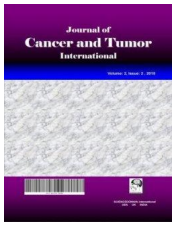

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# The Effect of Chemotherapy on Clinical, Haematological and Biochemical Profile in Breast Cancer Patients Undergoing Chemotherapy at Cape Coast Teaching Hospital; A Longitudinal Study

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author CA, RPS, RKDE, MM, FNG, DLS and EM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PA, BKSD, RPS and RKDE managed the analyses of the study. Authors RSB, JBB, LAF, RPS, RKDE and FNG managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

**Background:** People with primary invasive breast cancer receive both local (surgery and radiation therapy) and systemic treatment (chemotherapy and hormonal therapy). However, there are substantial short-and long-term side effects from chemotherapy as documented in several studies**.** This study assessed the effects of chemotherapy on clinical, haematological and biochemical profile of breast cancer patients undergoing chemotherapy in the Cape Coast Teaching Hospital.
**Methods:** This longitudinal study was conducted in the female surgical ward of the Cape Coast Teaching Hospital (CCTH). We randomly sampled 51 patients diagnosed with breast cancer and scheduled to start chemotherapy and recorded their demographic, clinical and therapeutic data. Blood was collected for haematological profiles [haemoglobin (Hb), white blood cell (WBC) count, platelets (PLT) and biochemical analysis (lipid profile, uric acid and creatinine) for day 1, day 21 and day 42 of their chemotherapy cycles.
**Results:** Majority of the participants were within 46-60 years, married, overweight and had informal employment. Throughout chemotherapy cycles, systolic blood pressure (SBP) significantly decreased till after the third cycle (P=0.026), diastolic blood pressure (DBP) significantly decreased after second cycle but increased slightly after the third cycle (P=0.029). Hemoglobin though insignificant, decreased after the second cycle but increased sharply after the third cycle (P=0.281). White blood cells (WBC) significantly decreased throughout cycles (P=0.008) whereas high density lipoprotein (P=0.014) increased throughout cycles- Uric acid (P=0.852) and creatinine (P=1.000). were maintained throughout cycles
**Conclusion:** Throughout cycles, chemotherapy had significant adverse effect on the clinical profile (systolic and diastolic blood pressure), white blood cells (WBC) and high density lipoprotein (HDL) in patients undergoing treatment.


*Keywords: Chemotherapy; radiation therapy; hematological profile; breast cancer.*

## 1. INTRODUCTION

Breast cancer develops from breast tissue and like other cancers, occurs because of an interaction between an environmental (external) factor and a genetically susceptible host [1]. Signs of breast cancer may include a lump in the breast, a change in breast shape, dimpling of the skin, fluid coming from the nipple, or a red scaly patch of skin [2]. Risk factors for developing breast cancer include: female sex, obesity, lack of physical exercise, drinking alcohol, hormone replacement therapy during menopause, ionizing radiation, early age at first menstruation, having children late or not at all, and older age [3].

World Health Organization (WHO) reports have shown that the incidence of breast cancer is second only to the incidence of cervical cancer and 1.4 million patients are diagnosed annually with breast cancer worldwide [4]. Ghana has no population-based cancer registry however, there were 1,469 breast cancer patients identified through medical records during 2009 to 2014. This figure is expected to increase as Ghana's population ages and more females adopt Western lifestyles [4].

People with primary invasive breast cancer receive both local (surgery and radiation therapy) and systemic treatment (chemotherapy and hormonal therapy). However the National Comprehensive Cancer Center Network, and other groups recommend adjuvant chemotherapy for women with invasive breast tumors greater than 1 cm in diameter, irrespective of whether axillary lymph nodes are involved [5].

There are substantial short- and long-term side effects from chemotherapy and several studies have been conducted to that effect. Studies have examined short- and long-term side effects of chemotherapy on organs and cell lines among breast cancer patients [6-10]. However there is scanty data on the effects of chemotherapy on haematological and biochemical profile among breast cancer patients in our part of the world. Consequently, we assessed the effects of chemotherapy on clinical, haematological and biochemical parameters among breast cancer patients undergoing treatment in the Cape Coast teaching hospital.

