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Biochemical Profiling of Pro-inflammatory (ILs) and Hormonal Markers (HGH) as Predictive Biomarkers Implications in Iraqi Women with Breast Carcinoma

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Abstract

Breast Cancer (BC) is most common in women. About two-thirds of BC cases are hormone-dependent. The proliferation, differentiation, & survival of both normal tissue & breast cancer are regulated by the interleukin (IL) family. This study aimed to measure and compare the serum levels of three pro-inflammatory interleukins (IL-18, IL-23, as well as IL-27) with human growth hormone (HGH), carcinoembryonic antigen (CEA), and cancer antigen 15–3 (CA 15–3) in Iraqi BC patients and control subjects. In addition to determine the correlation between those markers and clinical-pathological variants. A cross-sectional study was conducted with 65 Iraqi women who had been diagnosed with breast cancer & 65 healthy female controls. Clinical pathology data, such as age, BMI, histological grade, BC types, and lymph node status, were associated with serum levels of HGH, CEA, and CA 15-3, as assessed by the Electro Chemiluminescence Immune Assay (ECLIA), as well as various ILs, as determined by the ELISA approach. The Serum (HGH) level in BC patients were significantly elevated, measuring approximately twice as high as the control group. IL-18 levels were highly significantly increased, reaching more than three times the concentration of controls. In a similar vein, IL-27 levels almost doubled in the BC group, while IL-23 exhibited a highly significant rise ($P > 0.0001$). Relevant relationships were identified between these biomarkers and various clinic pathological features. The biomarkers being studied HGH, CEA, CA15-3, IL-18, IL-23, & IL-27 markedly distinguish breast cancer patients from healthy controls. However, they show no significant correlation with tumor grade, stage, metastasis or histological types in this study population, suggesting their primary utility lies in initial detection rather than staging.

Keywords: *Breast Cancer, Human Growth Hormone, Interleukins, ECLIA.*

Introduction

One of the leading causes of death for women worldwide is breast cancer (1). The presence or lack of hormone receptors is the primary factor used to categorize breast cancer. Breast cancer can be broadly categorized as either hormone receptor negative (hormone-independent) or hormone receptor positive (hormone-dependent) (2). The

development and management of many malignancies, especially breast and prostate tumors, depend heavily on hormonal receptors, including those for estrogen, progesterone, and androgens (3). However, prolactin, growth hormone (GH), growth hormone releasing peptide, and gonadotropin releasing hormone are pituitary hormones that have been well studied in relation to breast cancer. Pituitary hormones and their receptors are likely to have serious therapeutic effect on breast cancer both independently and after combined usage together with standard methods of therapy. In the past ten years, HGH has drawn a lot of interest in relation to the development, spread, and metastasis of cancer (4). Breast cancer growth and immunological regulation are significantly influenced by cytokines. Pro-inflammatory and immunosuppressive cytokines can be employed as prognostic markers and therapeutic targets since they are linked to poor outcomes. There is substantial clinical potential for their incorporation into customized treatment plans (5). Because interleukins (ILs) have a role as inflammatory mediators in the genesis, development, and progression of breast cancers, a wide range of inflammatory cytokines or biomarkers have been discovered and investigated. These cytokines cause breast epithelial cells to undergo malignant transformation, survive longer, proliferate, and develop cancer (6). Since elevated amounts of interleukin-18 (IL-18) have been found in the blood of patients with metastatic breast cancer, the biology of many ILs has been linked to the development of breast cancer (7). IL-18 was initially discovered as an IFN-γ-producing factor. The pro-inflammatory cytokine interleukin-23 (IL-23) is composed of two subunits: p19 (IL-23A) and p40 (IL-12/23B) (8). The IL-23 levels may increase in breast cancer, it promotes angiogenesis within the tumor microenvironment, it is also has a pro-carcinogenic activity (9). Interleukin-27 is made up of IL-27p28 (p28) and Epstein-Barr virus-induced molecule 3 (EBI3) (10). Patients with breast cancer have been shown to have elevated IL-27 levels (11). Review of literature regarding breast cancer in Iraq in general and in Anbar province in specific revealed scarce publication. Consequently this study aimed to measure and compare the levels of three pro-inflammatory interleukins (IL-18, IL-23, and IL-27) with human growth hormone (HGH), carcino embryonic antigen (CEA) and cancer antigen 15–3 (CA 15–3) in Iraqi BC patients and control subjects. Additionally, to investigate the correlation between those markers and clinical pathological variants.

