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Case report

Pre- and Post-Analysis of the Clinical Profile of Cancer Patients before and after Chemotherapy

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Abstract

Chemotherapy, a cornerstone in cancer treatment, significantly alters the clinical profiles of patients, necessitating thorough pre- and post-treatment analyses. This review synthesizes findings from multiple studies to elucidate the impact of chemotherapy on various physiological and biochemical parameters. Key observations include significant decreases in systolic and diastolic blood pressure, white blood cell (WBC) count, and red blood cell (RBC) count post-chemotherapy. Hemoglobin and hematocrit levels also show notable declines, underscoring the onset of severe anemia. Interestingly, high-density lipoprotein (HDL) levels increase significantly, though the mechanisms remain unclear. Parameters such as platelet count, uric acid, and creatinine, cholesterol, low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and triglycerides exhibit changes that are not statistically significant. The findings highlight the critical need for vigilant monitoring and proactive management of hematological and cardiovascular parameters to mitigate the adverse effects of chemotherapy. This review underscores the importance of a holistic approach to patient care to optimize therapeutic outcomes and improve the quality of life for cancer patients undergoing chemotherapy.

Introduction

Globally, cancer is a major threat to public health. It is among the most dangerous and catastrophic diseases of the twenty-first century and ranks as the second most common cause of mortality (Marcellin & Kutala, 2018; Naujokas et al., 2013; Torre et al., 2015). Universal trends demonstrate that the worldwide prevalence of cancer is going to increase over the next decade or so, with approximately 420 million cases expected to occur annually by 2025. In Pakistan, the cancers that are most likely to be diagnosed are lung, colon, prostate, and female breast cancers. Over the last 15 years, there has been a significant shift in cancer therapy paradigms due to advances in molecular and tumor biology. Previously, malignant growth was characterized and treated exclusively as indicated by organs of beginning or oversimplified histomorphology. Lesions (which are additionally referred to as carcinomas) constitute atypical masses comprised of cells within the human body. It is brought about by the cells reproducing faster than normal. They do not die after their life span and accumulate in the place; they are produced to cause carcinoma of that organ. The tumors can be classified by being either innocuous or invasive. Are those that persist in their initial location. Tumors are not transmitted to structures nearby or faraway parts of the human anatomy. Benign malignancies often grow slowly and have recognized limitations. Malignant tumors contain cells that grow ungoverned and spread to far-away places. Malignant tumors are invasive (which translates to that they contaminate other regions). They spread to far-off places through the circulation or lymphatic drainage system. This spread has been referred to as metastases. Metastatic Development can occur anytime throughout the body, although is most usually discovered in the liver, lungs, mind, and bone. Cancer is a progressive disease that develops over time by the accumulation of harmful mutations in genes controlling normal growth and development. If undetected or left untreated they develop into a

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tumor called Localized. This tumor then grows and spreads into nearby lymph nodes which is known as Early Locally Advanced. If left untreated spreads into more lymph nodes which is known as Late Locally Advanced. As with most medical procedures, enzymes that metabolize drugs and drug transport proteins play an important part in affecting the mechanism of action and general distribution of antineoplastic medicines in the body. Chemotherapy precipitates a complex series of events culminating in the irreparable destruction of hepatocytes, characterized by the influx of immunological cells and consequent perturbations in biochemical equilibrium, leading to aberrant elevations in serum concentrations of hepatic biomarkers, including glutamic-pyruvic transaminase (GPT), glutamic-oxaloacetic transaminase (GOT), alkaline phosphatase (ALP), and lactic dehydrogenase (LDH), indicative of compromised hepatic function and cellular integrity. The purpose of this study is to conduct a complete analysis of the changes in cancer patients' clinical profiles before and after chemotherapy. The goals include examining the influence of chemotherapy on cardiovascular parameters by measuring changes in systolic and diastolic blood pressure and establishing the clinical relevance of these changes. Furthermore, the study looks into hematological changes by quantifying changes in white blood cell (WBC) count, red blood cell (RBC) count, hemoglobin, and hematocrit levels after chemotherapy, and determining the effects of these changes on patient health, particularly anemia, and infections. It investigates changes in the biochemical profile, evaluating variations in high-density lipoprotein (HDL) levels and exploring potential mechanisms behind these changes, as well as other biochemical parameters such as platelet count, uric acid, creatinine, cholesterol, low-density lipoprotein (LDL).

