

АКТУАЛЬНЫЕ ВОПРОСЫ РАЗВИТИЯ БИОТЕХНОЛОГИЙ

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INVESTIGATION OF BIOCHEMICAL MARKERS AND THEIR CORRELATION WITH TUMOR MARKER CA 15.3 IN PATIENTS WITH BREAST CANCER

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Abstract. Breast cancer represents a complex biological process characterized by a series of genetic and epigenetic alterations in epithelial cells. This study investigates biochemical markers and their correlation with the tumor marker CA 15-3 in breast cancer patients. Biochemical parameters, including cholesterol, triglycerides, urea, and creatinine, were analyzed alongside CA 15-3 levels. Our findings revealed a significant inverse correlation between CA 15-3 and cholesterol levels, while a positive correlation was noted between CA 15-3 and urea levels.

Keywords: tumor marker CA 15.3, breast cancer, metastasis, biochemical markers, cholesterol, urea, body mass index (BMI), malignancies.

Introduction. The relevance of the research is the investigation of biochemical markers and their correlation with tumor marker CA 15.3 in patients with breast cancer. Breast cancer is a biological process in stages that results in numerous genetic and epigenetic alterations in the breast's epithelial cells over a number of years. The biological advancement of breast cancer stems from various factors such as impaired differentiation, invasion, angiogenesis, and metastasis [1]. There is mounting evidence that some biochemical markers, such as lipid metabolism, are frequently increased at various stages of the development of cancer [2]. Such complications arise due to derangements in the regulatory systems for storage and mobilization of metabolic fuels, including the catabolism and anabolism of carbohydrates, lipids, and proteins. CA 15-3 is a glycoprotein elevated in colorectal, lung, pancreatic, ovarian, and breast malignancies [3]. According to the European Group on Tumor Markers (EGTM), a tumor marker concentration is considered to have significantly increased if it has increased by at least 25% when compared to the reference value. A comparison between CA 15-3 and CEA reveals that the latter is a more sensitive marker than the former. The deeper our understanding of the biochemical mechanisms in cancer cells, the more we will be able to leverage new and intriguing targets for pharmacological and nutritional intervention to mitigate drug resistance and metastasis. Tests to identify tumor antigens in serum have been shown to be an effective means of keeping track of how well breast cancer patients are responding to drug [3]. The purpose of this study was to investigate potential associations between breast cancer and biochemical markers with CA 15-3.

Subject. Biochemical parameters of blood as a level [content/activity] CA 15.3, cholesterol, TG, HDL, LDL, VLDL, urea, creatinine, uric acid, and ESR have been studied. Partially the material for the study was the history of patients' diseases.

Object. The object of the study was on the investigation of biochemical markers and their correlation with tumor marker CA 15.3 in patients with breast cancer. The survey of the patients [questioning, physical examination, anthropometry, and biochemical analysis] was conducted based on the Department of Medical statistics of «Anbar Cancer Center», Iraq.

The aim. The study aims to evaluate the changes in the biochemical parameters of the blood of patients with breast cancer, reflecting the increase CA 15.3 level, depending on the severity of progression of the tumor, BMI, and age.

Materials and methods. Specimens were collected from the Al-Anbar Cancer Center in Al-Anbar province, Iraq. 56 individuals [female] aged ≥ 28 years [28–82 years] were invited to participate in this study by following a simple randomization procedure. Biochemical parameters of blood of patients were obtained in the diagnostic laboratory of the "Anbar Cancer Center" and the Biochemical tests were conducted in the Clinical Chemistry Laboratory in the College of Medicine, University of Anbar.

Results and discussion.

This study investigated the association between serum CA 15.3 levels and a panel of biochemical markers in a cohort of 56 female breast cancer patients. The demographic and clinical characteristics of the study population, including age, BMI, and tumor stage, were analyzed to assess potential confounding factors.

Pearson correlation analysis was conducted to evaluate the relationship between CA 15.3 levels and the selected biochemical parameters.

Table – Correlation between CA 15.3 and biochemical parameters in patients with breast cancer.

