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The Role of Intravenous Iron in The Management of Iron Deficiency Anemia and The Extent of The Immune Function of White Blood Cells (Leaukocytes) Before and After Treatment among Breast Cancer Patients

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دور الحديد الوريدي في إدارة فقر الدم الناجم عن نقص الحديد وتطور الخلايا المناعية (خلايا الدم البيضاء) لدى مرضى سرطان الثدي قبل وبعد العلاج

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Abstract:
This study is to assess the effectiveness of a focused therapy protocol in enhancing hematological parameters, such as Hemoglobin (Hb), Platelet Count, White Blood Cell (WBC) count, Red Blood Cell (RBC) count, and Iron levels, in cancer patients with IDA. Involved the enrollment of 100 cancer patients who had been diagnosed with confirmed IDA. The levels of Hb, Platelet Count, WBC count, RBC count, and Iron levels were measured and studied before and after treatment. The therapeutic approach consisted of personalized iron supplementation and anti-inflammatory medication. Statistical studies were conducted to evaluate the significance of alterations in these parameters after therapy. There were notable increases in Hb levels (from 9.5 g/dL to 12.2 g/dL, $p = 0.03$), Platelet Count (from 94.69 x 10^9/L to 111.59 x 10^9/L, $p = 0.04$), and Iron levels (from 39.37 µg/dL to 54.93 µg/dL, $p = 0.02$) after therapy. The white blood cell (WBC) count shown a substantial decrease (from 16.30 x 10^9/L to 11.80 x 10^9/L, $p = 0.002$), suggesting a reduction in inflammation. While the rise in RBC count did not reach statistical significance ($p = 0.13$), a favorable trend was seen. The focused treatment plan successfully enhanced important blood-related measurements in cancer patients with IDA, highlighting its ability to improve patient outcomes and overall well-being. For the best management of IDA in cancer patients, it is recommended to regularly screen for the condition and create personalized treatment programs.

Keywords: Iron deficiency anemia, Cancer, Hemoglobin, Platelet Count, White Blood Cell count, Red Blood Cell count, Iron levels, treatment effectiveness.

الملخص
تهدف هذه الدراسة إلى تقييم فعالية بروتوكول علاج مركز في تحسين المعايير الدموية، مثل الهيموغلوبين*(Hb)* ، وعدد الصفائح الدموية، وعدد كريات الدم البيضاء*(WBC)* ، وعدد كريات الدم الحمراء*(RBC)* ، ومستويات الحديد، لدى مرضى السرطان المصابين بفقر الدم الناجم عن نقص الحديد *(IDA).* شملت الدراسة تسجيل 100 مريض بالسرطان تم

تشخيصهم بفقر الدم الناجم عن نقص الحديد المؤكد. تم قياس ودراسة مستويات *Hb* وعدد الصفائح الدموية وعدد كريات الدم البيضاء وعدد كريات الدم الحمراء ومستويات الحديد قبل العلاج وبعده. تضمن النهج العلاجي مكملات الحديد المخصصة والأدوية المضادة للالتهاب. تم إجراء الدراسات الإحصائية لتقييم أهمية التغيرات في هذه المعايير بعد العلاج. لوحظت زيادات ملحوظة في مستويات الهيموغلوبين) من 9.5 غم/دل إلى 12.2 غم/دل، *(p = 0.03*، وعدد الصفائح الدموية) من 94.69 × 10^9/ل إلى 111.59 × 10^9/ل، *(p = 0.04*، ومستويات الحديد) من 39.37 ميكروغرام/دل إلى 54.93 ميكروغرام/دل، *(p = 0.02*بعد العلاج. وأظهر تعداد خلايا الدم البيضاء *(WBC)* انخفاضًا كبيرًا) من 16.30 × 10^9/ل إلى 11.80 × 10^9/ل، *(p = 0.002*، مما يشير إلى تقليل الالتهاب. بينما لم يصل ارتفاع تعداد كريات الدم الحمراء إلى دلالة إحصائية*(p = 0.13)* ، لوحظ اتجاه إيجابي. نجح برنامج العلاج المركز في تعزيز القياسات المهمة المتعلقة بالدم لدى مرضى السرطان المصابين بفقر الدم الناجم عن نقص الحديد، مما يبرز قدرته على تحسين نتائج المرضى ورفاههم العام. ولأفضل إدارة لفقر الدم الناجم عن نقص الحديد لدى مرضى السرطان، يُوصى بإجراء فحوصات منتظمة للحالة ووضع برامج علاجية مخصصة.