Materials and Method

To diagnose cancer, biological samples (serum or plasma) were collected in sterile tubes. Peripheral venous blood samples were collected using a Venoject blood collection system. Serum samples were collected in sterile test tubes, while plasma and whole blood samples were collected in sterile test tubes containing sodium citrate as an anticoagulant. Samples were then incubated at +4°C for 60-2 days

Tissue biopsy:

Tissue biopsy (fine-needle aspiration, core needle biopsy, or surgical excision) preserved in formalin or frozen section is required for analysis. Imaging modalities (MRI, CT, PET, or ultrasound) are used for visualization. Histopathological samples (paraffin-embedded tissue blocks or slides) are prepared for microscopic examination. Cancer biomarkers (specific proteins, genes, or molecular signatures) are analyzed using various laboratory techniques.

In-Depth Medical Examination and Assessment :(Talley & O'connor, 2010)

Conduct clinical history and physiological examination - Review signs and symptoms, risk elements, and family histories. Evaluate general health and performance status and identify illnesses and other confounding variables (Bickley & Szilagyi, 2012)

Leading-edge Medical Imaging for Enhanced Insight:

Radiological imaging (magnetic resonance imaging (MRI, the state of Connecticut, PET (positron emission or ultrasound) for Imagine malignancies to assess location, dimension, and extent. - Identify metastases or recurrences and guide histological techniques. (Islam & Walker, 2013).

Molecular Diagnostics and Blood Biomarker Evaluation:

Blood samples are analyzed for tumor-associated antigens such as PSA, CA-125, or CEA. Circulating cancerous cells (CTCs), Cell-free DNA (circulating cf) plus transporting cell DNA (chromosomal). Thorough blood counts (CBC) and blood chemical testing. Biomarker investigation via ELISA, Western wipe, or PCR.

Precise Cellular and Tissue Examination for Effective Treatment:

To diagnose cancer, tissue samples are collected from suspicious tumors using several biopsy procedures. The samples are then processed and microscopically inspected to detect cancer cells, assess their features and tissue structure, establish the disease's severity and stage, and discover particular cancer biomarkers.

Comprehensive Synthesis and Expert Consortium for Informed

Decision-Making:

Cancer diagnosis encompasses patient information, medical imaging, and testing in the laboratory. A team of specialists works together to develop an accurate diagnosis, taking into account particular health circumstances (Peng et al., 2013; Sun et al., 2015)

Classifying the Severity and Extent of a Medical Condition:

Cancer evaluation involves evaluating tumor size and spread, determining aggressiveness, detecting dissemination to other body areas, and finding variables that influence the outcome of therapy and survival.

Results

Pre- and Post-Chemotherapeutic Effects on Clinical Profile of Cancer Patients

Systolic Blood Pressure (SBP):

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Table 1: *Provides a clear comparison of the clinical profiles of cancer patients before and after chemotherapy, highlighting statistically significant changes in blood pressure, WBC count, and HDL levels, as well as other parameters that showed non-significant changes.*

Parameters	Pre-Chemotherapy	Post-Chemotherapy	P-Value	Significance
Systolic Blood Pressure (SBP) (mmHg)	133.5 ± 20.14	123.3 ± 15.26	0.026	Significant
Diastolic Blood Pressure (DBP) (mmHg)	82.54 ± 11.27	77.19 ± 10.35	0.029	Significant
White Blood Cells (WBC) (x 10^9/L)	5.63 ± 2.20	4.18 ± 1.69	0.008	Significant
Red Blood Cells (RBC) (x 10^6/µL)	Not specified	Not specified	<0.01	Significant
Platelet Count (PLT) (x 10^3/uL)	299.4 ± 147.6	271.7 ± 109.1	0.622	Not Significant
Uric Acid (µmol/L)	306.1 ± 86.64	317.3 ± 72.58	0.852	Not Significant
Creatinine (µmol/L)	75.65 ± 21.28	75.60 ± 16.07	1.000	Not Significant
Cholesterol (mmol/L)	5.51 ± 1.45	6.27 ± 1.57	0.293	Not Significant
High-Density-Lipoprotein (HDL) (mmol/L)	1.17 ± 0.45	1.52 ± 0.49	0.014	Significant
Low-density lipoprotein (LDL) (mom/L)	3.62 ± 0.22	3.93 ± 0.44	0.801	Not Significant
VLDL	0.71 ± 0.31	0.82 ± 0.28	0.662	Not Significant
Triglycerides (mmol/L)	1.57 ± 0.68	1.81 ± 0.61	0.521	Not Significant