## 2. METHODOLOGY

### 2.1 Study Design/Study Site/Participants/ Eligibility Criteria

This longitudinal single center study was conducted at Female Surgical Ward and Laboratory unit at the Cape Coast Teaching Hospital (CCTH) from May 2016 to

February2017. CCTH serves as the main referral health facility in the in the Cape Coast Metropolis and the rest of Central region and beyond. Fifty one (51) eligible breast cancer patients were recruited using simple randomized sampling technique. Patients undergoing surgery and radiation were excluded. We also excluded patients with hypertension, diabetes mellitus, liver disease and renal pathology.

## 2.2 Anthropometric Data/Blood Pressure

Their anthropometric data (weight and height) before the first dose and after the completion of every cycle of chemotherapy were taken. BMI was calculated and classified based on WHO criteria [11]. Blood pressure was recorded before the first cycle of chemotherapy and after completion of each cycle.

## 2.3 Blood Sample Collection

We collected 4 ml of venous blood from the participants. The sampling was done before the first dose chemotherapy and after the completion of every cycle of chemotherapy. Serum obtained from the centrifuged sample was analyzed for lipid profile, uric acid and creatinine levels, using automated ELITECH Auto analyzer. The principle for the assay of the lipids, creatinine and uric acid was based on enzymatic methods for lipids [12]. Jaffes's technique for creatinine [13] and the uricase method for uric acid respectively [14].

## 2.4 Statistical Analysis

Data was entered into Microsoft Excel and Statistical Package for Social Sciences (SPSS) 16.0 for windows version was used for statistical analysis. Continuous variable like age was reported using mean and standard deviation. Bivariate analysis was reported using t-test and multivariate analysis was done using ANOVA and the significance level was set at 0.05.

## 3. RESULTS

Of the 51 participants, 43.1% were within the age range 46-60 years, 51.0% were married, 74.5% were informally employed, 60.8% had invasive ductal carcinoma. Demographic characteristics of participants with the various classes of breast cancer are shown in Table 1. Demographic distribution of the participants showed that patients with advanced breast cancer (ABC), invasive ductal carcinoma (NST), and invasive ductal carcinoma (NOS) were mainly within 46-60, ≤45, and ≥61 years respectively. Majority were married with a few being single. Most had informal form of occupation and were overweight as well.

Table 2 demonstrates the baseline hematological and biochemical characteristics of the participants. Most of the study participants showed insignificant mean values of hematological parameters (Hb, PLT and WBC) before first dose. The biochemical parameters (creatinine and uric acid) recorded significant

**Table 1. Demographic characteristics of participants with the various classes of carcinoma**

| Parameter | Advanced breast cancer (n=6) | Invasive ductal carcinoma (NST) (n=14) | Invasive ductal carcinoma (NOS) (n=31) | P-value |
|---|---|---|---|---|
| **Age** | | | | 0.375 |
| ≤45 | 2(33.3) | 8(57.1) | 9(29.0) | |
| 46-60 | 3(50.0) | 3(21.4) | 9(29.0) | |
| ≥61 | 1(16.7) | 3(24.4) | 6(31.4) | |
| **Marital Status** | | | | 0.773 |
| Single | 0(0.0) | 1(7.1) | 2(6.5) | |
| Married | 4(66.7) | 9(57.1) | 14(45.2) | |
| Divorced | 0(0.0) | 2(14.3) | 8(25.8) | |
| Widowed | 2(33.3) | 3(21.4) | 7(22.6) | |
| **Occupation** | | | | 0.748 |
| Formal | 1(16.7) | 2(14.3) | 2(6.5) | |
| Informal | 4(66.7) | 11(78.6) | 23(74.2) | |
| Unemployed | 1(16.7) | 1(7.1) | 6(19.4) | |
| BMI kg/m$^2$ | 29.85±6.61 | 31.32±8.85 | 28.55±5.85 | 0.458 |
| **BMI Classification** | | | | 0.814 |
| Underweight | 0(0.0) | 0(0.0) | 1(3.2) | |
| Normal weight | 0(0.0) | 3(23.1) | 7(22.6) | |
| Overweight | 4(66.7) | 5(38.5) | 14(45.2) | |
| Obese | 2(33.3) | 5(38.5) | 9(29.0) | |