الكلمات المفتاحية: فقر الدم الناجم عن نقص الحديد، سرطان الثدي، الهيموغلوبين، عدد الصفائح الدموية، عدد خلايا الدم البيضاء، عدد خلايا الدم الحمراء، مستويات الحديد، فعالية العلاج.

Introduction

Breast cancer-related iron deficiency anemia (IDA) is a significant concern among breast cancer patients and can have substantial implications for their overall health and treatment outcomes. Iron deficiency anemia occurs when there is an insufficient amount of iron to support the body's needs, leading to decreased red blood cell production and subsequent anemia. In breast cancer patients, IDA can exacerbate cancer-related symptoms, increase fatigue, and compromise treatment effectiveness.

The prevalence of IDA in breast cancer patients varies, but studies have shown that it can affect a significant proportion of individuals. For example, Abali et al found that approximately 30% of breast cancer patients had IDA at the time of diagnosis. The presence of IDA was associated with advanced tumor stage, lymph node involvement, and larger tumor size, indicating a potential correlation between disease severity and iron deficiency [1].

The management of breast cancer-related IDA involves addressing the underlying iron deficiency and correcting the anemia. Intravenous (IV) iron therapy has emerged as a valuable treatment option for breast cancer patients with IDA due to its effectiveness and tolerability. IV iron therapy bypasses the gastrointestinal absorption issues associated with oral iron supplementation, allowing for faster and more efficient iron repletion.

Studies have demonstrated the specific role of IV iron therapy in managing breast cancer-related IDA. Henry et al conducted a randomized trial comparing IV iron therapy (ferric carboxymaltose) to standard medical care in breast cancer patients receiving chemotherapy [2]. The study showed that IV iron therapy effectively corrected iron deficiency and improved hemoglobin levels in patients with IDA. Additionally, patients who received IV iron reported reduced fatigue levels and improved quality of life compared to those receiving standard care [2].

Furthermore, Reinisch et al. investigated the impact of IV iron therapy on treatment outcomes in breast cancer patients with IDA undergoing adjuvant chemotherapy. The study found that patients who received IV iron had higher rates of treatment completion and fewer treatment delays or dose reductions compared to those who did not receive IV iron [3]. The IV iron group also exhibited better overall survival and disease-free survival rates, suggesting that IV iron therapy may enhance treatment tolerance and improve long-term outcomes.

Objectives of study:

1. Compare the development of iron deficiency during breast cancer treatment.
2. Measurement deficiency levels during the pre- and post-treatment stages.
3. Evaluation blood components during treatment periods and upon infection.

Researching questions:

1. Does iron deficiency anemia have a global effect on breast cancer?
2. Is anemia after treatment considered a major cause of iron deficiency?

Literature Review:

Recent studies have reported a correlation between iron and the development of cancer. However, there is still debate on whether this association is stronger in cases of iron deficiency or iron overload. An imbalance in iron levels can potentially contribute to all stages of cancer development, including the start, microenvironment, and metastasis. Significantly, a substantial body of research has confirmed that approximately 40% of cancer patients experience anemia at the time of their cancer diagnosis. Despite the unexpectedly high percentage, it may be attributed to the common link between anemia and chronic disease or bone marrow involvement. Hence, the possibility of iron deficiency playing a role in the development of tumors cannot be ruled out [4].

