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Original Article

Comparing the Levels of Total Plasma Antioxidant Capacity in Hamadan Hospitals Between Radiographic Technologists and Non-radiographic Technologists

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Abstract

Background: Changes in the plasma total antioxidant capacity (TAC) are considered an important prognosis in the formation and progression of many atherogenic diseases, the TAC, carcinogenesis, and inflammation. In this study, plasma TAC values were measured in radiographic and non-radiographic technologists.

Methods: The present study was conducted on 75 people exposed to radiation in the radiology centers of Hamadan hospitals and 75 non-radioactive people working in the other non-radiology departments of Hamadan hospitals. The people in the studied population were matched in terms of age and gender. After preparing their blood samples, the plasma of each was separated, and then, the plasma TAC values were measured by the calorimetric method.

Results: The results showed that the antioxidant capacity of total plasma was lower in radiographic technologists compared to individuals working in other non-radiology departments, so that in the two studied groups, it was 5.32 ± 0.66 and 6.70 ± 0.95 µmol/L, respectively ($P < 0.0001$).

Conclusion: The findings of this research revealed that the plasma TAC was lower in radiographic technologists than in individuals working in other non-radiology departments. Therefore, people exposed to radiation are more exposed to risks caused by changes in plasma TAC, and the use of antioxidant substances is recommended for these people.

Keywords: Plasma, Radiology, Total antioxidant capacity

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Introduction

The compounds of oxidants and free radicals have a high tendency to react with similar molecules since they are highly active and unstable. They have proteins, carbohydrates, and DNA that cause oxidative damage (1,2). The result of these reactions will be a disturbance in the functioning of the cells, and this damage will lead to the death of the mentioned cells if it is severe. Free radicals are created by several mechanisms; they can be formed by losing an electron or taking a hydrogen atom from chemical compounds. The sources of free radicals in the body are endogenous or exogenous (3,4). The most important of these free radicals are created in the body due to the radiation of ionizing rays (e.g., alpha, beta, gamma, and ultraviolet rays), or they are present in environmental pollutants (e.g., substances in cigarette smoke), or they are created as a result of the metabolism of some drugs and the consumption of alcoholic beverages and foods containing high fat (5,6). Since the compounds of oxidants and free radicals are necessary for many physiological and metabolic processes, the body must create a balance of these substances. To prevent the increase in the production of oxidants and provide more protection, body cells have a type of antioxidant biological defense mechanism. Therefore, according to the necessity of maintaining the balance of free radicals in the body by antioxidant agents, by maintaining this balance, the body's defense power can be improved to prevent diseases such as degenerative disorders, cancers, and other chronic diseases in humans (7,8). Studies have shown that radiation can cause the oxidation of biomolecules by producing free radicals. Considering the increasing use of different types of radiation in the radiology departments of hospitals, the possibility of increasing the production of free radicals in

the bodies of the radiologists in these departments does not seem remote (9,10). Given the possible increase in the level of free radicals in radiologists, it was decided to investigate the plasma total antioxidant capacity (TAC) of people working in these centers.

Materials and Methods

This research was conducted on all radiographic technologists (n = 75) working in the diagnostic radiology centers of Hamadan teaching hospitals. All employees in the radiology department of hospitals who were working as a test group were included in the study. All individuals in the test group had worked less than 130 hours in the radiology department. In addition, the effective radiation dose was read by the film badge, and its amount was less than 20 mSv per year.

The control group was also selected from non-radiologists (n = 75) working in the same educational and therapeutic hospitals and with the same demographic characteristics as the test group.

Plasma Separation: First, a few milliliters of fasting blood samples were taken from each person in the study population. Then, ethylenediaminetetraacetic acid anticoagulant was added with a concentration of 0.47 mol/L, and the samples were centrifuged at 2000 rpm for 5 minutes. The supernatant solution of each sample, which was the plasma, was separated.

To measure plasma TAC, different concentrations of ascorbic acid (1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 mg/dL of distilled water) were used as an aqueous phase scavenger. The percentage of hemolysis of red blood cells in an environment containing the 1-acetyl-2-phenylhydrazine solution with a concentration of 1 mM (a radical compound in the aqueous phase) was measured at a wavelength of 520 nm in a spectrophotometer (11).

Plasma TAC values were compared in two test and control groups using a t-test and analysis of variance statistical tests, and the data were analyzed by SPSS software (version 25) at a confidence level of 0.95.

Results

In this research, the plasma TAC was measured in radiographic and non-radiographic technologists working in Hamadan hospitals. Overall, 75 people working in the radiology centers of Hamadan government hospitals and 75 people working in the non-radiology departments of Hamadan hospitals were included in the study. Table 1 provides the data for the statistical analysis of the plasma TAC in the test and control groups. According to the results, the average plasma TAC levels in radiographic technologists and individuals working in other non-radiology departments were 5.32 µmol/L and 6.70 µmol/L, respectively. Moreover, the highest values of plasma TAC in the two test and control groups were 5.79 and 6.95 µmol/L, respectively. On the other hand, the lowest values of plasma TAC in the two test and control groups were 5.12 and 6.11 µmol/L, respectively.