**Table 2. Hematological and biochemical characteristics of participants before 1st dose**

| Parameter | Advanced Breast Cancer (n=6) | Invasive ductal carcinoma (NST) (n=14) | Invasive ductal carcinoma (NOS) (n=31) | P-value |
|---|---|---|---|---|
| **Hb g/dl** | 11.28±1.75 | 11.88±1.27 | 11.90±1.41 | 0.778 |
| **Hb Ranges** | | | | 0.543 |
| Low | 1(25.0) | 6(42.9) | 6(26.1) | |
| Normal | 3(75.0) | 8(57.1) | 17(73.9) | |
| High | 0(0.0) | 0(0.0) | 0(0.0) | |
| WBC $10^9$/l | 6.08±1.85 | 5.97±1.90 | 5.35±2.45 | 0.659 |
| **WBC Ranges** | | | | 0.709 |
| Low | 1(25.0) | 4(28.6) | 10(43.5) | |
| Normal | 3(75.0) | 10(71.4) | 12(52.2) | |
| High | 0(0.0) | 0(0.0) | 1(4.3) | |
| Platelets $10^3$/ul | 271.50±39.62 | 279.21±88.35 | 316.57±184.62 | 0.710 |
| **Platelets Ranges** | | | | 0.860 |
| Low | 0(0.0) | 1(7.1) | 2(8.7) | |
| Normal | 4(100.0) | 12(85.7) | 18(78.3) | |
| High | 0(0.0) | 1(7.1) | 3(13.0) | |
| Creatinine umol/l | 48.63±33.72 | 75.30±11.75 | 80.56±20.71 | 0.0.17 |
| **Creatinine Ranges** | | | | |
| Low | 1(25.0) | 0(0.0) | 1(4.3) | |
| Normal | 3(75.0) | 13(92.9) | 17(73.9) | |
| High | 0(0.0) | 1(7.1) | 5(21.7) | |
| Uric acid umol/l | 393.53±176.55 | 273.84±42.79 | 310.49±79.02 | 0.044 |
| **Uric acid Ranges** | | | | 0.043 |
| Low | 0(0.00) | 0(0.0) | 1(4.5) | |
| Normal | 2(50.0) | 14(100.0) | 19(86.4) | |
| High | 2(50.0) | 0(0.0) | 2(9.1) | |
| Cholesterol | 4.26±0.75 | 5.11±1.20 | 5.83±1.49 | 0.055 |
| **Cholesterol Range** | | | | 0.142 |
| Norm(<5.2mmol/l) | 4(80.0) | 5(62.5) | 11(37.9) | |
| High(>5.2mmol/l) | 1(20.0) | 3(37.5) | 18(62.1) | |
| HDL | 0.79±0.49 | 1.29±0.43 | 1.21±0.42 | 0.112 |
| **HDL Ranges** | | | | 0.523 |
| >0.91mmol/l (N) | 3(60.0) | 7(85.7) | 21(72.4) | |
| <0.91mmol/l (L) | 2(40.0) | 1(12.5) | 8(27.6) | |
| LDL | 2.79±0.81 | 3.13±0.96 | 3.89±1.51 | 0.146 |
| **LDL Ranges** | | | | 0.142 |
| <3.4mmol/l (N) | 4(80.0) | 5(62.5) | 11(37.9) | |
| >3.4mmol/l (H) | 1(20.0) | 3(37.5) | 18(62.1) | |
| VLDL | 0.66±0.11 | 0.70±0.54 | 1.18±1.60 | 0.902 |
| **VLDL Ranges** | | | | 0.113 |
| Low (<0.10mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal (0.10-1.70) | 5(100.0) | 7(87.5) | 29(100.0) | |
| High (>1.70mmol/l) | 0(0.0) | 1(12.5) | 0(0.0) | |
| **Triglyceride** | 1.46±0.24 | 1.53±1.18 | 1.60±0.55 | 0.902 |
| **Triglyceride Ranges** | | | | 0.119 |
| **Low (<0.45mmol/l)** | 0(0.0) | 0(0.0) | 0(0.0) | |
| **Normal (0.45-1.71)** | 5(100.0) | 7(87.5) | 18(62.1) | |
| **High (>1.71mmol/l)** | 0(0.0) | 1(12.5) | 11(37.9) | |

mean values before first dose with majority within normal range except for uric acid where patients with advanced breast cancer (ABC) had equally (50%) high and normal uric acid levels. The lipid profile of the participants before first dose was mainly normal except for patients with invasive ductal carcinoma (NOS) who had high levels of LDL (62.1%).

