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The Effect of Breast Cancer on antioxidants after during the chemotherapy phase and relationship with Cancer antigen (CA15-3)

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Abstract:

Breast cancer, a form of cancer originating in the cells of ducts or lobules in the breast, is detected by the cancer antigen CA15-3. This study indicated the effect of Breast cancer on antioxidants (SOD, GPX, TAC and thiol group) compared with healthy control group, were collected 90 specimens' (60 serum samples from Breast cancer patients and 30 serum samples from the control group), collected from Baghdad Teaching hospital during a period between to January to March 2024, with an age range between 30-55 year. The results indicate to high significant increase in mean level of Cancer antigen (CA15-3) and thiol group in serum of Breast cancer patients as compared with the control ($p \leq 0.05$), while the mean level of Superoxide Dismutase (SOD), Glutathione Peroxidase (GPX), Total antioxidant capacity (TAC) was showed a high significant decrease ($p \leq 0.05$) in serum of Breast cancer patients as compared with the control. This study aimed to the effect of Breast cancer on antioxidants during the chemotherapy phase and relationship with Cancer antigen (CA15-3).

Key Words: Cancer antigen (CA15-3), Glutathione Peroxidase, Superoxide Dismutase, Total antioxidant capacity, Thiol group.

تأثير سرطان الثدي على مضادات الأكسدة بعد مرحلة العلاج الكيميائي وعلاقته بمستضد (CA15-3)السرطان

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مستخلص:

سرطان الثدي هو أحد أنواع السرطان الذي ينشأ في خلايا القنوات أو الفصيصات في الثدي، ويتم الكشف عنه عن طريق مستضد السرطان CA15-3. وقد أشارت هذه الدراسة إلى تأثير سرطان الثدي على مضادات الأكسدة (SOD، GPX، TAC ومجموعة الثايول) مقارنة بمجموعة السيطرة، حيث تم جمع 90 عينة (60عينة من مرضى سرطان الثدي و30 عينة من مجموعة السيطرة)، تم جمعها من مستشفى بغداد التعليمي خلال الفترة ما بين يناير إلى مارس 2024، وبمدى عمري يتراوح بين 55-30 سنة. تشير النتائج إلى ارتفاع معنوي كبير في متوسط مستوى مستضد السرطان (CA15-3) ومجموعة الثايول في مصل مرضى سرطان الثدي مقارنة مع المجموعة الضابطة عند مستوى الاحتمالية ($p \leq 0.05$)، بينما أظهر متوسط مستوى إنزيم أكسيداز الفائق (SOD)، والكلوتاثيون بيروكسيديز (GPX)، والسعة الكلية المضادة للأكسدة (TAC) انخفاضاً معنوياً عند مستوى الاحتمالية ($p \leq 0.05$) في مصل مرضى سرطان الثدي مقارنة مع المجموعة السيطرة. تهدفت هذه الدراسة إلى معرفة تأثير سرطان الثدي على مضادات الأكسدة خلال مرحلة العلاج الكيميائي والعلاقة مع مستضد السرطان (CA15-3).

الكلمات المفتاحية: مستضد السرطان (CA15-3)، الكلوتاثيون بيروكسيديز، سوبر أكسيد ديسميوتاز، القدرة الكلية المضادة للأكسدة، مجموعة الثايول.

INTRODUCTION

Breast cancer a form of cancer originating in the cells of ducts or lobules in the breast is characterized by the uncontrolled proliferation of epithelial cells culminating in the formation of a tumor within breast tissue. This malignancy has the potential to metastasize to distant organs via the lymphatic system or bloodstream resulting in the development of secondary tumors in remote locations[1]. Various risk factors associated with breast cancer include age hormonal influences genetic predisposition, level of physical activity as well as environmental elements such as exposure to radiation and certain chemicals[2]. The primary indicators of breast cancer include the detection of a mass or enlargement in the breast or beneath the armpit a change in the size or shape of the breast a change in the color or texture of the skin such as redness peeling or the appearance of pimples[3].

Cancer antigen (CA15-3) is a serum tumor marker primarily associated with breast cancer commonly used for diagnosis, monitoring and predicting recurrence in patients with breast cancer[4]. CA15-3 is a soluble form of the MUC-1 protein shed into the bloodstream due to disrupted tissue architecture in neoplastic transformations making it detectable through immunoassays. Elevated CA15-3 levels have been linked to a higher risk of recurrence in early breast cancer patients with a significant impact on prognosis[5].