Research Design:

This study utilizes a prospective cohort design to examine the occurrence and treatment of IDA in individuals with breast cancer. The study aims to monitor the iron levels, complete blood count (CBC), and relevant clinical indicators of 100 breast cancer patients receiving therapy at the National Cancer Institute in Misrata.

Study Population:

The study cohort comprises female breast cancer patients, aged 18 to 54 years, who are currently undergoing treatment at the National Cancer Institute in Misrata.

Study Setting:

The study was conducted at the National Cancer Institute in Misrata, a leading facility for cancer treatment and research in the region.

Study Period:

The study duration starting in January 1, 2023, to December 31, 2023. This timeframe provided sufficient time to monitor any alterations in iron levels and other hematological parameters during the therapy period.

Sample Size:

The trial enrolled a cohort of 100 female patients diagnosed with breast cancer. The determination of this sample size was based on the prevalence rates of IDA in breast cancer patients and the requirement for sufficient statistical power to identify significant variations in iron levels and treatment results. The sample size was determined by the Documentation and Statistics Center within the National Institute for Oncology in Misrata.

Inclusion Criteria

- Female patients diagnosed with breast cancer.
- Aged between 18 and 54 years.

Exclusion Criteria

- Patients with pre-existing hematological disorders unrelated to breast cancer.
- Patients receiving iron supplementation or transfusions prior to the study.
- Pregnant or lactating women.
- Patients with chronic kidney disease or other severe comorbidities that might affect iron metabolism.

Sampling Technique:

Participants were chosen by a convenience sampling method, where eligible patients who visit the National Cancer Institute throughout the study period were asked to take part.

Study Tool:

Data were gathered via a standardized checklist that encompasses demographic details, medical background, CBC, and serum iron levels. The checklist guaranteed the uniformity and thoroughness of data collection.

Content Validity:

The checklist's content validity was validated by conducting an expert evaluation. Oncologists, hematologists, and research professionals assessed the checklist to guarantee that it inclusively encompasses all pertinent facets of IDA in breast cancer patients.

Experimental Study:

Participants were classified into two groups, pre and post treated. Both groups were closely observed for any alterations in CBC, and serum iron levels, during their treatment.

Reliability of the Checklist:

The reliability of the checklist was evaluated by conducting a pilot study with a sample size of 10%. The data collected was assessed for consistency using measures of test-retest reliability and inter-rater reliability.

Data Collection:

Data Collection Interventions

- **Baseline Data Collection:** At the initiation of the study, baseline demographic and clinical data were collected.
- **Follow-Up Assessments:** CBC and serum iron levels were measured at different intervals.

Demographic Data Collection:

Demographic data including age were collected using patient interviews and medical records.

Data Collection Protocol:

- CBC and Serum Iron Measurement: **Blood samples were collected from participants at baseline and during follow-up visits to measure hemoglobin, platlet, RBCs, WBCs, and serum iron.**

Variables and Data Entry and Analysis:

- **Independent Variables:** Age.
- **Dependent Variables:** CBC parameters, serum iron levels.
- **Data Entry:** Data were entered into a secure database using unique identifiers for each participant.
- **Data Analysis:** Statistical analysis was performed using SPSS software. Descriptive statistics summarized the demographic and clinical characteristics. Inferential statistics, including t-tests and chi-square tests, compared differences between groups. Multivariate regression analysis identified predictors of IDA and clinical outcomes. The Chi square test was used to compare the frequency of categorical variables. Binary logistic regression was performed to compute unadjusted and adjusted odds ratios (OR) and 95% confidence interval (95% CI) to describe the association between study variables.

This methodology outlines a comprehensive approach to investigating the prevalence and management of iron deficiency anemia in breast cancer patients, providing a robust framework for collecting and analyzing relevant data.

Results:

Patient Demographics

Table 1 displays the age distribution of the participants in the study. The mean age of the participants was 34.75 years, with a standard deviation of 9.12 years, suggesting a reasonably large variation in ages among the individuals. The P value for the age distribution was 0.21.