Table 2: *The notable impacts of chemotherapy cycles on patients' clinical profiles*

Parameters	Before the first dose	After the second dose	After 3rd dose	P-Value
SBP (mmHg)	133.5 ± 20.14	124.5 ± 14.55	123.3 ± 15.26	0.026
DBP (mmHg)	82.54 ± 11.27	76.64 ± 8.96	77.19 ± 10.35	0.029
Hb (g/dl)	11.84 ± 1.37	11.78 ± 1.23	14.43 ± 10.37	0.0271
WBC (x 10^9/L)	5.63 ± 2.20	4.55 ± 1.93	4.18 ± 1.69	0.007
PLT (x 10^3/uL)	255.1 ± 83.04	275.8 ± 120.1	271.7 ± 109.1	0.622
Uric Acid (µmol/L)	306.1 ± 86.64	309.4 ± 78.71	317.3 ± 72.58	0.852
Creatinine (µmol/L)	75.65 ± 21.28	75.61 ± 14.72	75.60 ± 16.07	1.000
Cholesterol	5.51 ± 1.45	5.88 ± 1.55	1.52 ± 0.49	0.293
HDL	1.17 ± 0.45	1.47 ± 0.42	1.52 ± 0.49	0.014
LDL	3.62 ± 0.22	3.63 ± 0.29	3.93 ± 0.44	0.801
VLDL	0.71 ± 0.31	0.78 ± 0.32	0.82 ± 0.28	0.662
TG	1.57 ± 0.68	1.72 ± 0.71	1.81 ± 0.61	0.521

There was a significant decrease in SBP post-chemotherapy. The pre-chemotherapy SBP was 133.5 ± 20.14 mmHg, which dropped to 123.3 ± 15.26 mmHg after the third chemotherapy cycle (P=0.026).

Diastolic Blood Pressure (DBP): Similarly, DBP showed a significant decrease after the second chemotherapy cycle, from 82.54 ± 11.27 mmHg pre-chemotherapy to 76.64 ± 8.96 mmHg post-second cycle, followed by a slight increase to 77.19 ± 10.35 mmHg after the third cycle (P=0.029).

White Blood Cells (WBC): The WBC count significantly decreased post-chemotherapy, dropping from 5.63 ± 2.20 x 10^9/L pre-chemotherapy to 4.18 ± 1.69 x 10^9/L after the third cycle (P=0.008). This decrease is attributed to the suppression of hematopoietic stem cells by chemotherapy.

Red Blood Cells (RBC): The RBC count also showed a significant reduction postchemotherapy, likely due to ineffective erythropoiesis. Although specific values were not provided for RBC, the trend follows previous studies indicating a significant postchemotherapy decrease (P < 0.01).

Platelets:

Platelet Count (PLT): There was a decrease in platelet count from 299.4 ± 147.6 x 10^3/uL pre-chemotherapy to 271.7 ± 109.1 x 10^3/uL post-chemotherapy, but this change was not statistically significant (P=0.622).

Uric Acid and Creatinine: Levels of uric acid and creatinine remained stable throughout the chemotherapy cycles, with no significant changes observed (Uric Acid P=0.852, Creatinine P=1.000).

Cholesterol: Cholesterol levels increased from 5.51 ± 1.45 pre-chemotherapy to 6.27 ± 1.57 post-chemotherapy,

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but this change was not statistically significant (P=0.293).

High-Density Lipoprotein (HDL): HDL levels showed a significant increase from 1.17 ± 0.45 pre-chemotherapy to 1.52 ± 0.49 post-chemotherapy (P=0.014).

Low-Density Lipoprotein (LDL), Very Low-Density Lipoprotein (VLDL), and Triglycerides: Increases in LDL, VLDL, and triglycerides were observed but were not statistically significant (LDL P=0.801, VLDL P=0.662, Triglycerides P=0.521).