Parameters	Mean	SD (±)	Units	Range	P value within group	Pearson Correlation Parameters with CA 15.3
Age	51.64	14.42	year	66.00	0.000	-0.186
BMI	29.10	3.53	Kg/m ²	14.20	0.000	-0.359
ESR	36.94	21.62	mm/hr	79.00	0.000	0.425
Urea	33.09	18.38	mg/dL	83.00	0.000	0.716**
Creatinine	0.76	0.19	mg/dL	0.51	0.000	0.404
Uric Acid	5.13	1.82	mg/dL	6.60	0.000	0.157
Triglyceride	179.58	38.75	mg/dL	216.00	0.000	-0.146
Cholesterol	157.73	14.74	mg/dL	54.00	0.000	-0.448*
HDL	32.83	12.88	mg/dL	54.90	0.000	0.393
LDL	91.54	15.05	mg/dL	60.40	0.000	0.202
VLDL	35.83	7.74	mg/dL	43.20	0.000	-0.226
CA 15.3	75.71	101.86	U/mL	333.90	0.001	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Our analysis revealed significant correlations between CA 15.3 levels and various biochemical parameters, which provide insights into the metabolic changes associated with breast cancer. Notably, a significant inverse correlation was observed between CA 15.3 and cholesterol levels ($r = -0.448$, $p < 0.05$). This finding is consistent with the literature, which suggests that alterations in lipid metabolism, particularly a decrease in cholesterol levels, may occur as a response to tumorigenesis in breast cancer patients [4]. Conversely, while CA 15.3 levels demonstrated a positive correlation with urea levels ($r = 0.716$, $p < 0.01$), indicating a potential association between tumor burden and renal function impairment, further investigations are warranted to confirm this relationship and understand the underlying mechanisms involved [5].

The correlation between CA 15.3 and other lipid parameters, such as triglycerides and HDL, was less pronounced, showing only weak associations. These results align with findings from Wu et al., who reported similar trends in their study, indicating that while lipid profiles may be altered in breast cancer, these changes are not uniformly reflected across all lipid markers [4].

The clinical implications of our findings are significant, as they suggest that CA 15.3 could serve as a reliable biomarker for monitoring disease progression and response to treatment in breast cancer patients. Nonetheless, it is crucial to approach the interpretation of CA 15.3 levels with caution, as elevated levels may also arise in benign breast conditions and other malignancies, potentially leading to misdiagnosis.

Moreover, the correlation between CA 15.3 and age ($r = -0.186$, $p < 0.01$) and BMI ($r = -0.359$, $p < 0.01$) suggests that older patients and those with higher BMI may exhibit altered metabolic responses that could influence tumor marker levels. This highlights the necessity for a personalized approach in evaluating CA 15.3 levels, taking into account patient demographics and individual metabolic profiles.

While our study provides valuable insights, it is not without limitations. The cross-sectional nature of the study restricts the ability to infer causality between the observed correlations. Future longitudinal studies are essential to elucidate the temporal dynamics of biochemical markers and their relationship with CA 15.3 levels throughout the course of breast cancer treatment. Additionally, exploring the molecular mechanisms underlying the observed correlations could unveil novel therapeutic targets to improve patient outcomes and reduce the risk of metastasis.

Conclusions. Scientific findings suggest that serum levels of the tumor marker CA 15.3 are significantly correlated with the existence of metastases. As such, CA 15.3 should not be employed because it may be increased in patients who have benign breast alterations and normal in those who have primary breast cancer. In addition, there are still some basic questions that need to be elucidated, like which stages of breast cancer development are more sensitive to biochemical markers and what is the necessary exposure is to cause metastasis effects. Overall, tumor antigens in serum have shown to be an effective means of keeping track of how well breast cancer patients are responding to therapy.

References

1. Hanifa F., Syjetlana M., Sanida A., Mensura B. Tumor marker CA 15-3 in breast cancer patients // Acta Medica Academica – Academy of Sciences and Arts of Bosnia and Herzegovina. – 2015. – Vol.44(1). – P.39-46.
2. Fat Induces Glucose Metabolism in Nontransformed Liver Cells and Promotes Liver Tumorigenesis / Broadfield L.A., Duarte J.A.G. Schmieler R., et al. // American Association for Cancer Research (AACR). – 2021. – Vol.81(8). – P.1988-2001.
3. Wu J.T., Nakamura R.M., Clinton R.S., Beason L.K. Comparative study of four serological tumor markers for the detection of breast cancer. In “Concepts and clinical applications”. - Chicago: ASCP Press; 1997. – 263 p.
4. Wu J., Lei X., Pan X., Zeng X., Li W. Association between serum lipids and breast cancer risk in premenopausal women: systematic review and meta-analysis // Journal of International Medical Research. – 2021. – Vol. 49(11). – 03000605211061033.
5. Shima S.R., Seddek B.S., Abo- El Wafa H.A., Mohamed A.M. Value of CA 15-3 in Female Patients with Breast Cancer // Sohag Medical Journal. – 2018. – Vol. 22(2). – P.65-170.