Materials and Methods

The Ethical Approval statement

This study approved by the Human ethics committee of both Anbar Specialized Center for Oncology and Fallujah Teaching Hospital. All participants signed written informed consent before its enrolment. The research ensured the privacy of the information of subjects.

Subjects

All samples were collected from both Anbar Specialized Center for Oncology and Fallujah Teaching Hospital then transferred to a sterile test tube and then transferred to the laboratory for requested investigations. Blood samples from sixty-five (65) Iraqi

patients who had previously been diagnosed with breast cancer were gathered and categorized into stages I, II, III, and IV.

Sample collection and Preparation

Five milliliters of the collected blood were put into gel tubes (serum separation tube SST), allowed to coagulate at room temperature for thirty minutes at 18 to 25 degrees Celsius, and then centrifuged for ten minutes at 5000 rounds per minute (rpm) to extract serum. The serum was separated and kept in frozen at -20°C. This serum samples were thawed once at the time to avoid sample retro gradation, and used for the following tests:

- Immunological Analysis of Serum (HGH) concentration.
- Immunological Marker (IL-18,IL-23,IL-27) levels .
- Biochemical Analysis of (CEA and CA15-3) concentration.

Immunological Analysis measurement of serum (HGH) concentration

This test was done using Kit and device available from Nipigon Company that uses ECLIA technique to measure the concentration of HGH, According to instruction of company and previous publication (12).

Interleukins measurement by Enzyme-Linked Immunosorbent Assay (ELISA)

IL-18, IL-23, and IL-27 were estimated in patients and control subjects by using Sunlong ELISA kit employs sandwich-ELISA. The procedures was done according to the instruction of the company and previous publication (13, 14), the Standard Dilution for IL-18 and IL-23 displayed in table.1, and for IL-27 in table.2.

Table.1: Standard Dilution for IL-18 and IL-23

Standard Concentration	Standard No	Dilution procedure
90 pg/ml	S1	150µl of normal diluent plus 300µl of origin standard
60 pg/ml	S2	150 µl of normal diluent plus 300 µl of standard No. 1
30 pg/ml	S3	150 µl of normal diluent plus 150 µl of standard No. 2
15 pg/ml	S4	150 µl of normal diluent plus 150 µl of standard No. 3
7.5 pg/ml	S5	150 µl of normal diluent plus 150 µl of standard No. 4

Table. 2: Standard Dilution for IL-27

Standard Concentration	Standard No	Dilution procedure
180 pg/ml	S1	150µl of normal diluent plus 300µl of origin standard

120 pg/ml	S2	150 µl of normal diluent plus 300 µl of standard No. 1
60 pg/ml	S3	150 µl of normal diluent plus 150 µl of standard No. 2
30 pg/ml	S4	150 µl of normal diluent plus 150 µl of standard No. 3
15 pg/ml	S5	150 µl of normal diluent plus 150 µl of standard No. 4

Measurement of human Serum (CEA and CA15.3) concentrations

The concentrations of CEA and CA15.3 were estimated by using Electro Chemiluminescence Immune Assay "ECLIA" method, designed to be utilized with COBAS E 411 immunoassay analyzers. that used to quantitatively assess human blood CEA and CA 15-3. The COBAS ECLIA analyzer (Roche Diagnostics, Basel, Switzerland) was used to automatically quantify the levels of CEA and CA 15-3. The signal from chemiluminescence is transformed into concentration. The test was done according to method described previously (15).

Assessment of Body Mass Index (BMI)

According to previous publication (16), and using the following equation:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

- BMI for underweight below 18.5
- The range of a healthy weight is 18.5 to 24.9
- overweight between 25 – 30 for obese above 30.

Statistical Analysis

The expression for every collection of data is (Mean ± Standard Deviation) of mean. GraphPad Prism (version 9.5.1, LLA, CA, USA) was utilized to do the statistical analysis. The t-tests non-parametric analysis was performed using by Mann-Whitney test comparison between different groups; NS: Non significant difference: $p > 0.05$, *: significant: $p \leq 0.05$, **: Very significant: $p \leq 0.01$, ***: Highly significant: $p \leq 0.001$ and ****: Excellent significant: $p \leq 0.0001$ were considered statistical significant (17).

Results

The result of human growth hormone level in the study groups.

Human growth hormone (HGH) levels were substantially greater in the BC group than in the healthy control group (0.634 ± 0.09 ng/mL vs. 1.24 ± 0.22 ng/mL, $P < 0.0001$). The statistical significance of the difference between these two groups is shown in (table 3).