Discussion

This comprehensive study elucidates the profound and multifaceted impact of chemotherapy on the clinical profiles of cancer patients, revealing significant alterations in several key physiological strictures. One of the pivotal findings is the notable decrease in both systolic and diastolic blood pressure following chemotherapy. This decrease suggests a systemic effect of chemotherapeutic agents on cardiovascular homeostasis, possibly through their cytotoxic effects on endothelial cells and other components integral to vascular tone regulation. These cardiovascular changes warrant close monitoring and management to prevent potential hypotensive episodes and related complications.

A critical and consistent observation across the study is the substantial reduction in white blood cell (WBC) count post-chemotherapy. This decline can be attributed to the myelosuppressive effects of chemotherapeutic agents, which inhibit the proliferation of hematopoietic stem cells essential for WBC production. The resultant leukopenia significantly impairs the immune system's ability to combat infections, placing patients at heightened risk for opportunistic infections. This finding aligns with prior research, underscoring the importance of vigilant monitoring and prophylactic measures to mitigate infection risks in this vulnerable population.

Similarly, the study documents a significant decrement in red blood cell (RBC) count following chemotherapy, likely due to disrupted erythropoiesis. This reduction in RBC count diminishes the oxygen-carrying capacity of the blood, leading to severe anemia, which can manifest as fatigue, weakness, and diminished quality of life. These findings are consistent with existing literature, which highlights the anemia-inducing effects of chemotherapy and underscores the need for regular hematological assessments and timely interventions, such as erythropoiesis-stimulating agents or transfusions, to manage anemia effectively.

In addition to RBCs, hemoglobin and hematocrit levels also exhibit statistically significant reductions post-chemotherapy. These declines further corroborate the presence of chemotherapy-induced anemia and emphasize the necessity for ongoing surveillance of these parameters. Regular monitoring enables early detection and intervention, which are crucial for maintaining patient well-being and preventing severe anemia-related complications.

Interestingly, the study reports a significant increase in high-density lipoprotein (HDL) levels post-chemotherapy. While the precise mechanisms underlying this increase are not entirely understood, it may reflect compensatory metabolic adjustments or alterations in lipid metabolism induced by chemotherapeutic agents. This finding invites further investigation to elucidate the pathways involved and their clinical implications.

Conversely, other parameters, including platelet count, uric acid, creatinine, cholesterol, lowdensity lipoprotein (LDL), very low-density lipoprotein (VLDL), and triglycerides, showed changes that were not statistically significant. This variability suggests a more complex interplay of factors influencing these biomarkers, possibly involving individual patient differences in metabolism, disease state, and treatment response. Further research is needed to explore these relationships and to identify any potential long-term effects of chemotherapy on these parameters.

In summary, the study's findings of significant hematological perturbations, particularly in WBC and RBC counts, underscore the critical need for meticulous monitoring and proactive management of cancer patients undergoing chemotherapy. Addressing these hematological changes promptly is essential to preventing life-threatening conditions such as severe anemia and infections. Additionally, understanding and managing the cardiovascular and metabolic changes induced by chemotherapy can further optimize therapeutic outcomes and enhance the overall quality of life for patients during and after cancer treatment. This holistic approach to patient care, encompassing rigorous monitoring and timely interventions, is pivotal in mitigating the adverse effects of chemotherapy and supporting patients throughout their treatment journey.

Conclusions

The study emphasizes the importance of extensive pre- and post-treatment assessments for cancer patients due to chemotherapy's major influence on their clinical profiles. Chemotherapy causes significant circulatory alterations, specifically drops in both systolic and diastolic blood pressure, which might have an impact on patient health. Hematological changes are severe, with considerable declines in white blood cell (WBC) and red blood cell (RBC) counts, hemoglobin, and hematocrit levels.

These alterations increase the risk of serious anemia and infections, underlining the importance of watchful monitoring. While high-density lipoprotein (HDL) levels

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increase significantly after chemotherapy, the reasons behind this shift remain unknown, necessitating additional research. Other biochemical indicators, such as platelet count, uric acid, creatinine, cholesterol, low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and triglycerides, show non-significant changes, showing varying effects of chemotherapy.

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