

Significance of Dietary Pattern in Oxidative Stress among Newly Diagnosed Essential Hypertension

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Abstract

Background: Hypertension is a significant global public health problem and it is associated with increased oxidative stress. Oxidative stress is disequilibrium between tissue oxidants (free radicals or reactive oxygen species ROS) and antioxidants and may be an integrative mechanism in the progress of cardiovascular diseases (CVD).

Aims & Objectives: To study the impact of dietary pattern on oxidative stress markers in newly diagnosed essential hypertension.

Material and Method: The study was conducted on 75 cases of essential hypertension (HT), 75 prehypertensives (preHT) and 50 control subjects for 15 months. After screening, serum uric acid (SUA) and serum malondialdehyde (S.MDA) level were investigated in both vegetarians (V) and nonvegetarians (NV) in all groups.

Findings: The difference in mean \pm SD of SUA and S. MDA level between control, preHT and HT group were found to be highly significant ($p < 0.0001$). SUA and S. MDA level was higher in NV as compared to vegetarians in all groups but significant results were found in case of SUA ($p < 0.001$).

Conclusion: Long-term vegetarians have improved antioxidant status and coronary heart disease risk profile than do apparently healthy omnivores.

Keywords: Hypertension, prehypertension, oxidative stress, serum uric acid, serum malondialdehyde, vegetarians, nonvegetarians, systolic blood pressure (SBP), diastolic blood pressure (DBP) .

Introduction

Hypertension is one of the most important public health challenge world-wide because of its high incidence and associated risks of cardiovascular disease for instance stroke, myocardial infarction and heart failure. Although it has frequently been indicated that the causes of essential hypertension are not known,

this is only partially true. Essential hypertension is a heterogeneous disorder, with different patients having different causal factors that lead to high blood pressure. Vascular oxidative stress has been shown in genetic and experimental models of hypertension.¹ In search for a causative factor for essential hypertension, uric acid and lipid peroxidation due to increased oxidative stress are considered.

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Although serum uric acid is regarded to be an antioxidant within its normal physiological conditions, it might be accountable for production of free radicals directly or indirectly in hypertensive. Hyperuricaemia (plasma uric acid level more than 6.8 mg/dl at

physiological temperature (37°C) and neutral pH)² has been found to be associated with subsequent morbidity and mortality in the general population among patients with congestive heart failure, diabetics and hypertensive patients. Moreover, hyperuricaemia has also been linked to multiple proatherogenic processes, including increased oxidative stress. In recent years, oxidative stress due to ROS is implicated in the pathogenesis of ample variety of diseases like cancer, cataract, diabetes mellitus, rheumatoid arthritis, atherosclerosis, hypertension.³ In addition the reasons for augmented rate of hypertension include life style changes, sugar rich diet, high fat processed foods and sedentary behavior.⁴

Rapid changes in diets and lifestyles that have took place with urbanization, industrialization and economic advancement have intensified over the past decade. Because of these changes, chronic diseases like hypertension are becoming increasingly significant cause of impairment and premature death.

Material & Method

A hospital based case control study was conducted among 200 subjects of age group between 20–50 years, irrespective of sex in the department of Physiology, Geetanjali medical college & hospital (GMCH), Udaipur.

Inclusion criteria: All the subjects were chosen randomly and following groups were made according to JNC7 criteria

Control group: 75 normotensive subjects

PreHT group: 75 cases of prehypertension

HT group: 75 cases of newly diagnosed cases of essential hypertension with SBP= 140-159 mmHg, DBP= 90-99 mmHg.

Exclusion criteria:

Patients with secondary hypertension, gout, diabetes mellitus, gestational hypertension, and patients taking antihypertensive, smokers and alcohol consumers were excluded from the study.

After obtaining ethical approval (Ref. No. GU/UCE/EC/2013/299 dated 15/05/2013), a written voluntary

informed consent was obtained from all the subjects. Then all the subjects were screened as per the detailed history, routine physical examination and appropriate tests. After screening, blood sample (5 ml) was drawn in to a plain vial after an overnight fast (12 hrs) by ante-cubital venous puncture from all the subjects. Then serum was separated by a centrifugation at 3000rpm for 10 minutes. After that serum sample was used for following biochemical analysis.

