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Original Research Article

Evaluation of Platelet Indices and Serum Iron in Women Diagnosed with Breast Cancer in Owerri, Nigeria

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Abstract: ***Background*:** Breast cancer is the leading cause of cancer-related mortality among women worldwide. Platelet indices and serum iron have been implicated in cancer pathophysiology and may serve as potential biomarkers in breast cancer. ***Objective*:** This study aimed to evaluate the levels of platelet indices and serum iron in breast cancer patients attending Imo Specialist Hospital, Owerri, Nigeria. ***Methods*:** A total of 60 subjects, comprising 30 breast cancer patients and 30 apparently healthy controls, were recruited for this cross-sectional study. Ethical approval was obtained, and informed consent was secured from all participants. Structured questionnaires were administered to gather socio-demographic and clinical data. Six (6) mL of venous blood was collected from each participant; 2mL was dispensed into ethylenediaminetetraacetic acid (EDTA) containers for platelet indices determination using an autoanalyzer, and 4 mL into plain tubes for serum separation and iron analysis using spectrophotometry. Data was analyzed using SPSS version 27, with mean, standard deviation, Student's t-test, Pearson correlation, and p-values determined. ***Results*:** The mean values of mean platelet volume (MPV), platelet distribution width (PDW), and serum iron were significantly higher in breast cancer patients [(10.51±1.89) fL, (20.29±7.66) %, and (50.40±15.22) µg/dL, respectively] compared to controls [(7.81±0.46) fL, (15.33±2.89) %, and (27.13±8.45) µg/dL] with p-values of 0.000, 0.002, and 0.000, respectively. However, no significant differences were observed in plateletcrit (PCT) (0.23±0.23) % and platelet large cell ratio (P-LCR) (22.91±7.52) % in breast cancer patients when compared to controls (0.19±0.07) % and (17.59±20.09) % (p=0.338 and p=0.180]. Age-stratified analysis revealed no significant differences in MPV, PDW, PCT, P-LCR, and serum iron between breast cancer patients aged 35–50 years and those older than 50 years (p>0.05). Furthermore, there was a non-significant positive correlation between serum iron and platelet indices, including MPV (r=0.09, p=0.607), PDW (r=0.04, p=0.833), PCT (r=0.15, p=0.421), and P-LCR (r=0.19, p=0.304). ***Conclusion*:** This study shows that breast cancer is associated with significantly raised MPV, PDW, and serum iron levels, suggesting enhanced platelet activation and altered iron metabolism in affected patients. These findings imply that MPV and PDW may serve as useful markers for platelet activation, tumor progression, and inflammation in breast cancer. Additionally, elevated serum iron may reflect its involvement in breast cancer pathogenesis. Routine evaluation of platelet indices, particularly MPV and PDW, along with serum iron levels, should be recommended as part of the diagnostic and prognostic assessment of breast cancer patients. Further large-scale studies are warranted to validate the utility of these parameters as biomarkers for breast cancer progression and therapeutic monitoring.

Keywords: Platelet Indices, Serum Iron, Breast Cancer.

1. INTRODUCTION

Cancer is a term for diseases in which abnormal cells divide without control and can invade other tissues [1]. Breast cancer, which forms in tissues of the breast, usually in the ducts (tubes that carry milk) and lobules (glands that produce milk), is one of the most prevalent malignancies globally. It occurs in both men and women, although male breast cancer is rare [2].

Breast cancer is among the leading causes of cancer-related deaths in women worldwide [3]. Globally, more than 2.3 million new cases are diagnosed each year, contributing significantly to the global cancer burden [3]. In Nigeria, the incidence of breast cancer is reported to be approximately 54.3 per 100,000 women, with rising trends annually [4].

Platelets are anucleated cytoplasmic fragments derived from megakaryocytes, traditionally known for their role in hemostasis and thrombosis [5]. However, beyond their role in coagulation, platelets are increasingly recognized for their contribution to cancer progression and metastasis [6]. Platelets secrete various growth factors and cytokines that promote angiogenesis, tumor growth, invasion, and metastasis of cancer cells [6].

Platelet indices, including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR), are part of routine hematological parameters measured in automated blood counts [7]. MPV reflects the average size of platelets and indicates platelet production and activation [8]. Larger platelets are metabolically and enzymatically more active, contributing to pro-thrombotic and inflammatory states associated with malignancies [9].