Antioxidants (AO) are complex compounds that work to combat harmful reactive species caused by oxidative stress, the most important of which are reactive oxygen species (ROS) and free radicals[6], Antioxidants play a crucial role in breast cancer by counteracting oxidative stress a key factor in the disease's development and progression, also regulating stress signaling inducing programmed cell death and enhancing the effectiveness of breast cancer treatment[7].

METHODS

Sample collection and study design: 90 specimens' (60 serum samples from breast cancer patients and 30 serum samples from the control group), collected from Baghdad Teaching Hospital during a period between January and March 2024, with an age range of 30-55 years. The study includes determination of serum cancer antigen (CA15-3) according to the standard enzymatic colorimetric methods by using kits provided from My Biosoruce - America.

The study also includes determination of serum Antioxidants which include Superoxide Dismutase (SOD), Glutathione Peroxidase (GPX), Total antioxidant capacity (TAC) and Thiol group, according to Zhang & Rao[8]; Sariri & Jafarian[9] ;Apak & Altun[10]; Riddles & Zerner[11]; respectively.

RESULTS

The present study includes the determination of Cancer antigen (CA15-3) and Antioxidants which include, Superoxide Dismutase (SOD), Glutathione Peroxidase (GPX), Total antioxidant capacity (TAC) and Thiol group. The results obtained are summarized in Table 1.

Table 1. mean ± standard deviation of biochemical parameters under investigation between patients and control.

Groups / Parameters	Mean ± SD		p-value
	Control	Patients	
CA 15-3(U/ml)	2.826±0.566	25.228±4.611	<0.05*
SOD (U/ml)	5.134±0.940	4.366±0.758	<0.05*
GPX(U/L)	0.836±0.272	0.364±0.123	<0.05*
TAC (mmol/L)	1.941±0.399	1.225±0.295	<0.05*
Thio group (mmol/L)	0.527±0.056	0.602±0.090	<0.05*

The results indicate that cancer antigen (CA15-3) showed a significant ($p \leq 0.05$) increase in the serum of breast cancer patients compared to the control group, Figure 1, and the thiol group showed a significant increase ($p \leq 0.05$) in the serum of breast cancer patients compared to the control group Figure 2, while the levels of phosphorus superoxide dismutase (SOD), glutathione peroxidase (GPX) and total antioxidant capacity (TAC) showed a significant ($p \leq 0.05$) decrease in the serum of breast cancer patients compared to the control group Figures 3, 4 and 5 respectively.