Table 1. Statistical Analysis Information of the Total Plasma Antioxidant Capacity Levels

Statistics (Total Plasma Antioxidant Capacity Levels)	Radiographic Technologists	Non-radiographic Technologists
Number	75	75
Mean	5.32	6.70
Standard deviation	0.66	0.95
Standard error of the mean	0.16	0.19
Median	5.45	6.53
Mode	5.33	6.49
Minimum	5.12	6.11
Maximum	5.78	6.95

Table 2 presents the comparison between the plasma TAC levels between two groups of radiographic technologists and individuals working in other non-radiology departments. According to the data, the average plasma TAC levels in these two groups were 5.45 ± 0.66 and 6.53 ± 0.95 µmol/L, respectively. The observed difference in the amount of plasma TAC at the level of more than 1% was based on the t-test. The observed difference in plasma TAC levels was significant at a level above 5%.

Discussion

With regard to the identification of free radicals in biological systems and their destructive role in the processes of cells, it seems necessary to gain knowledge of radical reactions and ways of producing these compounds in order to use appropriate solutions to deal with their production or reduce damage to cells and tissues. In recent years, researchers' attention has been focused on radicalization phenomena and the role of the body's opposing forces against free radicals.

Studies have shown that radiation can cause the oxidation of proteins and lipids by producing free radicals (12). According to the evidence, it has been determined that antioxidants have the property of protecting against ionizing rays. In a study on human lymphocytes exposed to radiation, it was observed that antioxidant vitamins had protective power against radiation, and the administration of these vitamins after radiation to lymphocytes led to a significant reduction in chromosomal abnormalities (13).

The current study sought to compare the plasma TAC levels in radiographic and non-radiographic technologists. In this study, a significant decrease was observed in plasma TAC levels in radiographic technologists compared to people working in non-radiology departments, and this difference was statistically significant.

According to the findings of Mousavikia et al, hospital radiology department staff experienced an increase in cytogenetic damage when exposed to radiation doses from radiology centers, and the activity level of antioxidant enzymes, namely, superoxide dismutase and catalase, was statistically different ($P > 0.05$) between radiation workers and the control group (9).

Additionally, the results of Gao et al showed that the activity level of superoxide dismutase and catalase

Table 2. Comparison of the Total Plasma Antioxidant Capacity Levels Between the Two Groups

Variables	Number	Mean ± SD (μmol/L)	Mean difference	SE (interval)	Confidence interval of the mean deviation	t	*P* Value
Radiographic technologists	75	5.45 ± 0.66	4.32	1.81	39.56–46.84	23.8	<0.0001*
Non-radiographic technologists	75	6.70 ± 0.95	4.32	1.81	39.56–46.84	23.8	<0.0001*

Note. *Independent two-sample t-test.

enzymes and plasma malondialdehyde levels in radiation workers working in hospitals increased significantly ($P > 0.05$) compared to the control group (10).

According to the findings of Siama et al, the activity of glutathione S-transferase and catalase enzymes decreased while the lipid peroxidation reaction increased in radiation workers working in radiology and photography. Of course, factors such as duration of employment, smoking, age, exposure dose, and number of patients were effective. Chronic low-dose exposure of hospital workers to ionizing radiation leads to reduced antioxidants in their peripheral blood lymphocytes (13).

In the research conducted by Ebrahimpour et al on 70 radiologists working in the radiology centers of Isfahan government hospitals, the level of 8-hydroxy-2-deoxyguanosine (8OHdG) as a marker of oxidative damage to the DNA molecule was measured in the urine samples of individuals. The results of this study showed that the average concentration of 8OHdG in the urine of radiation users was significantly different ($P > 0.05$) compared to non-radiation users (14).

In addition, the results of a study on radiologists demonstrated that these individuals suffered from genomic instability, chromosomal aberrations, and genetic mutations in the DNA molecule in the long term (15).

In the present study, plasma TAC levels were measured as the main marker against the body's radical reaction in radiographic technologists who are constantly exposed to radiation, and it was found that this laboratory factor was extremely lower than non-radioactive individuals, and this difference was significant. The decrease in plasma TAC levels in the test group is probably due to the neutralization of free radicals produced by ionizing radiation. Radiation can induce radical reactions and lipid peroxidation and reduce the basic function of antioxidants such as, vitamin antioxidants.