Serum Uric Acid: By Modified Trinder Method.⁵

Serum Malondialdehyde (MDA): Thiobarbituric acid (TBA) assay method.⁶

Statistical Analysis: The data were analyzed by using Statistical Package for the Social Sciences (SPSS) Version 16.0. Difference between the groups was analyzed by Analysis of variance test (ANOVA). Diet wise comparison of oxidative stress parameters were tested by Student t-test with p value <0.05 is considered as statistically significant.

Findings

Table: 1 Characteristics of study population among different groups (Mean ±SD)

Variables	Control	Pre HT Group	HT Group	Anova P Value
Age (Yrs.)	37.46 ± 8.09	35.84 ± 6.5	40.25 ± 7.71	<0.001
Veg./ Nonveg.	68/32	51/49	40/60	-
SBP (mmHg)	114.06 ± 16.77	134.00 ± 5.1	160.04 ± 11.49	<0.0001
DBP (mmHg)	74.66 ± 6.23	86.45 ± 2.93	92.00 ± 10.15	<0.0001

The difference in mean ± SD of SBP & DBP between three groups were highly significant (p<0.0001).

Table: 2 Diet wise variation of SBP among different groups (Mean \pm SD)

Diet	Control			PreHT			HT		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Non Veg	114.62 \pm 6.37		16	134.38 \pm 5.01		37	161.82 \pm 12.52		45
Veg	112.88 \pm 5.84		34	133.63 \pm 5.24		38	157.37 \pm 9.33		30
T value	0.92			0.63			1.76		
P value	NS			NS			NS		

Table: 3 Diet wise variation of DBP among different groups (Mean \pm SD)

Diet	Control			PreHT			HT		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Nonveg	75.21 \pm 6.75		16	87.27 \pm 2.83		37	92.44 \pm 11.17		45
Veg	73.50 \pm 5.99		34	86.63 \pm 3.05		38	91.33 \pm 9.68		30
T value	0.87			0.94			0.46		
P value	NS			NS			NS		

The table no. 2 & 3 showed that mean \pm SD value of both SBP and DBP were higher in NV as compared to V among all three groups but the results were not significant ($p > 0.05$)

Table: 4 Comparison of SUA and S. MDA level among different groups (Mean \pm SD)

Variables	Control	Pre HT Group	HT Group	Anova P Value
S. Uric acid (mg/dL)	4.91 \pm 0.97	5.90 \pm 0.97	6.56 \pm 0.76	<0.0001
S. MDA (nmol/mL)	1.30 \pm 0.20	1.63 \pm 0.28	2.14 \pm 0.42	<0.0001

The difference in mean \pm SD of SUA and S. MDA level between control, preHT and HT group were found to be highly significant ($p < 0.0001$).

Table: 5 Diet wise variation of SUA level among different groups (Mean \pm SD)

Diet	Control			Pre HT group			HT Group		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Non veg	5.65 \pm 0.77		16	6.55 \pm 0.80		37	6.77 \pm 0.59		45
Veg.	4.56 \pm 0.69		34	5.24 \pm 0.53		38	6.19 \pm 0.56		30
T value	4.82			8.34			4.25		
P value	<0.0001			<0.0001			<0.001		

Mean \pm SD of SUA was significantly higher in NV as compared to vegetarians in all groups ($p < 0.001$).

Table: 6 Diet wise variation of S. MDA level among different groups (Mean \pm SD)

Diet	Control			Pre HT group			HT Group		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Non veg	1.33 \pm 0.19		16	1.68 \pm 0.27		37	2.20 \pm 0.43		45
Veg.	1.28 \pm 0.21		34	1.57 \pm 0.27		38	2.04 \pm 0.39		30
T value	0.84			1.76			1.67		
P value	NS			NS			NS		

Mean \pm SD of S.MDA level was higher in NV as compared to V among HT, preHT and control group but this difference was not statistically significant ($p > 0.05$).

