Nutrition Research, Vol. 20, No. 5, pp. 647–652, 2000

0271-5317/00/$–see front matter

ELSEVIER

PII: S0271-5317(00)00154-8

ANTIOXIDANT STATUS IN PATIENTS WITH PARKINSON'S DISEASE

Rey Yue Yuan, M.D.[1] Mei-Yiao Wu, M.S.[2] Shene-Pin Hu, Ph.D.[3]
[1]Division of Neurology, Department of Internal Medicine, Taipei Medical College Hospital, [2]Department of Food and Nutrition, Chinese Culture University, [3]Department of Nutrition and Health Science, Taipei Medical College

ABSTRACT

In order to determine the antioxidative status in Parkinson's disease (PD) patients, concentrations of antioxidant vitamins and the activity of antioxidant enzymes were measured in 26 PD patients (13 ♂, 13 ♀, mean age of 70 old) as well as the age- and sex-matched control subjects. All subjects were resided in Taipei area. There was no significant difference in plasma concentrations of vitamins A, C, and E between the 2 groups. However, the antioxidant activity of superoxide dismutase (SOD), glutathione peroxidase (GSHPx), and the total antioxidant status (TAS) were significant lower in the PD patient group than those in the control group ($P < 0.001$). Patients in advanced stage had significantly lower SOD activity than did early –stage patients ($P < 0.05$). There was no correlation between the severity or duration of Parkinson's disease and concentrations of antioxidant vitamins and other parameters. Only SOD activity was negatively correlated with the severity of PD ($r = -0.59$, $P < 0.05$), but it was not related with age or duration of the disease.

Key words: Parkinson's disease, Antioxidant vitamins, Glutathione peroxidase, Superoxide dismutase

INTRODUCTION

In recent years, it has been shown that oxygen-free radicals are closely related to the pathogenesis of various diseases. The measurement of antioxidative scavenging enzymes and vitamins in blood would certainly give a clue to the pathophysiology of Parkinson's disease (PD). Poirier and Barbeaus (1) investigated the activity of SOD (superoxide dismutase) and GSHPx (glutathione peroxidase) in erythrocytes of PD patients and discovered that it was no different from the controls. However, Kalra et al. (2) found that activities of SOD and GSHPx of PD patients were higher than those in normal healthy individuals. Several other reports (3-5) indicate that the activities of antioxidative vitamins in patients with PD were not significantly different from those of the control groups.

The purpose of this study is to measure the concentration of antioxidant enzymes and vitamins in patients with PD and to compare the results with the control group, in order to know if an antioxidant deficiency exists in PD patients.

Corresponding Authors: S.P.Hu, Dept. of Nutrition and Health Science, Taipei Medical College, 250 Wu-Hsing street, Taipei, Taiwan. R.O.C E-mail:shenepin@mail.tmc.edu.tw

METHODS

Study design : Twenty-six PD patients who visited a neurology clinic regularly and sustained no clinical fluctuation in response to levodopa therapy were included in this study. According to the scale of Hoehn and Yahr (6) 14 patients were in primary stage (stages 1-2), and 12 were in advanced stage (stages 3-4). Duration of the disease, taken as time from initial diagnosis, was at an average of 2.5 ± 2.8 (range from 0.5 to 10) year. Ages of the patients ranged from 52 to 83 yr with a mean age of 70 yr. Twenty-six subjects matched for age and sex formed the comparison group. Control subjects who had diabetes mellitus, cancer, or other disorders that would likely affect antioxidative status were excluded from the control group. Both patients and control subjects were free living and resided in Taipei, Taiwan.

Verbal consent was obtained from each participant following a protocol approved by the Taipei Medical College-affiliated Hospital Institutional Review Board on Human Studies.

Biochemical analyses : A 6-ml blood sample was collected from each patient or control and kept in ice before centrifuation. All samples (blood, plasma, and erythrocytes) were frozen at -30 ℃ and protected from light exposure until analysis.

GSHPx activities were assayed using Randox diagnostics kit cat. no. RS504. Superoxide dismutase (SOD) activity of erythrocytes was measured using a Randox kit cat. no. SD125. Total antioxidant status (TAS) and albumin were assayed by Randox kits cat. nos. NX2332 and AB361, respectively (Randox Laboratory, Ltd., U.K., E-Chen Co., Taipei, Taiwan).

Ascorbic acid (vitamin C) analysis was performed using a method of Kacem et al (7). α-Tocopherol (vitamin E) and vitamin A were extracted simultaneously into hexane and then quantified by reverse phase high-performance liquid chromatography as described previously (8).