Furthermore, MPV has been proposed as a marker for identifying patients with invasive ductal breast carcinoma, with elevated MPV values linked to increased platelet aggregation, thromboxane synthesis, and β-thromboglobulin release [10]. Plateletcrit (PCT), calculated from platelet count and MPV, reflects the total platelet mass and has been associated with platelet activation status in malignancies [11]. Platelet-to-lymphocyte ratio (PLR), another derived parameter, has been associated with prognosis in various cancers, including breast cancer [12].

Iron is a vital trace element necessary for multiple biological processes, including oxygen transport, energy metabolism, and DNA synthesis [13]. However, disturbances in iron metabolism, leading to iron overload, can promote oxidative stress, DNA damage, and tumorigenesis [14].

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out at Imo Specialist Hospital, Umuguma, Owerri, Imo State, Nigeria.

2.2 Study Design

A cross-sectional study was carried out from the month of February to May, 2024 and all eligible subjects who gave a written informed consent for the study and completed a questionnaire were enrolled in the study. The study population consisted of 20 breast cancer patients and an equivalent number of age matched non-breast cancer subjects who served as the controls. The procedure was carried out at Imo Specialist Hospital, Owerri. The results of the tests were analyzed using SPSS version 27.

2.3 Sample Collection

Six (6) millilitres of venous blood sample was collected from the antecubital vein aseptically, 2ml was dispensed into ethylenediaminetetraacetic acid containers, while 4ml was dispensed into plain containers. The EDTA and plain containers were properly labeled with the subjects' names, sample numbers and date of collection. The blood dispensed into the EDTA container was stored in a refrigerator at 4^0C while the serum was stored in a freezer at -20^0C prior to use.

2.4 Ethical Consideration

This study was approved by the ethics review committee of Imo Specialist Hospital, Umuguma, Owerri, and subjects who gave their informed consent were enrolled in the study.

2.5 Laboratory Analysis

The platelet indices was determined using haematology autoanalyser (Sysmex KX2IN), while serum iron was estimated using spectrophotometry.

2.6 Statistical Analysis

Data obtained from the study were analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. The results were presented as mean ± standard deviation (SD). Student's t-test for independent samples was used to compare the mean differences between breast cancer patients and apparently healthy controls, as well as between different age groups of breast cancer patients.

The Pearson correlation coefficient (r) was used to determine the relationship between serum iron levels and platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), and platelet large cell ratio (P-LCR) among breast cancer patients. A p-value of less than 0.05 ($p<0.05$) was considered statistically significant. Results were summarized in tables for clarity and interpretation.

3. RESULTS

The mean values of MPV, PDW and serum iron were significantly higher in breast cancer patients (10.51±1.89)fl, (20.29±7.66)% and (50.40±15.22) µg/dl when compared to controls (7.81±0.46)fl, (15.33±2.89)% and (27.13±8.45) µg/dl (p=0.000, p=0.002 and p=0.000).

There was no significant increase in the mean values of PCT and PLCR in breast cancer patients (0.23±0.23) % and (22.91±7.52)% when compared to controls (0.19±0.07)% and (17.59±20.09)% (p=0.338 and p=0.180).

Table 1: Mean Values of Platelet Indices and Serum Iron in Breast Cancer Patients Versus Controls

Parameter	Test n=30	Control n=30	t-value	p-value
MPV (fl)	10.51±1.89	7.81±0.46	7.59	0.000*
PDW (%)	20.29±7.66	15.33±2.89	3.32	0.002*
PCT (%)	0.23±0.23	0.19±0.07	0.97	0.338
PLCR (%)	22.91±7.52	17.59±20.09	1.36	0.180
Iron (µg/dl)	50.40±15.22	27.13±8.45	7.32	0.000*

KEY:
*: Significant p-values
MPV- Mean Platelet Volume
PDW- Platelet Distribution Width
PCT- Plateletcrit
PLCR- Platelet Large Cell Ratio

There was no significant difference in the mean values of MPV(10.13±1.27)fl, PDW (21.65±10.53)%, PCT(0.30±0.34)%, PLCR(20.40±3.82)% and serum iron (43.91±16.79) µg/dl in breast cancer patients within the age range of (35-50)yrs when compared to breast cancer patients within the age range of (>50)yrs (10.63±2.58)fl, (20.13±6.29)% , (0.18±0.13)% ,(24.64±7.48)% and (54.92±14.49) µg/dl (t= 0.59, p=0.562; t= 0.44, p= 0,665; t= 1.21, p= 0.240; t=1.70, p= 0.103; t= 1.73, p=0.098).