Table 3 shows hematological and biochemical characteristics of participants after 2nd dose. After the second dose, all the hematological and biochemical parameters of participants remained

normal except for invasive ductal carcinoma (NST) patients who had 60% low Hb and WBC. Creatinine (p=0.029) and uric acid (p=0.016) of all participants showed significant changes with creatinine ranges showing a significant association (p=0.007) with type of cancer. were significant. Majority of the participants had high levels of cholesterol, HDL >0.91mmol/l, and LDL >3.4mmol/l but normal levels of VLDL and triglyceride.

Hematological and biochemical characteristics of participants after 3rd dose is demonstrated in Table 4. After 3rd cycle, most of the participants

**Table 3. Hematological and biochemical characteristics of participants after 2nd dose**

| Parameter | Advanced breast cancer (n=6) | Invasive ductal carcinoma (NST) | Invasive ductal carcinoma (NOS) | P-value |
|---|---|---|---|---|
| **Hb g/dl** | 12.50±1.80 | 11.57±1.21 | 11.78±1.19 | 0.533 |
| **Hb Ranges** | | | | 0.278 |
| Low | 1(33.3) | 6(60.0) | 6(30.0) | |
| Normal | 2(66.7) | 4(40.0) | 14(70.0) | |
| High | 0(0.0) | 0(0.0) | 0(0.0) | |
| WBC $10^9$/l | 3.83±1.75 | 4.86±1.85 | 4.50±2.05 | 0.720 |
| **WBC Ranges** | | | | 0.637 |
| Low | 1(33.3) | 6(60.0) | 9(45.0) | |
| Normal | 2(66.7) | 4(40.0) | 11(55.0) | |
| High | 0(0.0) | 0(0.0) | 0(0.0) | |
| Platelets $10^3$/ul | 281.00±37.72 | 301.10±147.74 | 262.40±115.17 | 0.718 |
| **Platelets Ranges** | | | | 0.823 |
| Low | 0(0.0) | 1(10.0) | 3(15.8) | |
| Normal | 3(100.0) | 7(70.0) | 14(73.7) | |
| High | 0(0.0) | 2(20.0) | 0(0.0) | |
| Creatinine umol/l | 54.13±48.20 | 66.45±11.50 | 80.41±73.79 | **0.029** |
| **Creatinine Ranges** | | | | **0.007** |
| Low | 1(33.3) | 0(0.0) | 0(0.0) | |
| Normal | 1(33.3) | 10(100.0) | 18(90.0) | |
| High | 1(33.3) | 0(0.0) | 2(10.0) | |
| Uric acid umol/l | 417.37±173.56 | 275.20±49.46 | 310.35±60.41 | 0.018 |
| **Uric acid Ranges** | | | | 0.246 |
| Low | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal | 2(66.7) | 10(100.0) | 17(85.0) | |
| High | 1(33.3) | 0(0.0) | 3(15.0) | |
| Cholesterol | 5.35±1.02 | 6.39±0.33 | 5.92±1.17 | 0.769 |
| **Cholesterol Range** | | | | 0.478 |
| Norm(<5.2mmol/l) | 1(33.3) | 0(0.0) | 7(43.8) | |
| High(>5.2mmol/l) | 2(66.7) | 2(100.0) | 9(56.3) | |
| HDL | 1.30±0.15 | 1.66±0.34 | 1.48±0.46 | 0.657 |
| **HDL Ranges** | | | | 0.849 |
| >0.91mmol/l (N) | 3(100.0) | 2(100.0) | 15(93.8) | |
| <0.91mmol/l (L) | 0(0.0) | 0(0.0) | 1(6.3) | |
| LDL | 3.41±0.61 | 3.97±0.52 | 1.50±0.78 | 0.910 |
| **LDL Ranges** | | | | 0.281 |
| <3.4mmol/l (N) | 1(33.3) | 0(0.0) | 9(43.8) | |
| >3.4mmol/l (H) | 2(66.7) | 2(100.0) | 7(43.8) | |
| VLDL | 0.64±0.29 | 0.76±0.14 | 0.80±0.35 | 0.733 |
| **VLDL Ranges** | | | | - |
| Low (<0.10mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal (0.10-1.70) | 3(100.0) | 2(100.0) | 16(100.0) | |
| High (>1.70mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Triglyceride | 1.42±0.65 | 1.68±0.32 | 1.77±0.76 | 0.736 |
| **Triglyceride Ranges** | | | | 0.924 |
| Low (<0.45mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal (0.45-1.71) | 2(66.7) | 1(50.0) | 9(56.3) | |
| **High (>1.71mmol/l)** | 1(33.3) | 1(50.0) | 7(43.8) | |