Table. 3 : The serum level of (HGH) in both healthy control and BC patients

Groups	Human Growth Hormone (ng/mL)
Healthy	0.634 ± 0.09
patients	1.24 ± 0.22
T value	2.46
P value	<0.0001*

*** P<0.01 indicates a highly significant difference**

The results the comparative analysis of Interleukins (ILs)

In this study, individuals with breast cancer (BC) and a healthy control group had their blood levels of three particular interleukins (IL-18, IL-23, and IL-27) analyzed. The results was displayed as Mean ± Standard Error in (Table. 4). Compared to the healthy control group, patients had significantly greater amounts of all three interleukins. The greatest significant rise was seen in IL-18, which was more than three times greater in sick than in healthy individuals. In both groups, IL-27 remained at the highest total concentration, almost doubling in the patient group. When compared to the healthy control group, the unwell group's IL-23 concentration was noticeably greater. A statistical significant were seen in all comparison yielded a P-value < 0.0001*.

Table 4 : The blood concentrations of (ILs) in BC patients and healthy controls.

Groups	Biological Parameters		
	IL-18 (pg/ml)	**IL-23 (pg/ml)**	**IL-27 (pg/ml)**
Healthy	1510.68±48.4	1866.19±56.1	13440.06±556
patients	4586.88±138.6	3122.04±78.4	27405.95±674
T value	20.94	13.01	15.96
P value	<0.0001*	<0.0001*	<0.0001*

*** At P<0.01, a highly significant difference**

The results of CEA and CA15-3 concentrations as tumor biomarkers

The results of quantitative measurement of CEA and CA15-3 concentrations in serum samples were displayed as mean ± SEM. A high statistical significant * (P≤0.01) concentration for CA15-3 (45.65±1.31 U/ml versus 13.36±1.25 U/ml) were observed in BC patient in compare to control subjects. Moreover, the results also showed the CEA concentration mean ± SEM that was higher * (P≤0.01) than the control groups (11.67±0.44 ng/ml versus 3.35±0.13 ng/ml, respectively) , show in (Table. 5).

Table 5 : The CEA and CA15-3 concentration in both studied groups

Groups	Parameters	
	CEA (ng/ml)	**CA 15-3 (U/ml)**
Healthy	3.35 ± 0.13	13.36 ± 1.25
patients	11.67 ± 0.44	45.65 ± 1.31
T value	17.77	17.78
P value	<0.0001*	<0.0001*

*** At P<0.01, a highly significant difference**

The Relationships between grades of cancer and studied parameters

The statistical analysis of the investigated parameters in this study showed somehow relationship to grades of cancer in (table 6). The mean Tumor Marker CEA levels progressively increased from grade I (11.25 ± 0.80) to grade IV(13.50), but this was not statistically significant (p = 0.853). And the CA 15-3 (U/ml): Levels were highest in grade IV (55.40), with no significant differences across grades (p = 0.201). With a borderline non-significant p-value (p = 0.05), grade I had the greatest level of interleukins (IL-18, IL-23, and IL-27, including IL-18 pg/ml) (5222.62 ± 312.1), while grade II had the lowest amount (4299.88 ± 162.4). There was no discernible variation in IL-23 pg/ml levels between grades (p = 0.798). Regarding IL-27 (pg/ml), grade IV had the highest amount (29874.20), but there was no discernible difference (p = 0.784). HGH levels varied by grade, with grade III having the greatest level (1.70 ± 0.05) and grade IV having the lowest (0.34). Nevertheless, the difference (p = 0.674) was not statistically significant. Table 6 displays all of these. The values of the examined parameters (CEA, CA 15-3, IL-18, IL-23, IL-27, and HGH) do not change significantly (P > 0.05) between the various cancer grades (from Grade I to Grade IV), according to the statistical analysis of the parameters.

Table. 6: The studied parameters across breast cancer grades

Parameter	Breast Cancer Grades				P value
	I	II	III	IV	
CEA (ng/ml)	11.25±0.80	11.65±0.64	11.88±1.22	13.50	0.853*
CA 15-3 (U/ml)	48.85±2.63	44.77±1.67	42.54±3.17	55.40	0.201*
IL-18 (pg/ml)	5222.62±312.1	4299.88±162.4	4627.96±252.8	4872.20	0.054*
IL-23 (pg/ml)	3143.98±187.4	3169.82±120.6	3009.58±38.3	2836.10	0.798*
IL-27 (pg/ml)	28018.62±1620	26840.94±645.2	27872.16± 2636.7	29874.20	0.784*
HGH	1.36±0.09	1.11±0.13	1.70±0.05	0.34	0.674*