Table 1. The Age of The Participants.

	Participants (n = 100)	**P value**
Age (years)	34.75± 9.12	0.21

Clinical outcomes

Table 2 presents a comparison of the Hemoglobin (Hb) levels in subjects prior to and during treatment. The pretreatment group had an average Hemoglobin level of 9.5 g/dL, with a standard deviation of 0.84 g/dL. This suggests that the individuals had consistently low Hemoglobin levels. Conversely, the group that received post-treatment had a noteworthy rise in Hemoglobin levels, averaging at 12.2 g/dL with a standard deviation of 2.9 g/dL. The comparison yielded a P value of 0.03, signifying a statistically significant enhancement in Hemoglobin levels after the treatment.

Table 2. The Hemoglobin (Hb) [g/dL] levels in pre- and post-treated participants.

	Pretreated Participants (n = 100)	**Post treated Participants (n = 100)**	P value
Hemoglobin (Hb) [g/dL]	9.5± 0.84	12.2 ±2.9	0.03

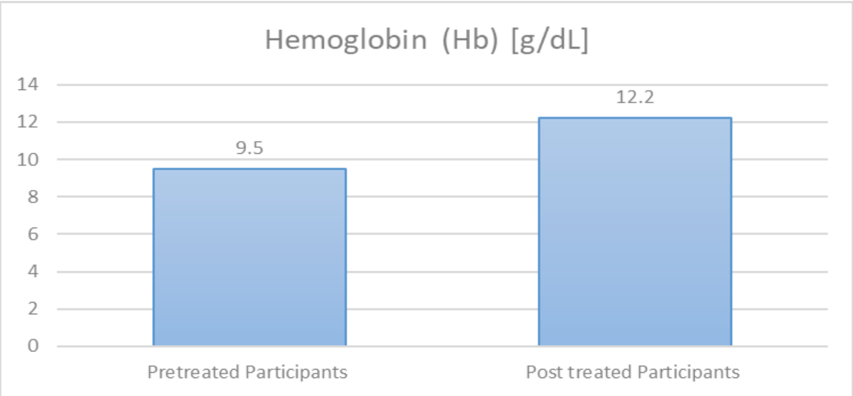

Figure 1. The Hemoglobin (Hb) [g/dL] levels in pre- and post-treated participants.

Table 3 displays the values of Platelet Count in subjects prior to and during therapy. The group that received pre-treatment had an average Platelet Count of 94.69 x 10^{9}/L, with a standard deviation of 24.9 x 10^{9}/L. After the treatment, the mean Platelet Count rose to 111.59 x 10^{9}/L, accompanied by a larger standard deviation of 39.34 x 10^{9}/L. The P value for this comparison was 0.04, signifying that the rise in Platelet Count levels after therapy is statistically significant.

Table 3. The Platelet Count [10^{9}/L] levels in pre- and post-treated participants.

	Pretreated Participants (n = 100)	**Post treated Participants (n = 100)**	P value
Platelet Count [10^{9}/L]	94.69± 24.9	111.59±39.34	0.04

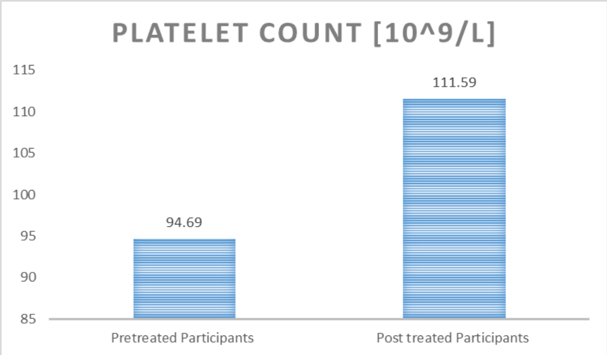

Figure 2. The Platelet Count [10^{9}/L] levels in pre- and post-treated participants.