**Table 4. Hematological and biochemical characteristics of participants after 3rd dose**

| Parameter | Advanced breast cancer | Invasive ductal carcinoma (NST) | Invasive ductal carcinoma (NOS) | P-value |
|---|---|---|---|---|
| **Hb g/dl** | 12.20±1.25 | 12.06±0.90 | 16.82±23.15 | 0.859 |
| **Hb Ranges** | | | | 0.876 |
| Low | 1(33.3) | 2(40.0) | 10(52.6) | |
| Normal | 2(66.7) | 3(60.0) | 8(42.1) | |
| High | 0(0.0) | 0(0.0) | 1(5.3) | |
| WBC $10^9$/l | 3.89±1.27 | 3.81±0.88 | 4.33±1.92 | 0.805 |
| **WBC Ranges** | | | | 0.711 |
| Low | 1(33.3) | 3(60.0) | 11(57.9) | |
| Normal | 2(66.7) | 2(40.0) | 8(42.1) | |
| High | 0(0.0) | 0(0.0) | 0(0.0) | |
| Platelets $10^3$/ul | 310.33±41.06 | 263.60±128.07 | 267.79±114.42 | 0.819 |
| **Platelets Ranges** | | | | 0.800 |
| Low | 0(0.0) | 1(20.0) | 3(15.8) | |
| Normal | 3(100.0) | 3(60.0) | 14(73.7) | |
| High | 0(0.0) | 1(20.0) | 2(10.5) | |
| Creatinine umol/l | 78.33±8.80 | 75.58±8.08 | 75.17±18.67 | 0.955 |
| **Creatinine Ranges** | | | | 0.841 |
| Low | 0(0.0) | 0(0.0) | 2(10.5) | |
| Normal | 3(100.0) | 5(100.0) | 16(84.2) | |
| High | 0(0.0) | 0(0.0) | 1(5.3) | |
| Uric acid umol/l | 312.33±35.73 | 247.66±42.50 | 336.38±73.01 | 0.045 |
| **Uric acid Ranges** | | | | 0.137 |
| Low | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal | 3(100.0) | 5(100.0) | 12(63.7) | |
| High | 0(0.0) | 0(0.0) | 7(36.8) | |
| Cholesterol | 4.63±1.01 | 6.71±0.00 | 6.69±1.55 | 0.278 |
| **Cholesterol Range** | | | | 0.468 |
| Norm(<5.2mmol/l) | 1(50.0) | 0(0.0) | 1(14.3) | |
| High(>5.2mmol/l) | 1(50.0) | 1(100.0) | 6(85.7) | |
| HDL | 1.32±0.47 | 1.74±0.00 | 1.54±0.56 | 0.807 |
| **HDL Ranges** | | | | 0.788 |
| >0.91mmol/l (N) | 2(100.0) | 1(100.0) | 6(85.7) | |
| <0.91mmol/l (L) | 0(0.0) | 0(0.0) | 1(14.3) | |
| LDL | 2.62±0.21 | 0.44±0.00 | 4.25±1.47 | 0.368 |
| **LDL Ranges** | | | | 0.208 |
| <3.4mmol/l (N) | 2(100.0) | 0(0.0) | 3(42.9) | |
| >3.4mmol/l (H) | 0(0.0) | 0(0.0) | 4(57.1) | |
| VLDL | 0.68±0.21 | 0.62±0.00 | 0.89±30 | 0.529 |
| **VLDL Ranges** | | | | - |
| Low (<0.10mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal (0.10-1.70) | 2(100.0) | 1(100.0) | 7(100.0) | |
| High (>1.70mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Triglyceride | 1.50±0.47 | 1.36±0.0 | 1.96±0.66 | 0.533 |
| **Triglyceride Ranges** | | | | 0.565 |
| Low (<0.45mmol/l) | 0(0.0) | 0(0.0) | 0(0.0) | |
| Normal (0.45-1.71) | 1(50.0) | 1(100.0) | 3(42.9) | |
| High (>1.71mmol/l) | 1(50.0) | 0(0.0) | 4(57.1) | |

