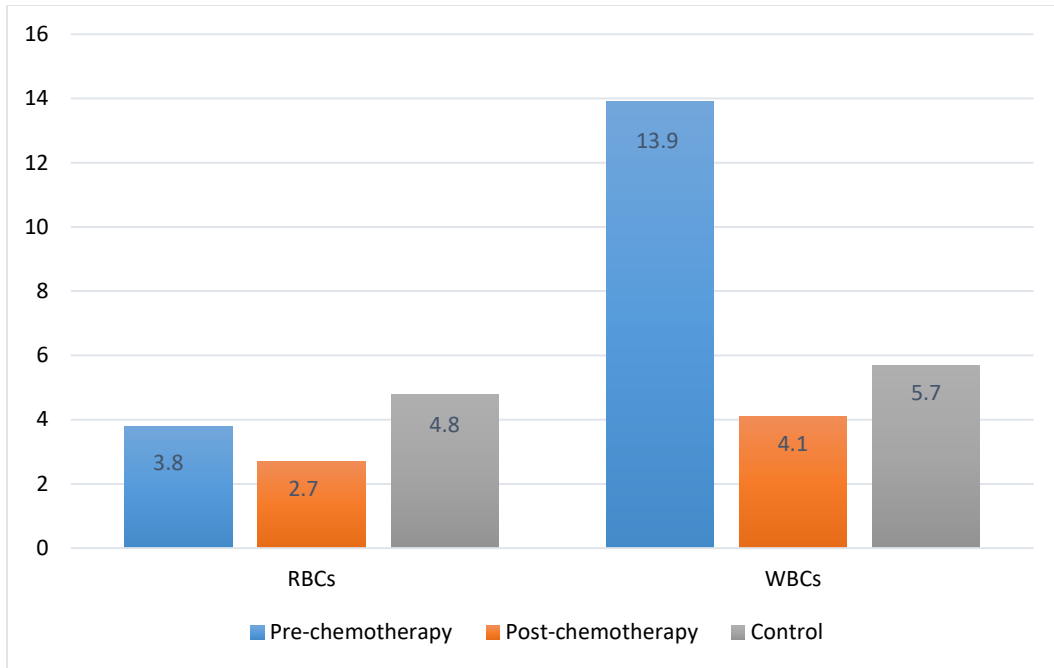


Figure 1: Mean of RBCs, WBCs in Pre-chemotherapy, Post-chemotherapy and control.

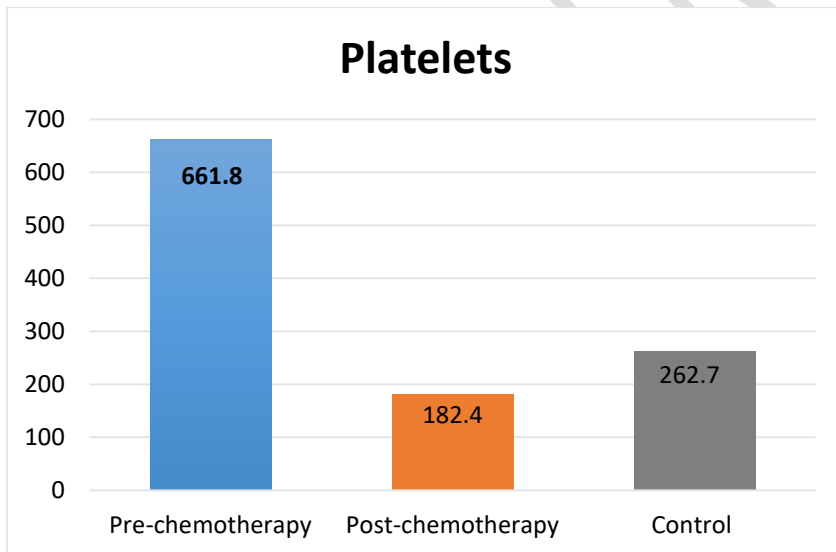


Figure 2: Mean of platelets in Pre-chemotherapy, Post-chemotherapy and control.

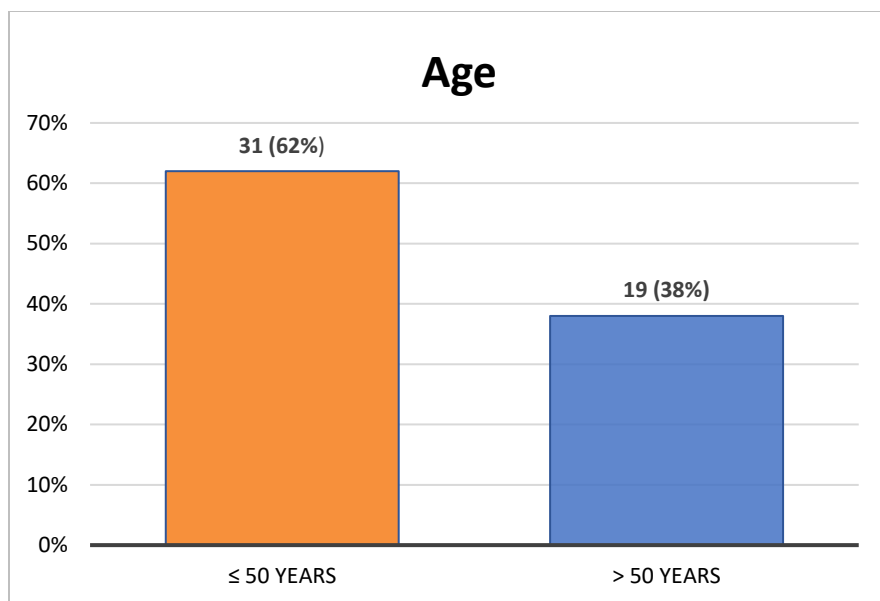


Figure 3: Distribution of age of breast cancer patients.