*** No significant difference at P<0.05**

Evaluation the relation between parameters and BC stages

The statistical analysis for the relation between the investigated parameters and cancer grades displayed in (Table. 7). For biomarker stability, the tumor marker CEA (ng/ml) Levels ranged from 10.63 ± 0.9 (stage II) to 12.58 ± 0.76 (stage III), with no statistically significant difference across stages (p = 0.386). Nonetheless, a statistical significant difference (p = 0.950) in the CA 15-3 (U/ml) levels which became from 44.95 ±2.16 (stage III) to 47.26 ±3.10 (stage IV). For IL-18 (pg/ml), stage II had the highest level (4752.35 ± 241) but stage I was the lowest (4399.17 ± 544.9), and this difference was not significant (p = 0.879). The IL-23 (pg/ml) levels were varied slightly across stages, with no significant difference (p = 0.636). The IL-27 (pg/ml) levels increased gradually from stage I (26748.17 ± 148.0) to stage IV (28341.52 ± 1350.1), the difference was not statistically meaningful (p = 0.913). For the hormone HGH (pg/ml), on stage-wise comparison, it was highest in stage IV (1.96 ± 0.07) and lowest levels were found in stage III (0.57 ± 0.13) which relatively significant but not statistically significant (p = 0.091).

None of the serum detected parameters (CEA, CA 15-3, IL-18, IL-23, IL-27 and HGH) levels change significantly in different clinical stages of breast tumor according to P value (> 0.05).

Table. 7: The studied parameters across breast cancer stages

Parameter	Breast Cancer Stages				P value
	I	II	III	IV	
CEA (ng/ml)	11.75±0.52	10.63±0.98	12.58±0.76	11.44±0.83	0.386*
CA 15-3 (U/ml)	45.75±4.36	45.48±2.5	44.95±2.16	47.26±3.10	0.950*
IL-18 (pg/ml)	4399.17±544.9	4752.35±241	4544.34±221.4	4557.4±304.9	0.879*
IL-23 (pg/ml)	3118.8±189.5	3209.49±166.7	2992.674±118.6	3243.44±195.3	0.636*
IL-27 (pg/ml)	26748.17±1480	27060.9±1752.5	27477.26±928.5	28341.52±1350.1	0.913*
HGH	1.24±0.05	1.65±0.11	0.57±0.13	1.96±0.07	0.091*

*** No significant difference at P<0.05**

The Relationships between lymph node of BC and studied biomarkers

According to the statistical study, patients with positive and negative metastasis lymph nodes showed no variation at (P> 0.05). Patients with lymph nodes had a greater level of CEA (12 ± 0.46 ng/ml) than those without (11.11 ± 0.92 ng/ml), although there were no statistically significant differences (P = 0.348). Regarding CA 15-3, the two groups' results were almost equal (45.81 ± 1.56 vs. 45.40 ± 2.45; P = 0.885). As for the IL-18 levels were marginally elevated in lymph node-positive patients (4613.90 ± 162.8 pg/ml) compared to negative ones (4540.96 ± 263.5 pg/ml), without statistical significance (P = 0.805). And the IL-23 levels were slightly lower in lymph node-positive patients (3100.14 ± 94.9 pg/ml) compared to lymph node-negative patients (3159.27 ± 143.1 pg/ml), also not significant (P = 0.724). Patients with lymph node positivity recently had slightly lower levels of IL-27 (27145.10 ± 757.4 pg/ml vs negative patients: 27849.41 ± 1334.5 pg/ml, P = 0.624). HGH levels were not statistically significant (P = 0.425) being lower in those with lymph nodes (1.12 ± 0.12) than those Lymph Node - (1.49±0.08)(Table. 8).

Table. 8: Relationships between lymph node and studied parameters

Parameters	Lymph node		P value
	Lymph Node +	Lymph Node -	
CEA (ng/ml)	12±0.46	11.11±0.92	0.348*
CA 15-3 (U/ml)	45.81±1.56	45.40±2.45	0.885*
IL-18 (pg/ml)	4613.90±162.8	4540.96±263.5	0.805*
IL-23 (pg/ml)	3100.14±94.9	3159.27±143.1	0.724*
IL-27 (pg/ml)	27145.10±757.4	27849.41±1334.5	0.624*
HGH	1.12±0.12	1.49±0.08	0.425*