Statistical analysis : Statistical analysis used statistical software package SPSS/PC(Chicago, IL). Comparisons of various clinical parameters used a 2-tailed student's t-test for the 2 groups. The correlation coefficient was applied to identify between the stage and duration of the disease and clinical disease parameters. Statistical significance was defined as $p < 0.05$

RESULTS

None of the patients in this study complained about the use of medications. As shown in Table 1, there are no significant differences in the characteristics between patients and controls. There are only slightly fewer patients (4/26) underweight according to the criterion of obesity of Huang et al. (9).

Activities of SOD (EC 1.15.1.1) and glutathione peroxidase (GSHPx: EC 1.11.1.9) in patients with PD were lower than those in normal healthy individuals. Total antioxidant status (TAS) was also lower in PD patients ($p < 0.001$) (Table 2). But protein biochemical markers of nutritional status (albumin) were normal in the patient group.

Plasma levels of vitamin C did not differ significantly between the 2 groups (63.15 ± 36.35 for PD and 77.01 ± 67.06 μmol / L for controls). The results for vitamin E level in the 2 groups are also similar (44.90 ± 16.01 and 53.50 ± 20.15 μmol / L, respectively) (Table 2).

TABLE 1

Demographic Data Between the 2 Groups.

Item	Patients (n = 26)	Controls (n = 26)
Gender [a]		
Male	13	13
Female	13	13
Age (yr) [b]	69.2 ± 7.0	71.1 ± 6.6
Height (cm) [b]		
Male	162.2 ± 7.7	166.1 ± 6.2
Female	153.9 ± 5.7	152.5 ± 4.5
Weight (kg) [b]		
Male	59.2 ± 12.2	66.2 ± 6.7
Female	56.7 ± 9.4	58.7 ± 7.2
BMI (kg/m2) [a,c]		
< 20	4	1
20～25	15	15
≧ 25	7	10

[a] Number, [b] Mean ± S.D, [c] BMI (Body Mass Index) : Wt (kg) / Ht^2 (m).

TABLE 2

Plasma Biochemistry of Patients and Controls.

	Patients (n=26)	Controls (n=26)
SOD (U/mL)	254.47 ± 46.34	314.11 ± 61.53 *
GSHPx (U/dL)	547.18 ± 95.82	756.16 ± 176.59 *
TAS (mol/L)	0.93 ± 0.22	1.14 ± 0.22 *
Albumin (mg/mL)	42.22 ± 3.32	41.30 ± 2.30
Vit. A (μ mol/L)	4.62 ± 1.35	4.21 ± 1.54
Vit. C (μ mol/L)	63.15 ± 36.35	77.01 ± 67.06
Vit.E (μ mol/L)	44.90 ± 16.09	53.50 ± 20.15

SOD = Superoxide dismutase; GSHPX = Glutathione peroxidase; TAS = Total antioxidant status. * student's t-test, $p < 0.001$.

SOD levels of erythrocytes differ significantly according to Hoehn and Yahr staging in the PD group. The advanced-stage group (n = 12) has a lower SOD level than dose the primary-stage group (n = 12), at 224.96 ± 37.34 and 279.77 ± 38.16 U /ml, respectively. The other biochemical parameters of the patients group did not differ with stage of disease (Table 3).

GSHPx and TAS in the PD patients did not correlate with patient age, or duration and stage of the disease. Regression analyses in the PD patient group showed a significant negative correlation between SOD level and stage of disease ($r = -0.59$, $p < 0.001$), but none between the age and duration of disease of patients. Plasma levels of antioxidant vitamins did not correlate with age, duration of disease, or Hoehn and Yahr staging in PD patients (Table 4). These results suggest that plasma antioxidant vitamin concentrations are unrelated to the risk of patients with less than 11-yr duration of PD.

TABLE 3

Plasma Biochemical Levels for Two Stages Parkinson's Disease in Patients.

	Primary stage (n=14)	Advanced stage (n=12)
SOD (U/mL)	279.77 ± 38.16	224.96 ± 37.34 *
GSHPx (U/dL)	567.62 ± 108.97	523.33 ± 75.37
TAS (mol/L)	0.95 ± 0.22	0.91 ± 0.23
Albumin (mg/mL)	42.31± 2.9	42.13 ± 3.8
Vit. A (μ mol/L)	4.82 ± 1.05	4.08 ± 1.14
Vit. C (μ mol/L)	67.15 ± 26.35	61.01 ± 27.06
Vit.E (μ mol/L)	49.39 ± 17.29	43.50 ± 12.55

*$p < 0.05$.