recorded insignificant normal hematological and biochemical parameters except uric acid which showed significant mean value (p=0.045). Though manifested insignificant, majority of the participants had low WBC, normal PLT levels, and equal normal and low Hb levels. Regarding biochemical parameters most patients had normal creatinine and uric acid, high cholesterol and HDL, low LDL, normal VLDL and triglyceride.

Table 5 shows the clinical, hematological and biochemical characteristics of participants throughout the cycles of chemotherapy. Systolic blood pressure (SBP) reduced significantly

(p=0.026) throughout the cycles whilst diastolic blood pressure (DBP) significantly (p=0.029) reduced by 2nd cycle and increase again slightly after 3rd cycle. WBC reduced significantly (p=0.008) throughout the cycles, and HDL increased significantly (p=0.014) throughout the cycles. The comparative mean values of the rest of the parameters throughout the cycles were insignificant although Hb decreased by the 2nd cycle and increased after 3rd cycle, uric acid increased throughout the cycle, creatinine was maintained throughout cycles. Cholesterol, LDL, VLDL and triglyceride increased throughout the cycle of chemotherapy (p>0.05).

Table 6 Compares the various clinical, hematological, and biochemical parameters among the stages of the cycles, comparing the various parameters, SBP decreased (p=0.035) after 2nd dose to after 3rd dose, DBP decreased (p=0.071) from 1st dose to after 2nd dose, WBC decreased significantly (p=0.008) throughout all the stages of the cycle and HDL increased significantly (p=0.014) from the 1st dose to after 2nd dose. Comparison of the rest of the parameters recorded insignificant values (p>0.005).

## 4. DISCUSSION

For hundreds of thousands of patients diagnosed with cancer each year, chemotherapy remains the anti-cancer treatment of choice [15]. Cyclophosphamide, adriamycin and 5-fluorouracil (CAF) is one of the most effective anti-neoplastic therapies in use today and is prescribed to millions of women worldwide for the adjuvant or palliative treatment of breast cancer (Fisher 1989). However chemotherapy, (CAF regimen) is known to have adverse effect on the hematological and biochemical profile consequently causing neutropenia, thrombocy-topenia, anemia, hyperuricemia and dyslipidemia [16].

**Table 5. Clinical, hematological and biochemical demographics of participants**

| Parameter | Before 1st dose | After 2nd 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 | 15.44 ± 10.39 | 0.281 |
| WBC (x 109/L) | 5.63 ± 2.20 | 4.55 ± 1.93 | 4.18 ± 1.69 | 0.008 |
| PLT (x 103/uL) | 299.4 ± 147.6 | 275.8 ± 120.1 | 271.7 ± 109.1 | 0.622 |
| Uric acid (µmol/l/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 | 6.27±1.57 | 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 |
| Triglyceride | 1.57±0.68 | 1.72±0.71 | 1.81±0.61 | 0.521 |