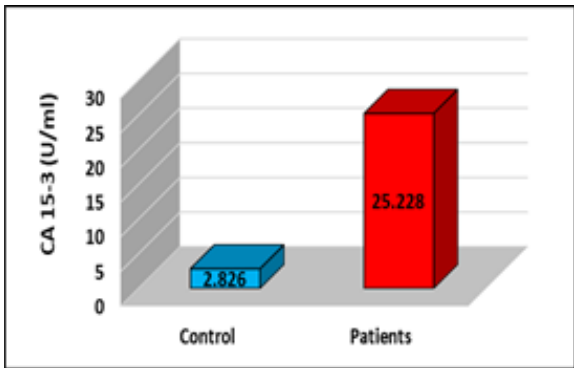

Figure1. The mean of serum (CA15-3) in patients and control groups

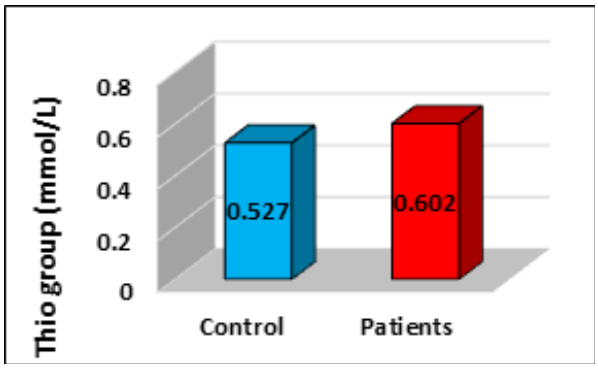

Figure2. Mean of serum (Thio group) in patients and control groups

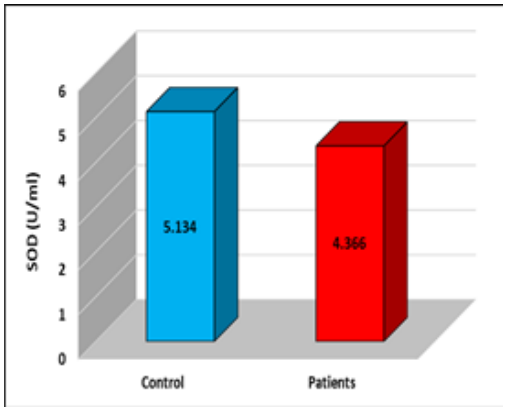

Figure3. Mean of serum SOD in patients and control groups

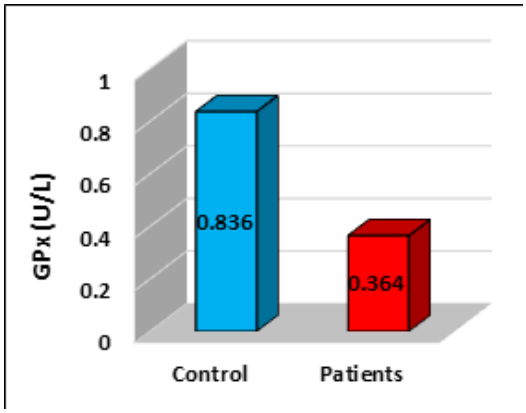

Figure 4. Mean of serum GPX in patients and control groups

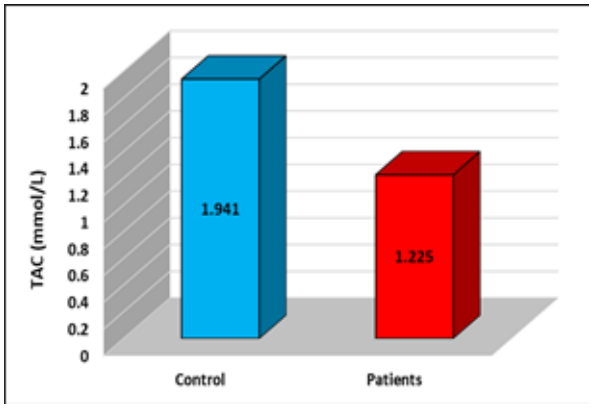

Figure5. Mean of serum TAC in patients and control groups

Table 2. Correlations between patients and healthy control for biochemical parameters.

		CA15.3	
		Control	**Patients**
GPX	**R**	-0.212	-0.087
	P	0.309	0.627
SOD	**R**	-0.128	-0.032
	P	0.500	0.828
TAC	**R**	-0.190	-0.144
	P	0.316	0.364
Thio_ group	**R**	0.182	-0.132
	P	0.336	0.345

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

Scattered dot diagram of correlation serum (CA15-3) healthy control for biochemical parameters.

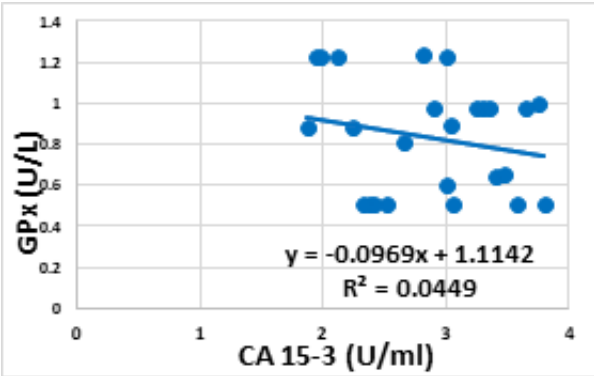

Figure1. Scattered dot diagram of correlation between serum (CA15-3) and GPx in control groups