Discussion

There is a close relationship between the diet and chronic degenerative diseases such as obesity, hypercholesterolemia and hypertension. Our study showed that NV had higher mean SBP and DBP than V in HT, preHT and control group but the results were not significant ($p > 0.05$). Our results were similar to the study of Nande PJ et al.⁷ but they found significant results in case of DBP ($0.01 < p < 0.05$). These findings are steady with the results of the DASH (Dietary Approaches to Stopping Hypertension) trial, that a dietary pattern plenteous in fruits, vegetables, low fat dairy products and with abbreviated total and saturated fat can be efficient in the suppression of hypertension.⁸ Diet represents a significant role in the primary suppression of hypertension. It is a conception that the non vegetarian diet comprises cholesterol and saturated fatty acids and these are the root cause of problems like coronary heart diseases and hypertension. Vegetarian diets are normally ample in carbohydrates, n-6 fatty acids and dietary fiber and are more helpful in preventing, treating or reversing heart disease. Lifestyle adjustments in diet are playing important role in determining the outcome for people with hypertension.⁹

In the present study serum uric acid level was found to be significantly high in NV as compared to vegetarians among HT, preHT and control group ($p < 0.001$). Choi HK et al.¹⁰ also noticed that SUA level enhanced with increasing total meat or sea food intake and diminished with increasing dairy intake. Similarly Schmidt JA et al.¹¹ found that vagan had the highest concentration followed by meat eaters and vegetarians. This might be due to their lack of ingestion of dairy foodstuffs, which are believed to lower UA concentrations.¹²

In humans yield of UA relies on purine uptake¹³ and a purine-ample diet (such as veal, bacon, kid meat, mutton, turkey, pork, duck, goose, etc) would be responsible for rising only 1 to 2 mg/dL of uric acid¹⁴ whereas diary foodstuff intake has a reciprocal relation with uric acid.^{15,10} Since dairy products are low in purine content and it may perform its urate-lowering effect by increasing the elimination of uric acid and its precursor xanthine.¹²

The results of our study also presented that the oxidative stress marker, serum MDA level was high in NV compared to V among HT, preHT and control group but this difference was not statistically significant ($p > 0.05$). This is in accordance with the findings of Somannavari MS & Kodliwadmth MV¹⁶ but they found that the difference was significant. Whereas Szeto et al.¹⁷ shown that there was no significant change of MDA level between V and NV. The increased oxidative stress and associated oxidative damage are mediators of renovascular injury in cardiovascular pathologies.¹⁸ Dierckx et al.¹⁹ concluded that serum MDA level (a marker of lipid peroxidation) was significantly increased in NV, as their diet is good resource of iron and copper and these transitional metals in the diet have important role in the initiation and progression of lipid peroxidation. Further these findings were confirmed by Sagare SM et al.²⁰ This may be due to higher and habitual consumption of fruit and vegetables, dark and whole grain products, grain sprouts, plant oils and oil seeds plentiful in trace elements like zinc, copper and selenium, mono and polyunsaturated fatty acids, antioxidant vitamins, fibers, complex carbohydrates and flavonoids by vegetarians.

The diminished risk of diseases found among vegetarians suggests that biological processes are molded by diet.²¹ Therefore, much attention is currently focused on the beneficial effect of vegetarian versus non-vegetarian diet.^{22,23} Efficient lifestyle modification may reduce blood pressure as much as a single antihypertensive drug. Combinations of two or more lifestyle alterations can accomplish even better results.²⁴

Conclusion

The present study indicates that vegetarian nutrition provides sufficient antioxidants which efficaciously prevent the free radical generation and thus responsible for better antioxidant status and decreased oxidative stress. Maintenance of the oxidative balance in hypertensive patients would be helpful in preventing the CVD and other diseases associated with hypertension. Therefore, our study emphasizes the monitoring of the blood pressure, oxidative stress parameters (SUA and serum MDA level) at regular interval for therapeutic interventions. Moreover, the progress of disease could be prevented by giving proper education to the patient about healthy lifestyle and also advising them to practice yoga, aerobics, walk etc.

Conflict of Interest: None

Source of Funding: Self

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