**Table 6. Anova comparison of parameters throughout the cycles**

| Parameter | Before 1st dose | After 2nd dose | After 3rd dose | $P^{*}$ | $P^{\alpha}$ |
|---|---|---|---|---|---|
| SBP (mmHg) | 133.49 | 124.45 | 123.26 | 0.050 | 0.035 |
| DSP (mmHg) | 82.54 | 76.54 | 77.19 | 0.031 | 0.071 |
| Hb (g/dl) | 11.84 | 11.78 | 15.44 | 0.999 | 0.259 |
| WBC ($10^9$/l) | 5.63 | 4.55 | 4.18 | 0.040 | 0.008 |
| PLT ($10^3$/µl) | 299.41 | 275.82 | 271.74 | 0.653 | 0.596 |
| Uric Acid (µmol/l) | 306.07 | 309.43 | 317.28 | 0.977 | 0.798 |
| Creatinine (µmol/l) | 75.65 | 73.79 | 75.60 | 0.887 | 1.000 |
| Cholesterol | 5.51 | 5.88 | 6.28 | 0.545 | 0.251 |
| HDL | 1.173 | 1.471 | 1.520 | 0.027 | 0.054 |
| LDL | 3.616 | 3.629 | 3.934 | 0.991 | 0.738 |
| VLDL | 0.714 | 0.780 | 0.823 | 0.638 | 0.505 |
| Triglyceride | 1.571 | 1.717 | 1.809 | 0.636 | 0.508 |

*One-way Anova Multiple comparison of parameters using initial measurement (Before 1st) as a baseline for comparison with the other measurements. $P^{*}$ indicates before 1st dose verse after 2nd dose whiles $P^{\alpha}$ indicates before 1st dose verse after 3rd dose*

Our study, in the same vein, reinforces these findings on the adverse effects of chemotherapy on haematological and biochemical parameters. We observed that throughout cycles, systolic blood pressure decreased till after the third cycle and diastolic blood pressure decreased after second cycle but increased slightly after the third cycle. Hemoglobin, though insignificant, decreased after second cycle but increased sharply after the third cycle. White blood cells (WBC) decreased throughout cycles whilst HDL increased throughout the chemotherapy cycles. The levels of uric acid and creatinine remained unchanged throughout the cycles.

The reduced blood pressure (SBP and DBP) recorded in this study confirms the findings of Henderson et al. [16] who observed a significant decrease in systolic and diastolic blood pressure among patients undergoing chemotherapy. Thus confirming the assertions of Henderson and colleagues that cardiotoxicity is reduced during chemotherapy. Our findings however contradicts that of the Partridge et al. [17] which reported cardiac dysfunction as a long term effect of cancer chemotherapy. The duration of the study accounts for the difference in findings. Whereas our study lasted for approximately six months (up to the third cycle) that of Partridge et al. covered data of breast cancer patients over years [8].

Increased frequency of anemia with each doxorubicin dose administration has been reported in breast cancer patients undergoing chemotherapy [7]. Though hemoglobin levels fluctuated throughout the cycles of chemotherapy in our study none of our participants was diagnosed of anemia. This difference could be as a result of the drugs administered. The earlier studies involved the administration of doxorubicin, whilst in our study multivitamins and fersolate (ferrous sulphate) was administered (in addition to the doxorubicin) to curb the likelihood of anemia among our patients. The WBC level observed during the third cycle of our study affirms the observations made in earlier studies [18,6,7].

In agreement with earlier studies conducted in a breast cancer clinic in Kumasi, Ghana [19], we observed an abnormal lipid profile among the breast cancer patients. All lipid parameters increased throughout cycles however, only HDL was significantly increased. The observed increase in HDL also corresponds with earlier studies which recorded normal lipid levels and increased HDL levels at 3 and 6 months of chemotherapy respectively [9,20].

Hyperuricaemia causes renal dysfunction due to high cell turn over (tumour lysis syndrome) in cancer treatment [21]. Even though uric acid increased throughout the cycles of chemotherapy the increase was not significant to warrant any effect on renal function hence the observed creatinine among our participants. The short duration of our study and the small sample size employed limits the scope of this study.

## 5. CONCLUSION

Throughout cycles, chemotherapy had significant adverse effect on the clinical profile (systolic and diastolic blood pressure), white blood cells (WBC) and high density lipoprotein (HDL) in patients undergoing treatment. These parameters should be regularly monitored in breast cancer patients undergoing chemotherapy.

## CONSENT

Informed consent was obtained from the participants or their relatives or spouses before recruitment into the study.

## ETHICAL APPROVAL

Ethical approval was granted by the Institutional Review Board of the University of Cape Coast (IRB/UCC), and the hospital.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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