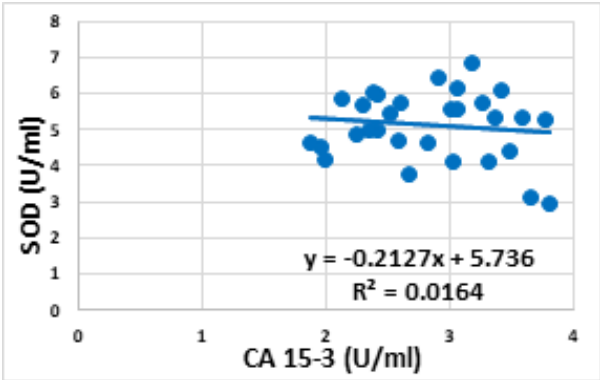

Figure2. Scattered dot diagram of correlation between serum (CA15-3) and SOD in control groups

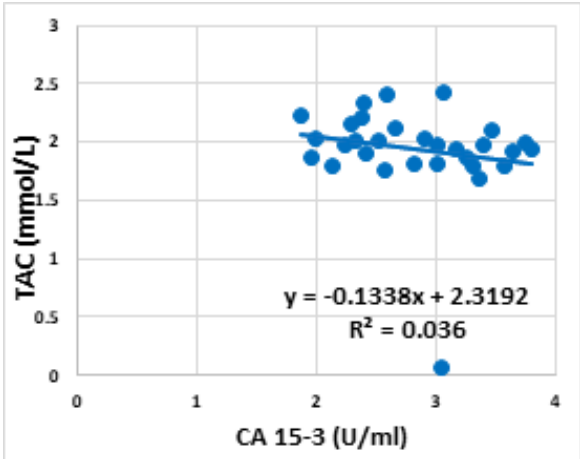

Figure3. Scattered dot diagram of correlation between serum (CA15-3) and TACin control groups

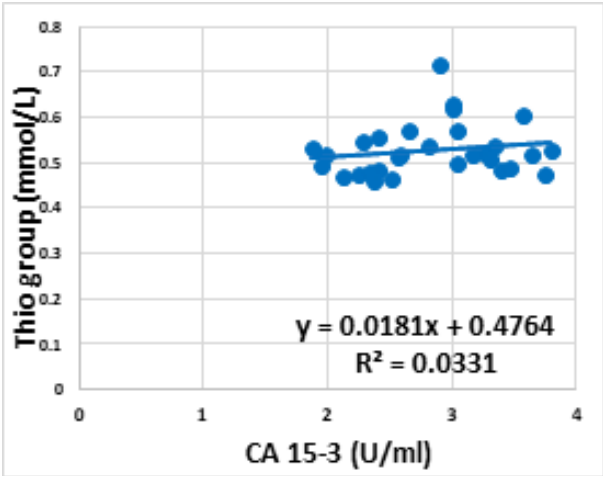

Figure 4. Scattered dot diagram of correlation between serum (CA15-3) and Thio group in control groups

Scattered dot diagram of correlation serum (CA15-3) healthy patients for biochemical parameters.

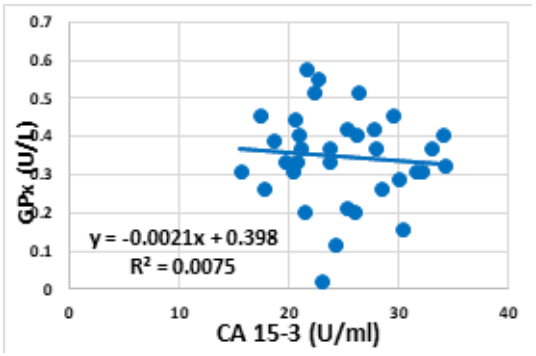

Figure5. Scattered dot diagram of correlation between serum (CA15-3) and GPX in Patients groups

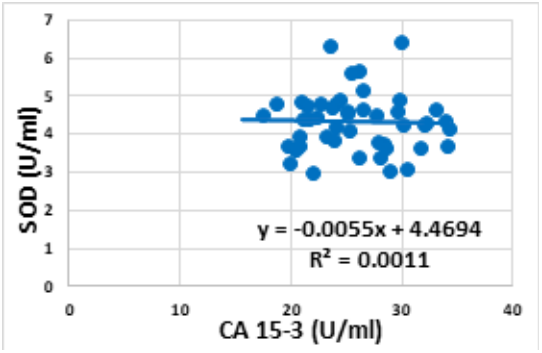

Figure 6. Scattered dot diagram of correlation between serum (CA15-3) and SOD in Patients groups