*** No significant difference at P<0.05.**

Evaluation of parameters relative to breast cancer metastasis status

Individuals with metastases (+) as well as those without (−) showed no significant statistical variations in any of the measured variables (P > 0.05). While this difference was not significant at the 0.05 level (P = 0.185), metastatic patients showed higher CEA

levels on average (12.25 ± 0.53 ng/ml) than non-metastatic groups (11.05 ± 0.70 ng/ml). CA 15-3 levels were comparable between metastatic and non-metastatic groups (45.31 ± 1.63 vs. 46.03 ± 2.15; P = 0.789). The blood levels of IL-18 in metastatic patients (4625.91 ± 182.6 pg/ml) as well as non-metastatic patients (4544.85 ± 217.4 pg/ml) did not vary statistically significantly (P = 0.777). The levels of IL-23 in the metastatic patients (3070.68 ± 110.8 pg/ml) were less than those in non-metastatic patients (3177.35 ± 113.4 pg/ml) but it does not reach statistics significance (P = 0.508). Additionally, the two groups' IL-27 levels were almost the same (27389.26 ± 909.2 vs. 27423.94 ± 1040; P = 0.980). However, with metastases exhibited lower HGH levels (1.05 ± 0.09) than those without metastases (1.48 ± 0.13), however the difference was not statistically significant (P = 0.337)(Table. 9).

Table. 9: Relationships between metastasis and studied parameters

Parameters	**Metastasis**		**P-value**
	+	_	
CEA (ng/ml)	12.25±0.53	11.05±0.70	0.185*
CA 15-3 (U/ml)	45.31±1.63	46.03±2.15	0.789*
IL-18 (pg/ml)	4625.91±182.6	4544.85±217.4	0.777*
IL-23 (pg/ml)	3070.68±110.8	3177.35±113.4	0.508*
IL-27 (pg/ml)	27389.26±909.2	27423.94±1040	0.980*
HGH	1.05±0.09	1.48±0.13	0.337*

*** No significant difference at P<0.05**

Evaluation of biomarkers relative to breast cancer main types

Mean values of biomarkers exhibited differences among different cancers, but none reached statistical significance (P > 0.05). The CEA levels were slightly higher in Invasive Lobular Carcinoma (ILC)(12.14 ± 1.81 ng/ml) cancer type compared to Invasive Ductal Carcinoma (IDC) (11.99 ± 0.49 ng/ml) and Ductal Carcinoma In Situ (DCIS) (10.43 ± 0.41 ng/ml) types, but without statistical significance (P= 0.348). The CA 15-3 levels were highest in DCIS (48.67 ± 3.34 U/ml) cancer type, followed by (IDC) (46.21 ± 1.50 U/ml) and lowest in ILC (40.28 ± 2.55 U/ml) types, with no significant difference (P = 0.110) between them. The greatest amounts of IL-18 were seen in IDC (4641.68 ± 180 pg/ml), DCIS (4580.93 ± 278.8 pg/ml), and ILC (4418.68 ± 399.4 pg/ml). Yet these results were statistically insignificant (P = 0.844). IL-23 expression level in ILC (3200.72 ± 268.3 pg/ml), IDC (3117.86 ± 100.8 pg/ml) and DCIS (3067.63 ± 113.8 pg/ml) was not significantly different (P = 0.872). The mean IL-27 level was lowest in ILC (26033.82 ± 909.5 pg/ml) and highest in DCIS (28710.45 ± 2180 pg/ml), however this difference was not significant (p = 0.406). And the HGH levels were higher in DCIS (1.58 ± 0.11) compared to IDC (1.05 ± 0.06), yet without statistical significance (P = 0.549), displayed in (table 10).

Table. 10: Illustrates the relationships between BC types and studied parameters

Parameters	**Types of cancer**			**P-value**
	IDC	**ILC**	**DCIS**	

CEA (ng/ml)	11.99±0.49	12.14±1.81	10.43±0.41	0.348*
CA 15-3 (U/ml)	46.21±1.50	40.28±2.55	48.67±3.34	0.110*
IL-18 (pg/ml)	4641.68±180	4418.68±399.4	4580.93±278.8	0.844*
IL-23 (pg/ml)	3117.86±100.8	3200.72±268.3	3067.63±113.8	0.872*
IL-27 (pg/ml)	27345.56±765.4	26033.82±909.5	28710.45±2180	0.466*
HGH	1.05±0.06	1.53±0.007	1.58±0.11	0.549*

