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Original research article

Pre and post radiotherapy serum oxidant/antioxidant status in breast cancer patients: Impact of age, BMI and clinical stage of the disease

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ABSTRACT

Aim: In this study the effects of radiation therapy (RT) on serum oxidant/antioxidant status in breast cancer patients and the impact of age, BMI and clinical stage of the disease on the aforementioned variables were investigated.

Background: RT that is used for cancer treatment is dependent on the production of reactive oxygen species.

Materials and methods: Eighty patients with breast cancer participated in this study and received RT at a dose of 50 Gy for 5 weeks. Blood samples were obtained in one day before and after the end of RT. Serum status of malondialdehyde (MDA), total antioxidant status (TAS), superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) were analyzed by spectrophotometry or ELISA and selenium (Se) level were analyzed by atomic absorption spectrometry. Paired *t*-test was used for comparing pre and post radiotherapy data.

Results: Before and after the radiotherapy, a significant increase in MDA level was observed, while a significant decrease in GPx activity, SOD, TAS and Se levels were found ($p < 0.05$). The level of the CAT enzyme had no significant changes ($p = 0.568$). The results showed some changes in the status of TAS, SOD and GPx which are associated with age, BMI and clinical stage of the disease.

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Conclusion: It seems that RT would have the potential to cause variations in the status of antioxidant/oxidant system. Although, some changes in variables were observed by sub-classification of the age, BMI and the disease stage, but it seems that these changes are not necessarily dependent to them.

1. Background

Cancer is the second cause of mortality worldwide and breast cancer is the most prevalent cancer in women, comprising 29 percent of all cancers that they are affected with.[1] It is also worth mentioning that more than one million women are diagnosed with breast cancer annually.[2] According to statistics, the incidence rate of this disease is comparatively low in Asian and African countries, but it is increasing more rapidly in comparison with other countries.[3] Although breast cancer is more prevalent in people older than 50 years, in Iran, the incidence rate of the disease seems to be lower than in the other countries.[4]

The exact etiology of breast cancer has not been completely understood, so it is assumed as a multifactorial disease. Several studies suggested that exposure to various carcinogens would increase the risk of cancer and the best known among the possible causes of breast cancer development are inflammatory factors, nutritional parameters, obesity and genetic mutations.[5,6]

Currently, surgery, radiotherapy (RT), chemotherapy and hormone therapy are effectively used for the treatment of cancer patients.[7,8] RT, as one of commonly used methods for the treatment of cancer, is able to destroy remaining cancer cells after surgery.[9] Patients with cancer need RT either for curative or palliative purposes, but unfortunately, this valuable method is associated with some major side effects.[10] It has been shown that the risk of heart disease would increase after radiation in these patients.[11,12] Although, in RT, the aim is to affect just the target organs, skin, bone marrow hematopoietic cells and the other organs with rapid proliferation rate will also be damaged.[13–16]

Radiation therapy leans on ROS (reactive oxygen species) toxicity and can damage cellular macromolecules, such as DNA (deoxyribonucleic acid), RNA (ribonucleic acid), microRNAs, proteins and membrane in tumor cells.[17–19] Antioxidants protect normal cells against radiation injury through various enzymatic systems, such as catalase, glutathione peroxidase and superoxide dismutase. In addition, normal cells would benefit from non-enzymatic systems (such as selenium, glutathione and tocopherol) to scavenge the free radicals.[20,21] It has been suggested that radiation can cause a decline in the level of vitamins A, E, C and selenium in breast cancer patients.[22,23]

2. Aim

There are some data regarding the effects of RT on various antioxidant/oxidant systems, but the results do not seem to be conclusive. Some studies have reported that RT is able to change the status of the antioxidant/oxidant system,[23–27] while other reports have pointed out this treatment does not have big effects on the antioxidant/oxidant system.[23,28,29] Therefore, in this study, we aimed to determine the exact effects of RT on the oxidant/antioxidant status, the activity of glutathione peroxidase (GPx) and the levels of catalase (CAT), superoxide dismutase (SOD) and selenium (Se) in a group of women with breast cancer. To this end, we followed all the patients before and after RT to determine the effects of this type of treatment on aforementioned variables. In addition, we determined the impact of age, BMI and clinical stage of the disease on the above mentioned biochemical variables.

3. Materials and methods

3.1. *Study population*

This study was performed on 80 women with breast cancer approved by pathological examinations. The demographic and clinical data of the patients, including age, clinical stage, body mass index (BMI) and histological grade were recorded for each patient. The stage of breast cancer was determined by the tumor node metastasis (TNM) system.[30] Forty-five patients with early stage of breast cancer (stage I and II) and 35 patients

Table 1 – Characteristics of breast cancer patient included in this study.

Mean ± SD		*n* (%)
Age (years)	50.42 ± 11.1	80 (100)
BMI (kg/m^2)	30.22 ± 5.26	80 (100)
Clinical stage		
Stage I		8 (10)
Stage II		37 (46.3)
Stage III		31 (38.8)
Stage IV		4 (5)
Estradiol receptor		
Positive		58 (72.5)
Negative		22 (27.5)
Progesterone receptor		
Positive		58 (72.5)
Negative		22 (27.5)
Her-2		
Positive		32 (40)
Negative		48 (60)
Histology type		
IDC		75 (93.8)
ILC		5 (6.2)

Notes: Age and BMI are expressed as mean ± standard deviation (SD); BMI: Body mass index (kg/m^2); Her-2: human epidermal growth factor receptor; IDC: invasive ductal carcinoma; ILC: invasive lobular carcinoma.