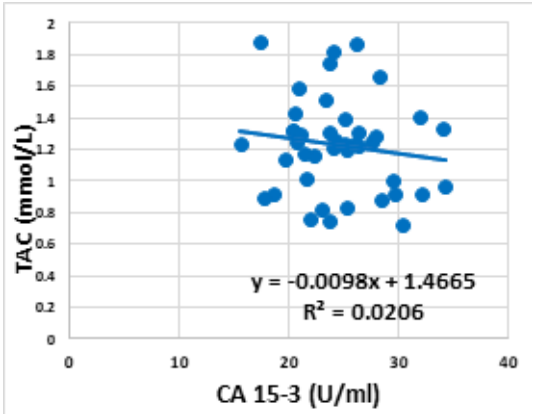

Figure7. Scattered dot diagram of correlation between serum (CA15-3) and TACin Patients groups

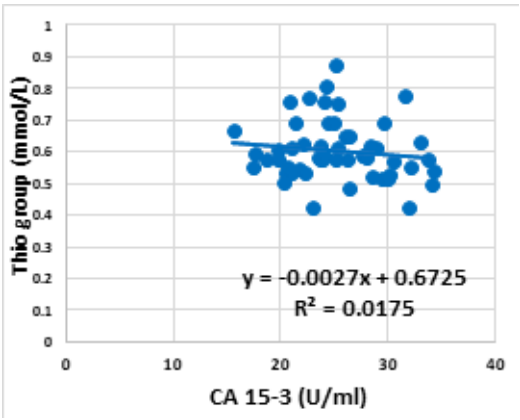

Figure8. Scattered dot diagram of correlation between serum (CA15-3) and Thio group in Patients groups

Discussion

Breast cancer (BC) is most common cancer site in women worldwide. The CA 15-3 is tumor associated antigen which detects soluble forms of MUC-1 protein. In normal breast tissue MUC-1 is expressed in the duct and acini, but with neoplastic transformation normal cell polarization and tissue architecture is disrupted leading to shedding of MUC-1 in the blood where

it can be measured by immunoassay. It is the most widely used serum marker in patients with BC[12]**.** In this study, a higher level was found in the patient group compared to the control group, and the results of this study are consistent with the results of Liu & Chen [13]**.**

The results of the case study indicated an Superoxide Dismutase-SOD, decrease in patients with breast cancer compared to the control group The low level of superoxide dismutase (SOD) in breast cancer patients can be attributed to the increased oxidative stress and decreased antioxidant defense mechanisms. significant reduction in SOD levels in patients, highlighting the impact of oxidative stress on SOD activity in breast cancer and the results of this study are consistent with the results of Barartabar & Ziamajidi[14]**.**

the reason for the decrease Glutathione Peroxidase-GPX in patients compared to the control group, be due to Chemotherapy drugs can induce the different variations in body cells and metabolisms which can result increase in oxidative stress and decrease in antioxidant capacity This is what our current study indicated and is consistent with the results Pakmanesh& Mahjoub[15], he decrease in GPX levels in breast cancer patients may be due to a negative correlation with ROS[16()].

Total antioxidant capacity (TAC) plays a crucial role in breast cancer, especially during chemotherapy. Studies have shown that breast cancer patients undergoing chemotherapy experience alterations in oxidative stress markers, with chemotherapy exacerbating oxidative stress by increasing levels malondialdehyde and reducing TAC , This is what our current study indicated and is consistent with the results Phani& Payala[17].

It was found that the level of thiol groups increased significantly in the sera of breast cancer patients. The results of the current study are not consistent with the results of the study Eryilmaz & Erel[18] and this may be due to the patients' lifestyle and the use of some therapeutic substances such as medications or nutritional supplements.

Conclusion

From all the previous results, we can conclude that the cancer antigen (CA15-3) showed a high significant increase, and the thiol group also showed a significant increase, while the level of antioxidants (superoxide dismutase-SOD, glutathione peroxidase-GPX, total antioxidant capacity-TAC) showed a high significant decrease as a risk factor for breast cancer,

and the total antioxidant capacity may help in evaluating the effects of chemotherapy in breast cancer.

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