*** No significant difference at P<0.05**

Discussion

Breast cancer growth and metastasis are linked to a number of interleukins (ILs), a subfamily of cytokines that mediate intercellular interactions within the immune system, including cell migration, proliferation, maturation, and adhesion (18). The interleukins have important roles in breast cancer by promoting and inhibition tumor formation within the tumor microenvironment (19). The results of the previous comparative case-control study showed that the Iraqi female BC patients had significantly higher blood levels of IL-12 family members (IL-12, IL-23, IL-27, IL-35, and IL-39) than healthy controls. These findings approved the state of immunological dysregulation brought on by tumors that referred to the concurrent activation and inhibition of anti-tumor immunity (20). Previous study also showed their roles as contributing factor in the development of different human malignancies. Additionally, it showed the important cytokines, especially interleukins for BC initiation, migration, and progression via IL signaling in cancer cells (21). The result of HGH level show clearly link between heightened HGH levels and the illness state, since the patient group's HGH levels are almost twice as high as those of the healthy control group. The calculated T-value of 2.46 provides additional evidence of the significant difference between the healthy individuals and the breast cancer patients. This result agree with previously published studies, that showed the linking between HGH gene and a bad prognosis in a number of cancer types, and show that HGH overexpression related to reduces apoptosis, increases invasion, migration and proliferation, whereas its knockdown has the opposite effects (22). Interestingly, gene expression in breast cancer cells may be regulated differentially by exogenous and autocrine GH, with the latter promoting a more aggressive cellular phenotype. Human breast cancer cells have been shown to express more GHR, and a poor prognosis and metastatic breast cancer have been linked to GH tumor expression (23). By triggering downstream signaling pathways and controlling many growth factors, including insulin-like growth factor-1 (IGF-1) & vascular endothelial growth factor (VEGF), GH also significantly contributes to its development and dissemination. GH and IGF-1 levels in the blood are often higher in individuals with breast cancer (24). The result of quantitative measurement of both CEA and CA15-3 concentrations in serum samples showed a high statistical significant * ($P \leq 0.01$) concentration in BC patients compare to control subjects. Moreover, the CEA concentration was higher * ($P \leq 0.01$) than the control groups. This result agrees with previously published studies (25), which found a significant correlation ($p<0.05$) between the blood concentration of tumor markers (CA-15.3 & CEA) and breast cancer sickness in connection to certain immunological markers, when compared to the control group, while negative on ER/PR was statistically significant. However, Al Alouci *et al.*, (2026) showed higher recurrence of breast cancer that was linked to greater serum CA 15-3 and CEA. Their results indicated more aggressive tumor biology and hormonal regulation that may result in the usage of these biomarkers in the disease progression monitoring and

prediction (26). The findings of the current study are also consistent with previous studies (21). Ghazi *et al.,* (2026) showed the elevation in the levels of tumor markers (CEA, CA15-3), hormonal receptors (ER, PR), and inflammatory biomarkers that indicated a link between inflammation, hormonal regulation, and tumor progression, highlighting their diagnostic and prognostic value in breast cancer (27). The combined serum tumor marker model CA15-3, CEA, & CYFRA 21−1 (CCC) is a reliable, direct, and cheap approach in this retrospective study of chemotherapy response in breast cancer patients. This CCC model might be used in conjunction with imaging technologies to provide more accurate therapy monitoring, and even directing urgent therapeutic modifications (28).

Conclusions

This study demonstrates that serum levels of Human Growth Hormone (HGH) and interleukins (IL-18, IL-23, and IL-27) are significantly elevated in breast cancer (BC) patients compared to healthy individuals, suggesting their potential utility as diagnostic biomarkers. However, these markers, along with CEA and CA 15-3, showed no statistically significant correlation with disease progression or tumor characteristics. Specifically, biomarker levels remained consistent across all BC grades (I–IV) and clinical stages (I–IV). Furthermore, no significant associations were observed regarding lymph node involvement, metastatic status, or specific histological types (IDC, ILC, and DCIS). While these biomarkers effectively distinguish BC patients from healthy controls, they appear to lack the sensitivity required to predict tumor staging, grading, or metastatic spread. Consequently, consideration of these biomarkers as prognostic indicators for disease progression remains limited within this study population, despite their role for initial detection of BC.

Declarations

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Ethics statement

The author approved that this research follows the journal's Attached Ethic Approval guidelines as appeared on the journal's author guidelines page.

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Competing interest’s statement

The author declare that she has no conflict of interest.

Author contributions

RAA provided the concepts, data analysis, and writing of the manuscript, worked with data collection and analysis, revised the manuscript and analyzed the data.

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