Table 4 presents a comparison of the levels of WBC Count in subjects before and after therapy. The group that received pre-treatment had an average white blood cell count of 16.30 x 10^{9}/L, with a standard deviation of 2.01 x 10^{9}/L. On the other hand, the group that received post-treatment exhibited a reduction in WBC count, with an average of 11.80 x 10^{9}/L and a standard deviation of 7.30 x 10^{9}/L. The P value for this comparison was 0.002, indicating a statistically significant decrease in WBC Count levels after therapy.

Table 4. The WBC Count [10^{9}/L] levels in pre- and post-treated participants.

	Pretreated Participants (n = 100)	**Post treated Participants (n = 100)**	**P value**
WBC Count [10^{9}/L]	16.30± 2.01	11.80±7.30	0.002

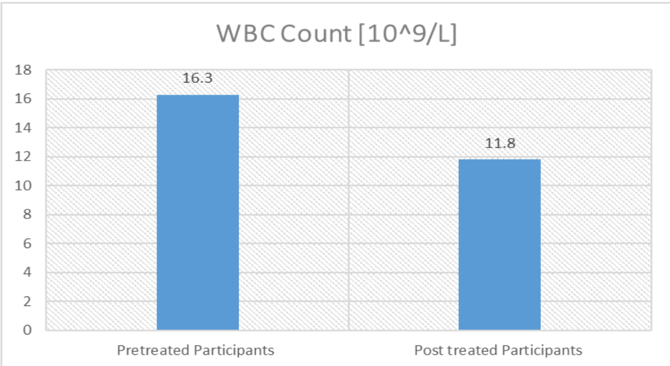

Figure 3. The WBC Count [10^9/L] levels in pre- and post-treated participants.

Table 5 displays the values of RBC Count in subjects prior to and during therapy. The group that received pre-treatment had an average RBC Count of 3.90 x 10^{12}/L, with a standard deviation of 0.23 x 10^{12}/L. After the treatment, the mean red blood cell count rose to 4.15 x 10^{12}/L, with a standard deviation of 0.58 x 10^{12}/L. The comparison yielded a P value of 0.13, suggesting that the observed rise in RBC Count levels after therapy is not statistically significant.

Table 5. The RBC Count [10^{12}/L] levels in pre- and post-treated participants.

	Pretreated Participants (n = 100)	**Post treated Participants (n = 100)**	**P value**

RBC Count [10^{12}/L]	3.90± 0.23	4.15±0.58	0.13

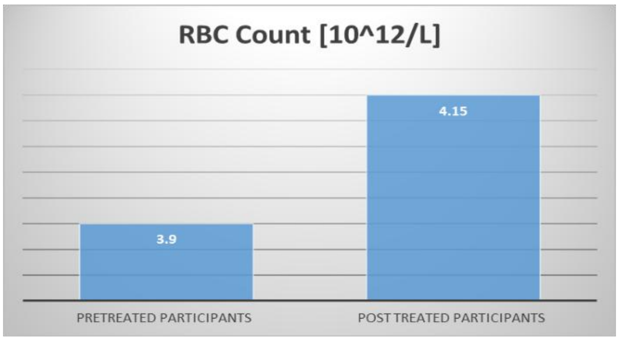

Figure 4. The RBC Count [10^12/L] levels in pre- and post-treated participants.

Table 6 presents a comparison of the Iron Level in individuals prior to and during therapy. The group that received pre-treatment had an average Iron Level of 39.37 µg/dL, with a standard deviation of 7.87 µg/dL. After the treatment, the mean Iron Level showed a substantial rise to 54.93 µg/dL, with a standard deviation of 23.5 µg/dL. The P value for this comparison was 0.02, demonstrating a statistically significant increase in Iron Levels after therapy. This indicates that the treatment successfully increased the iron levels of the subjects, hence enhancing their total iron status.

Table 6. The Iron Level [µg/dL] levels in pre- and post-treated participants.