Table 2: Mean Values of Platelet Indices and Serum Iron in Breast Cancer Patients Based on Age

Parameter	(35-50)yrs	(>50)yrs	t-value	p-value
MPV (fl)	10.13±1.27	10.63±2.58	0.59	0.562
PDW (%)	21.65±10.53	20.13±6.29	0.44	0.665
PCT (%)	0.30±0.34	0.18±0.13	1.21	0.240
PLCR (%)	20.40±3.82	24.64±7.48	1.70	0.103
Iron (µg/dl)	43.91±16.79	54.92±14.49	1.73	0.098

KEY:
MPV- Mean Platelet Volume
PDW- Platelet Distribution Width
PCT- Plateletcrit
PLCR- Platelet Large Cell Ratio

There was a non-significant positive correlation of serum iron with MPV, PDW, PCT, PLCR in breast cancer patients (r=0.09, p=0.607; r=0.04, p=0.833; r=0.15, p=0.421 and r=0.19, p=0.304).

Table 3: Correlation of Serum Iron with MPV, PDW, PCT, PLCR in Breast Cancer Patients

Variable	N	r	p-value
MPV (fl)	30	0.09	0.607
PDW (%)	30	0.04	0.833
PCT (%)	30	0.15	0.421
PLCR (%)	30	0.19	0.304

KEY:
MPV- Mean Platelet Volume
PDW- Platelet Distribution Width
PCT- Plateletcrit
PLCR- Platelet Large Cell Ratio

4. DISCUSSION

Breast cancer remains the leading cause of cancer death among women worldwide [3]. Platelet-related indices have been suggested as potential prognostic markers in malignancies [15].

In this study, MPV was significantly elevated in breast cancer patients compared to controls, suggesting increased platelet activation and inflammatory responses in malignancy [8]. Similar findings have been reported, where elevated MPV was associated with poor prognosis in breast, endometrial, and gastric cancers [16]. MPV has also been correlated with advanced tumor stage and metastasis in breast cancer [17]. However, conflicting reports exist; for instance, Mutlu et al. observed that lower MPV predicted a better pathologic response to neoadjuvant chemotherapy [18].

PDW was also significantly higher in breast cancer patients, reflecting variability in platelet size and increased heterogeneity due to inflammatory responses

[19]. This finding aligns with previous studies demonstrating that higher PDW is associated with metastasis and poor prognosis in breast cancer [19, 20].

No significant difference was observed in PCT between breast cancer patients and controls, consistent with findings by Lu *et al.*, suggesting that PCT may not be altered in early or stable disease [21]. Conversely, some studies reported elevated or reduced PCT in cancer patients, possibly due to differences in cancer stages, treatment status, or comorbidities [22, 23]. Similarly, P-LCR did not show significant variation between groups, a finding in line with other reports [24]. Although some studies suggested P-LCR as a prognostic factor, results have been inconsistent [25].

Serum iron was significantly higher in breast cancer patients, potentially linked to estrogen-driven upregulation of iron metabolism and oxidative stress pathways [26]. Elevated iron levels may result from tumor-induced dysregulation of iron homeostasis or systemic inflammation [27].

Furthermore, no significant correlation was found between serum iron and platelet indices (MPV, PDW, PCT, P-LCR), suggesting independent regulation of iron metabolism and platelet activation in breast cancer patients, consistent with previous reports [28].

5. CONCLUSION

This study has shown that breast cancer is associated with significantly raised MPV, PDW, and serum iron levels, suggesting enhanced platelet activation and altered iron metabolism in affected patients. However, PCT and P-LCR did not show significant alterations. These findings imply that MPV and PDW may serve as useful markers for platelet activation, tumor progression, and inflammation in breast cancer. Additionally, elevated serum iron may reflect its involvement in breast cancer pathogenesis. Routine evaluation of platelet indices, particularly MPV and PDW, along with serum iron levels, should be recommended as part of the diagnostic and prognostic assessment of breast cancer patients. Further large-scale studies are warranted to validate the utility of these parameters as biomarkers for breast cancer progression and therapeutic monitoring.

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