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Association between Antioxidant Enzymes and Breast Cancer

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Abstract

The exact antioxidant status in breast cancer patient is still not clear. So present study was focused on enzymic antioxidants such as Superoxide dismutase, Catalase, Glutathione-S-transferase, Glutathione peroxidase and Glutathione reductase in the serum of 25 histopathologically proven breast cancer patients. When the data were analyzed with age matched control the antioxidant levels were found to decrease indicating enhanced free radical activity in breast cancer patients while the antioxidant defense mechanism is weakened. However further elaborate clinical studies are required to evaluate the role of such antioxidant enzymes in breast cancer management.

Key Words: Glutathione, Oxidative stress, Antioxidants, Malignancy, Breast Carcinoma

Introduction

Breast caner is one of the most common malignant tumors in our country. Recently, patients suffering from it and dying of it are increased. Though breast cancer could be found early, some patients still died of metastasis and recurrence [1]. Alteration in the oxidant -antioxidant profile is known to occur in cancer [2]. Oxidative stress is due to a disturbance in the balance between the production of ROS and the efficiency of the antioxidant defense. In other words, oxidative stress results if excessive production of ROS overwhelms the antioxidant defense system or when there is a significant decrease or lack of antioxidant defense [3]. Experimental evidence revels that ROS (reactive oxygen species) are involved in initiation and promotion of carcinogenesis, where inactivation or loss of certain tumor suppressor genes is occurred [4]. Free radicals are formed in both physiological and pathological conditions in mammalian tissues. Free radicals are capable of altering all major classes of biomolecules, such as lipid, nucleic acid and protein, with changes in their structure and function [5]. Prime targets of free radicals are poly unsaturated fatty acid in cell membranes and their interaction results in lipid peroxidation. The levels of free radical molecules are controlled by various cellular defense mechanisms, consisting of enzymatic (Catalase, Glutathione peroxidase, Superoxide dismutase) and non-enzymatic (vit.E,vit.C and Glutathione) components [6]. We therefore examined the levels of Superoxide dis mutase, Catalase, Glutathione-S-transferase, Glutathione peroxidase and Glutathione reductase in breast cancer patients.

Materials and Methods

Blood samples were collected from Aringar Anna Cancer Institute, Kancheepuram from 25 clinically and histopathologically proven breast cancer patients and compared with age matched control. The patients were not using hormones, oral contraceptives and were non-smokers. None of them had secondary disorder. Informed consent was obtained from all the participants. The human ethics committee of office of the Director, Govt. Arignar Anna Memorial cancer Hospital, Regional Cancer Center, Karapettai, Kancheepuram vide Ref.No.262/E1/08 has approved the study. Controls consisted of members of the public with no previous history of breast cancer and other cancer related diseases. Blood samples were collected, centrifuged for 15 minutes at 3000rpm and the serum was separated and stored at 4˚C for analysis. Superoxide dis mutase was assayed by following the inhibition of autooxidation of epinephrine spectrophotometrically at 480 nm by Misra Friedovich method. Catalase activity was estimated by measurement of chromic acid in serum at 620 nm by Sinha method. Glutathione peroxidase activity was estimated according to the method of Rotruck et al. with modifications. A known amount of enzyme preparation was allowed to react with H_2O_2 in the presence of reduced glutathione. after specified time period, the remaining glutathione content was measured as described by Anderson. The activity of Glutathione-S-transferase was assayed by the method of Habig et al. by following the increase in absorbance at 340 nm using 1-Chloro-2,4-dinitrobenzene (CDNB) as the substrate. The activity of Glutathione reductase was estimated by Pinto Barley method. The data for biochemical analysis are expressed as mean and standard deviation (SD). The statistical comparisons were performed by one way ANOVA.

Results and Discussion

The mean body weight of breast cancer patient was 61(range 50 - 74) which alters slightly during the study. Values are mean standard deviation of 50 breast cancer patients and controls are indicated in Table 1. The mean and standard deviation of Antioxidant status in breast cancer patients in comparison with age matched control are indicated in Table 2.

Table 1: Mean body weight of Breast cancer patients compared to control.

Parameters	Controls	Patients
No. of persons	50	50
Mean Age	51.6 ± 8.2	52.9 ± 7.7
Mean body weight (kg)	61.8 ± 5.5	62.7 ± 5.7

Table 2: Serum Antioxidant level in Breast cancer Patients compared to control.

Parameters	Control	Breast Cancer Patient
SOD(Unit/mL)	3.2 ± 0.51	1.7 ± 0.16**
CAT(Unit/mL)	5.2 ± 0.94	2.8 ± 0.85**
GST(μ mol/ min)	1.65 ± 0.02	1.12 ± 0.05**
GPx(μ mol/ min)	10 ± 0.5	7.3 ± 2.5**
GRx(μ mol/ min)	4.5 ± 0.05	1.0 ± 0.05**

**p< 0.001 as compared to respective control

The reactive oxygen species (ROS) play an important role in tumor initiation, and that ROS levels, in a healthy organism, are controlled by endogenous mechanisms including glutathione and enzymes like catalase or superoxide dismutase [7]. Elevated ROS levels can initiate DNA damage, and might ultimately lead to carcinogenesis [8]. Compounds capable of either scavenging free radicals or suppression of superoxide generation and antioxidant compounds show cancer chemopreventive effects [9]. Oxidative stress caused by increased free radical generation and/or decreasedantioxidant level in the target cells and tissues has been suggested to play an important role in carcinogenesis [10-12]. It has been hypothesised that the production of ROS combined to a decreased antioxidant enzyme level may be characteristic of tumour cells [13,14].

SOD and Catalase are considered as primary antioxidant enzymes,since they are involve in direct elimination reactive oxygen metabolites.They also act as anti carcinogensand inhibitors at initiation and promotion /transformation stage in carcinogenesis.Mutation caused bypotassium superoxide in mammalian cellsis bloked by SOD.Catalase also prevents chromosomal aberration by hypoxanthine/xanthine Oxidase in Chinese hamster cells [15]. In the present study the level of SOD and CAT were found to be lower in breast cancer patients when compared to control which is similar to the study of Sinha *et al* [16]. Fridovich and Tayarani [17-19] have demonstrated in their respective study that the reduction in SOD activities increases the toxic effect ofO_2 and might lead to cellular damage.

The second line of defense against ROS is provided by Glutathione enzymes. Glutathione (GSH) is the most abundant thiol in cells that can directly scavenge free radical or act as substrate for Glutathione peroxidase (GPx) or Glutathione-S-transferase (GST) during detoxification of H_2O_2 and electrophillic compounds. Glutathione peroxidase reduces H_2O_2 and organic peroxides (ROO) while oxidizing GSH. Oxidized Glutathione (GSSG) is reduced back to GSH by Glutathione reductase (GR) in the presence of f NADPH. GSH in conjugation with GPx, plays a central role in defense against free radicals, peroxides and a wide range of xenobiotics and carcinogens [20]. According to Vanu Ramkumar Ramprasad, Cancer bearing animals showed a significant decrease in Glutathione enzymes when compared to control animals which supports the present study that these enzymes were found to decrease in breast cancer patients. From the results of the present study, we suggest that increased lipid peroxidation and decrease in antioxidant defense is associated with the development of breast cancer may offer a selective growth advantage to tumour cells over their surrounding normal counter parts. However, further clinical studies are required before a definitive conclusion to be drawn.

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