	Pretreated Participants (n = 100)	Post treated Participants (n = 100)	P value
Iron Level [µg/dL]	39.37± 7.87	54.93±23.5	0.02

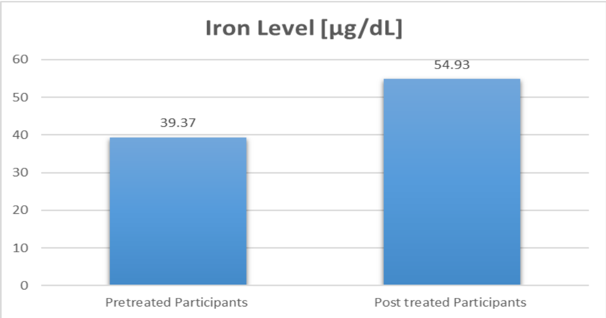

Figure 5. The Iron Level [µg/dL] levels in pre- and post-treated participants.

The chi-square test results offer valuable information on the distribution and significance of the differences seen in the pre-treatment and post-treatment variables among the study participants. The chi-square test was conducted on the pre-treatment Hb levels, resulting in a chi-square value of 14.364 with 86 degrees of freedom (df). The chi-square values for plt (0.980 with 98 degrees of freedom), WBC (6.020 with 92 degrees of freedom), RBC (25.240 with 61 degrees of freedom), and Iron (0.980 with 98 degrees of freedom).

The post-treatment Hb has a chi-square value of 21.440 with 21 df. The chi-square value for post-treatment Platelet Count is 67.960 with 18 df and a p-value of less than 0.001, indicating a very significant difference. Similarly, the post-treatment WBC has a chi-square value of 32.440 with 21 df and a p-value of 0.053, indicating a borderline significant change. The post-treatment RBC Count has a chi-square value of 45.040 with 13 df and a p-value of less than 0.001, indicating a statistically significant change. The most notable distinction is seen in the iron levels after treatment, with a chi-square value of 102.800, 29 degrees of freedom, and a p-value of less than 0.001. To summarize, the notable chi-square values for these post-treatment variables indicate that the treatment had a considerable impact on enhancing the blood parameters of the subjects.

The binary logistic regression model shows substantial connections between several hematological parameters and the outcomes of cancer treatment in both the pre- and post-treatment cancer group. The levels of Hb before treatment are strongly associated with the outcome, with an odds ratio (OR) of 11.57 and a 95% confidence interval (CI) of 17.16. The p-value is 0.0030. The levels of platelets before treatment show a strong positive relationship with the outcome, with an OR of 14.21 and a 95% CI of 93.42. The p-value is 0.0140.

Table 7. The Correlation between study variables.

VARIBLE	Chi-Square	Df	Asymp. Sig.
pre-Hb	14.364	86	.040
pre-Platelet	.980	98	.013
pre-WBC	6.020	92	.013
pre-RBC	25.240	61	.048
pre-Iron	.980	98	.025
Post-Hb	21.440	21	.032
Post-Platelet	67.960	18	.000
Post-WBC	32.440	21	053
Post-RBC	45.040	13	000
Post-iron	102.800	29	.000

Furthermore, the study found a positive association between pre-treatment WBC count (OR: 11.14, 95% CI: 24.45, p=0.0320) and RBC count (OR: 3.14, 95% CI: 18.65, p=0.045). The pre-treatment iron levels exhibit a notable and positive correlation (OR: 14.27, 95% CI: 54.46, p=0.03). After the treatment, certain variables show strong associations. Specifically, post-treatment Hb levels (OR: 12.17, 95% CI: 19.90, p=0.008), platelet levels (OR: 23.65, 95% CI: 102.36, p=0.001), WBC count (OR: 7.25, 95% CI: 13.20, p=0.04), and RBC count (OR: 0.448, 95% CI: 5.52, p=0.05) all have significant positive associations with the outcomes of the treatment. The data indicate that both pre- and post-treatment hematological indicators play a crucial role in predicting the effectiveness of cancer treatment.