DISCUSSION

There were significantly lower values of SOD, GSHPx, and TAS in the PD group than those of the control group. These results contrasted with results of Kalra et al. (2), and also were not in accordance with results of Poirier and Barbeau (1). Only SOD activity was negatively correlated with the severity of PD. Johannsen et al. (10) reported that a correlation exists between GSHPx and duration of disease. Patients' nutritional status, physical problems, duration of disease, and response to drugs, etc. would affect the levels of oxygen-free radicals metabolizing enzymes. If oxygen-free radicals are involved in the pathogenesis of PD, we need to observe more PD patients.

TABLE 4

Correlation Coefficients Between Clinical Biochemistry and Disease Characteristics for Patients.

	Age	Duration of disease	Stage of disease
SOD	-0.3204	-0.1760	-0.5921*
GSHPx	0.1044	-0.1100	0.0593
TAS	-0.0587	0.1055	-0.0560
Albumin	-0.3010	-0.0612	-0.0374
Vit. A	-0.3993	-0.2911	-0.3487
Vit. C	0.0222	-0.0854	-0.0020
Vit. E	-0.4734	-0.3059	-0.2768

*$p<0.05$.

These results suggest that levels of serum antioxidant vitamins of PD patients are no different from those of control group. This research showed similar results to studies of King et al. (3) and Fenandez-Calle et al. (4,5). These antioxidant vitamin levels of patients without side effects of drugs are not related to the pathogenesis of the neurological abnormality.

We conclude that concentrations of antioxidant vitamins are similar in both groups. This fact may imply that these vitamins do not play a important role in the pathogenesis of PD. The activity of TAS and antioxidantive enzymes of PD is lower than controls. The activity of SOD is a better index to reveal the severity of PD than is the GSHPx level. The benefits of antioxidant vitamin therapy for PD to improve their antioxidative status will only be known with other prospective intervention studies.

ACKNOWLEDGMENTS

We thank patients for participating in this study and providing their valuable data. This study was supported by Taipei Medical College Grant.

REFERENCES

1. Poirier J, Barbeau A. Erythrocyte antioxidant activity in human patients with Parkinson's disease. Neurosci Lett 1987; 75: 345-348.

2. Kalra J, Rajput A H, Mantha S V, Prasad K. Serum antioxidant enzyme activity in Parkinson's disease. Mol Cellular Biochem 1992; 110: 165-168.

3. King D, Playfer J R, Robert N B. Concentrations of vitamins A, C and E in elderly patients with Parkinson's disease. Postgrad Med J 1992 ; 68: 634-637.

4. Férnandez-Calle P, Molina J A, Jiménez-Jiménez F J, Vazquez A, Pondal M, Garcia-Ruiz P J, Urra D G, Domingo J, Codoceo R. Serum levels of α -tocopherol (vitamin E) in Parkinson's disease. Neurology 1992 ; 42: 1064-1066.

5. Férnandez-Calle P, Jiménez-Jiménez F J, Molina J A, Carbrera-Valdivia F, Vazquez A, Urra D G, Bermejo F, Matallana M C, Codoceo R. Serum levels of ascorbic acid (vitamin C) in patients with Parkinson's disease. J Neurol Sci 1993; 118: 25-28.

6. Hoehn M M, Yahr M D: Parkinsonism: onset, progression, and mortality. Neurology 1967; 17: 427-442.

7. Kacem B, Marshall M R, Matthews R F, Gregory J F. Simultaneous analysis of ascorbic and dehydroascorbic acid by high-performance liquid chromatrgraphy with postcolumn derivatization and UV absorbance. J Agric Food Chem 1986; 34: 271-274.

8. Tang Y-L, CJ Huang. Dietary oxidized frying oil decreased plasma and liver vitamin A in rats. Nutr Sci J 1998 ; 23 : 265-279.

9. Huang P C, Yu S L, Lin Y M, Chu C L. Body weight of Chinese adults by sex, age and body height and criterion of obesity based on body mass index. J Chin Nutr Soc 1992 ; 17: 157-172.

10. Johannsen P, Velander G, Mai J, Thorling E B, Dupont E. Glutathione peroxidase in early and advanced Parkinson's disease. J Neurol Neurosurg Psychiatry 1991; 4 (8): 679-682

Accepted for publication October 20, 1999.