Table 1: Shows comparison of RBCs, WBCs and platelets between pre-chemotherapy and control.

Parameters	Pre-chemotherapy (n=50)	Control (n=50)	P. value
RBCs	3.8 ± 1.1	4.8 ± 0.4	0.000*
WBCs	13.9 ± 1.9	5.9 ± 1.3	0.000*
Platelets	661.8 ± 128.5	262.7 ± 73.4	0.000*

Table 2: Shows comparison of RBCs, WBCs and platelets between post-chemotherapy and control

Parameters	Post-chemotherapy (n=50)	Control (n=50)	P. value
RBCs	2.7 ± 0.7	4.8 ± 0.4	0.000*
WBCs	4.1 ± 2.3	5.9 ± 1.3	0.000*
Platelets	182.4 ± 102.4	262.7 ± 73.4	0.000*

Table 3 Shows comparison of RBCs, WBCs and platelets between post-chemotherapy and **Pre-chemotherapy**

Parameters	Post-chemotherapy (n=50)	Pre-chemotherapy (n=50)	P. value
RBCs	2.7 ± 0.7	3.8 ± 1.1	0.000*
WBCs	4.1 ± 2.3	13.9 ± 1.9	0.000*
Platelets	182.4 ± 102.4	661.8 ± 128.5	0.000*

4 Discussions

Chemotherapy is a common treatment for breast cancer, aimed at reducing tumor size or eliminating cancer cells. However, chemotherapy drugs often have a significant impact on hematological parameters, which can result in various complications [13]. This discussion will explore the changes observed in hematological parameters pre- and post-chemotherapy in breast cancer patients within the Sudanese population, highlighting the implications for patient management and treatment outcomes.

The current study demonstrated before initiation the first cycle of chemotherapy decreased in RBCs count, increased in WBCs and PLTs count. And after initiation the first cycle of chemotherapy showed decreased in the three parameters (pancytopenia). This study agrees with another study that was conducted by Preeti C, et al. on a two-hundred breast cancer patients came to hospital in India for prognostic significant of peripheral blood. The mean age of breast cancer patients was (47-49) years old. The study showed reduced in RBCs count, and increased WBCs, PLTs count before start the chemotherapy, and three parameters fall after take chemotherapy [8]. Another discovery that the hematological parameters were affected by breast cancer disease and treatment like chemotherapy was reported by Melak A in Gonder town. A study of 267 patients with breast cancer, who were hospitalized in Gonder hospital during September 2017 to August 2021, revealed that RBCs, WBCs and platelets were significantly reduce after initiation of chemotherapy. While reduce in RBCs, increase in WBCs and platelets count before chemotherapy [10]. Akinsegun Akinbami, et al. concluded that a Breast cancer patients presented with deranged full blood count pattern, consequent to the disease compared with the controls [11]. The hemoglobin concentration, red blood cell (RBC) count, and lymphocyte count, were reduced in the breast carcinoma when compared to a control, Manigatta, et al. concluded that a hemoglobin, RBCs, and WBCs are hematological indicators which predict the severity and mortality of breast carcinoma [12].

5 Study limitations

The study limitations include its focus on women from Khartoum state, potentially limiting its generalizability across Sudan .and in Khartoum state included only patients attended Khartoum

Oncology hospital-Sudan during the study period. Other hospitals and private clinics in Khartoum state are not included. Additionally, the sample size is small.

6 Conclusions:

The evaluation of hematological parameters pre- and post-chemotherapy in breast cancer patients among the Sudanese population can yield important conclusions related to the impact of chemotherapy on these patients' health. Here are some potential conclusions based on typical findings in such studies:

- A significant drop in RBC count levels can be observed, indicating chemotherapy-induced anemia.
- There is usually a marked reduction in WBC count, leading to leukopenia and increased risk of infections.
- A decrease in platelet count (thrombocytopenia) can also be seen, heightening the risk of bleeding complications.
- The need for supportive treatments such as erythropoiesis-stimulating agents, granulocyte colony-stimulating factors, and platelet transfusions may be highlighted to manage these adverse effects.

7 Recommendations

- Emphasizing the importance of regular monitoring of hematological parameters before, during, and after chemotherapy to promptly identify and manage adverse effects.
- Suggesting the need for tailored interventions based on individual patient profiles to mitigate hematological toxicity and improve quality of life.
- Recombinant erythropoietin should be used alongside chemotherapy to manage anemia in breast cancer patients.
- Active breast cancer awareness campaign should be carried out on the need for early diagnosis.
- More studies should be done to investigate the other pattern of other hematological parameters in breast cancer disease.

Ethical approval: Ethical approval was obtained from the Federal Ministry of Health Ethical Research committee (Khartoum state), and the agreement was taken from Hayat university College and Khartoum Oncology Hospital-Sudan.

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Details of the AI usage are given below:

- 1.
- 2.
- 3.

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