Table 8. Binary logistic regression model between study variables in pre and post-treatment cancer group.

Variables	OR (95% CI)		P value
	Lower Bound	Upper Bound	
pre-Hb	11.57	17.16	.0030
pre-Platelet	14.21	93.42	.0140
pre- WBC	11.14	24.45	.0320
pre-RBC	3.14	18.65	.045
pre-Iron	14.27	54.46	0.03
Post-Hb	12.17	19.90	0.008
Post-Platelet	23.65	102.36	0.001
Post-WBC	7.25	13.20	0.04
Post-RBC	.4480	5.52	0.05
Post-iron	28.65	66.18	0.006

Discussion:

The examination of variables before and after treatment in this study demonstrates noteworthy enhancements in various hematological parameters after therapy, emphasizing the effectiveness of the supplied medication. These findings align with the current body of research on the treatment of IDA and its impact on cancer treatment. The levels of Hb showed a notable rise after the treatment, increasing from an average of 9.5 g/dL to 12.2 g/dL (p = 0.03). This enhancement demonstrates proficient administration of anemia, a prevalent complication in cancer patients resulting from both the illness itself and the therapy procedures [5]**.** Anemia care is essential due to the substantial influence that low levels of Hb can have on patients' quality of life and their capacity to tolerate cancer treatments [6].

The study observed a notable increase in Platelet Count after therapy, from 94.69 x 10^9/L to 111.59 x 10^9/L (p = 0.04). Thrombocytopenia, which refers to a low platelet count, is significant because it might increase the risk of bleeding and complicate cancer treatment [7]**.** The rise in platelet count indicates that the medication successfully reduced this risk, hence promoting improved clinical outcomes for patients.

The decrease in WBC count from 16.30 x 10^9/L to 11.80 x 10^9/L (p = 0.002) after treatment suggests a reduction in inflammation or infection, which is advantageous for the patients' recovery. An increase in WBC counts is frequently linked to inflammation and infection, which can create complications after cancer therapy [8]**.** This outcome is consistent with the discoveries made by Zohora et al, who highlighted the significance of controlling inflammation in individuals with cancer [9]. Although the rise in RBC count from 3.90 x 10^12/L to 4.15 x 10^12/L did not show statistical significance ($p = 0.13$), the overall trend is good. RBCs play a crucial role in the transportation of oxygen, and it is vital to have sufficient amounts of RBCs to sustain energy levels and overall well-being [10]. The absence of statistical significance may be attributed to the heterogeneity in individual responses, as observed in the study conducted by [4].

The largest significant enhancement was observed in iron levels, which rose from 39.37 µg/dL to 54.93 µg/dL after therapy ($p = 0.02$). Iron is essential for numerous physiological processes, such as the transportation of oxygen and the production of DNA. Its insufficiency is prevalent in individuals diagnosed with cancer [6]. The substantial rise in iron levels after treatment indicates that the therapy successfully targeted iron deficiency, a crucial aspect of controlling anemia associated with cancer (Shubham et al., 2020). This outcome aligns with the discoveries of Al [11], who emphasized the correlation between iron deficiency and breast cancer. Olufemi et al examine the distinction between IDA and anemia of chronic disease in cancer patients. The study emphasizes the significance of precise diagnosis and focused treatment. The results of our study indicate that the medication effectively treated IDA by increasing hemoglobin and iron levels. This distinguishes it from anemia of chronic disease. providing differentiation is crucial for providing appropriate therapy and can result in improved patient management and outcomes [12].