Considering the role of radicalization of radiation in radiographic technologists working in radiology centers, which was proved in this study and other similar studies, it is necessary for radiologists to pay serious attention to this issue. The reduction of the plasma TAC is considered an important prognosis for the emergence of other diseases and is a warning sign that will endanger the health of these individuals in the future. Therefore, the consumption of dietary antioxidants and vitamins is recommended for radiation workers.

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Authors' Contribution

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Competing Interests

None.

Ethical Approval

This study was approved by the Research Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1386.193).

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References

1. Noguchi N, Saito Y, Niki E. Actions of thiols, persulfides, and polysulfides as free radical scavenging antioxidants. Antioxid Redox Signal. 2023;39(10-12):728-43. doi: 10.1089/ars.2022.0191.
2. Goli Z, Mashayekhi S, Taheri M, Mazdeh M, Safari MR. Determination of plasma malondialdehyde values as a laboratory index of lipid peroxidation reaction in multiple sclerosis patients and its comparison with normal people. Avicenna J Care Health Oper Room. 2023;1(3):90-3. doi: 10.34172/ajchor.34.
3. Kaneko T, Mita Y, Nozawa-Kumada K, Yazaki M, Arisawa M, Niki E, et al. Antioxidant action of persulfides and polysulfides against free radical-mediated lipid peroxidation. Free Radic Res. 2022;56(9-10):677-90. doi: 10.1080/10715762.2023.2165918.
4. Goodarzi MT, Safari MR, Zal F. Inhibitory action of Vit C and mannitol on induced cytotoxic effect of glycated protein-metal ion on rat hepatocyte. Int J Pharmacol. 2006;2(2):201-4. doi: 10.3923/ijp.2006.201.204.
5. Safari MR, Noroozi R, Azari I, Mazdeh M, Taheri M, Ghafouri-Fard S. RAGE polymorphisms are not associated with risk

of multiple sclerosis in Iranian population. Gene Rep. 2019;15:100400. doi: 10.1016/j.genrep.2019.100400.
6. Valko M, Leibfritz D, Moncol J, Cronin MT, Mazur M, Telser J. Free radicals and antioxidants in normal physiological functions and human disease. Int J Biochem Cell Biol. 2007;39(1):44-84. doi: 10.1016/j.biocel.2006.07.001.
7. Safari MR, Dowlati Beirami A, Khazaie M, Komaki A, Noroozi R, Ghafouri-Fard S, et al. GRM7 polymorphisms are not associated with ischemic stroke in Iranian population. Nucleosides Nucleotides Nucleic Acids. 2020;39(5):792-8. doi: 10.1080/15257770.2019.1697883.
8. Ghafouri-Fard S, Safari M, Taheri M, Samadian M. Expression of linear and circular lncRNAs in Alzheimer's disease. J Mol Neurosci. 2022;72(2):187-200. doi: 10.1007/s12031-021-01900-z.
9. Mousavikia SN, Bahreyni Toossi MT, Khademi S, Soukhtanloo M, Azimian H. Evaluation of micronuclei and antioxidant status in hospital radiation workers occupationally exposed to low-dose ionizing radiation. BMC Health Serv Res. 2023;23(1):540. doi: 10.1186/s12913-023-09516-2.
10. Gao J, Dong X, Liu T, Zhang L, Ao L. Antioxidant status and cytogenetic damage in hospital workers occupationally exposed to low dose ionizing radiation. Mutat Res Genet Toxicol Environ Mutagen. 2020;850-851:503152. doi: 10.1016/j.mrgentox.2020.503152.
11. Valkonen M, Kuusi T. Spectrophotometric assay for total peroxyl radical-trapping antioxidant potential in human serum. J Lipid Res. 1997;38(4):823-33.
12. Goli Z, Mashayekhi S, Mazdeh M, Taheri M, Zafari S, Safari MR. Comparison of selenium serum levels in patients with multiple sclerosis and normal individuals. Avicenna J Care Health Oper Room. 2023;1(1):7-10. doi: 10.34172/ajchor.30.
13. Siama Z, Zosang-Zuali M, Vanlalruati A, Jagetia GC, Pau KS, Kumar NS. Chronic low dose exposure of hospital workers to ionizing radiation leads to increased micronuclei frequency and reduced antioxidants in their peripheral blood lymphocytes. Int J Radiat Biol. 2019;95(6):697-709. doi: 10.1080/09553002.2019.1571255.
14. Ebrahimpour K, Forouharmajd F, Salehi A. Effects of occupational exposure to radioactive beams on oxidative DNA damage in radiography staff in Isfahan's public hospitals. Iran Occupational Health. 2020;17(1):59. [Persian].
15. Kochanova D, Gulati S, Durdik M, Jakl L, Kosik P, Skorvaga M, et al. Effects of low-dose ionizing radiation on genomic instability in interventional radiology workers. Sci Rep. 2023;13(1):15525. doi: 10.1038/s41598-023-42139-5.