Kanuri et al. emphasize the simultaneous presence of IDA and anemia associated to cancer, and how it affects the overall well-being of individuals. The notable enhancements in hemoglobin, platelet count, and iron levels observed after treatment in our study are consistent with previous discoveries, suggesting that proficient care of IDA can improve the quality of life for individuals with cancer. The therapy approach utilized in our study has the potential to enhance overall patient well-being and treatment tolerance by targeting both IDA and cancer-related anemia [4]. Jiang and Elliott examine the impact of reduced iron levels on immune cell function and its association with cancer cells. The study revealed a notable rise in iron levels, which has the potential to enhance the performance of immune cells like natural killer cells, hence improving their capacity to identify and eliminate cancer cells. This immunological advantage highlights the significance of maintaining sufficient amounts of iron in cancer patients to facilitate efficient immune responses against malignancy [13].

Hung et al. examine the cancer risk in patients with IDA and discover a notable correlation. The results of the study indicate a substantial increase in iron levels after treatment, emphasizing the potential to decrease the risk of cancer by addressing IDA. According to Hung et al., appropriately managing iron deficiency can help reduce one of the risk factors associated with the development of cancer [14]. Hashemi et al. investigate the presence of both absolute and functional iron deficiency in cancer patients with various types of malignancies. The results indicate that the treatment successfully resolved both absolute and functional iron shortage, as evidenced by the observed increase in iron and hemoglobin levels. Hashemi et al. underline that adopting a comprehensive approach to managing iron deficiency can lead to improved treatment outcomes and better patient health [15].

Elstrott et al. examine the significance of replenishing iron in adults with IDA and its effects on other disorders, such as cancer. The substantial enhancements in iron levels found in our investigation are consistent with their discoveries, emphasizing the crucial function of iron replenishment in the management of anemia in cancer patients. Ensuring adequate iron levels can improve patient outcomes and enhance the overall effectiveness of treatment [6]. Al Khamees et al. investigate the frequency of iron deficiency and its correlation with breast cancer in women who have not yet reached menopause and those who have already gone through menopause. The results of our study, which showed a notable increase in iron levels after therapy, align with their focus on the criticality of addressing iron deficiency in individuals with cancer. By targeting iron deficiency, we can enhance treatment outcomes and potentially mitigate the risk of cancer progression [11].

To summarize, our study has shown that the treatment protocol effectively manages IDA and its associated hazards in cancer patients, as evidenced by the significant improvements in hematological parameters. These findings are consistent with previous research that emphasizes the significance of managing iron deficiency in order to improve patient outcomes, enhance immunological function, and enhance overall quality of life. Efficient administration of IDA is essential for maximizing cancer therapy and ensuring optimal patient care, as demonstrated by the cited research.

Conclusion:

- The study showed a notable enhancement in Hb, Platelet Count, and Iron levels after the treatment, showing the effectiveness of the therapy in controlling anemia and iron deficiency in cancer patients.
- The fall in WBC counts after treatment indicates a reduction in inflammation, demonstrating the anti-inflammatory benefits of the therapy.

- : The notable increase in iron levels after treatment highlights the crucial importance of replenishing iron to enhance the general health and treatment results of cancer patients.
- Effective management of anemia and iron deficiency can have a positive impact on the quality of life for cancer patients, leading to improved treatment tolerance and general well-being.
- The results are consistent with prior studies that highlight the significance of managing iron deficiency and anemia in cancer treatment. This underscores the need for specific therapeutic treatments.

Recommendations:

- Implement regular screening for IDA in cancer patients to promptly detect and resolve iron deficiency, hence improving the management of symptoms associated with anemia.
- Customize iron supplementation methods to address the unique requirements of cancer patients, taking into account variables such as age, gender, and type of cancer.
- Optimize patient outcomes by including anemia management methods, such as iron supplementation and anti-inflammatory medications, into routine cancer care procedures.
- Implement continuous monitoring of hematological parameters throughout cancer therapy to make necessary modifications to therapeutic interventions, guaranteeing consistent enhancement in patient well-being.
- Advocate for additional research and clinical trials to investigate the enduring consequences of iron replenishment and anemia control in cancer patients, with the goal of improving and expanding current treatment strategies.

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