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RESEARCH ARTICLE

VITAMIN C AS A MARKER OF OXIDATIVE STRESS IN HYPERTENSION.

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Abstract

The etiology of essential hypertension includes increased oxidative stress. Vitamin C is one of the potent reducing agents and scavenger of free radicals in biological systems. The role of benefit of vitamin C, an antioxidant to antihypertensive therapy were studied along with MDA level in comparison with control. It was found plasma ascorbic acid concentration to be inversely associated with systolic and diastolic BP in hypertensive subjects. A decrease in Vitamin C, an increase in malondialdehyde levels were observed in hypertensive group as compared to control. The increase in MDA and decrease in Vitamin C were statistically significant. Vitamin C or ascorbic acid is an antioxidant that may decrease the blood pressure (BP) and influence the endothelial dysfunction.

Introduction:-

Vitamin C (l-ascorbic acid) is a water-soluble micronutrient required for multiple biological functions. It is necessary for normal growth and development, and is an essential enzyme cofactor for several enzymes in the post-translational hydroxylation of collagen, biosynthesis of carnitine, conversion of the neurotransmitter dopamine to norepinephrine, peptide amidation, and in tyrosine metabolism. Vitamin C is one of the potent reducing agents and scavenger of free radicals in biological systems, working as a scavenger of oxidizing free radicals and harmful oxygen-derived species, such as hydroxyl radical, hydrogen peroxide (H2O2), and singlet oxygen. (Jacques 1992)
Hypertension or Elevated blood pressure (BP) is a major public health problem in developing country like India with relation to modified life style and stress. As elevated blood pressure is a strong and independent risk factor for cardiovascular and renal disease morbidity and mortality , identifying preventive measures is an important for a healthy life.(UPHS 1979)

Studies have demonstrated a role of vitamin C in maintaining the normal production and biological activity of endothelium-derived nitric oxide which plays a role in vascular tone and reactivity. (Kim et al., 2002) Thus, plasma vitamin C levels should be investigated for its possible role in lowering or maintaining normal BP. We evaluated the levels of plasma Vitamin C level on the patients of both hypertensive and normotensive subjects.

Material and Methods:-

The study was carried in the department of Biochemistry and central investigation laboratory in MGM Hospital, Aurangabad. Institutional ethical committee clearance was obtained for the study. Written and informed consent were taken from the patients for the study. In the present study, we investigated the relationship between plasma

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Vitamin C level and the incidence of hypertension in normotensive subjects who had undergone repeated routine health check-ups and hypertensive subjects.

Sample Size Cases- 30 hypertensive patients from MGM College and Hospital, Aurangabad Controls- 30 normotensive controls.

Methods The blood samples (3-5ml fresh blood) were drawn and collected in a clean, disposable plastic tube from anterior cubital vein under aseptic condition for estimation of Plasma Vitamin C and serum MDA (Malondialdehyde) levels. Plasma Vitamin C were assessed by Sauberlich method using colorimeter . (Sauberlich et al., 1982) Estimation of MDA was done by NouroozZadeh's method.(Nourooz-zadeh et al., 1995) Blood pressure was measured by standard techniques using sphygmomanometer, using 140/90 mmHg for diagnosis of hypertension. Statistical analysis: The data were evaluated by SPSS statistical package version 20.0. The results obtained were statistically analyzed by using student t-test. Value of Vitamin C was given in mg/dl. MDA levels were given in nmol/ml. Systolic and diastolic blood pressure was measured in mm of Hg. All Values were expressed as mean ± standard. The results were considered significant when $p < 0.05$.

Result:-

The mean age of the patients for this study was (43±5.3) and controls was (41.8±4.8).

Table 1:- Mean of systolic and diastolic blood pressure in cases and Controls.

Blood Pressure (mm of Hg)	Hypertensive Cases (n=30)	Normotensive Controls (n=30)	p-value
Systolic Blood Pressure	153.44±6.36	127.77±10.43	0.002
Diastolic Blood Pressure	110.48±5.65	83.38±8.35	0.0001

Values are given as mean ± SD.
p-value <0.05 considered as statistically significant.

Table 1 shows the mean values of systolic and diastolic blood pressure in cases and controls. The mean of systolic and diastolic blood pressure in cases was 153.44 and 110.48 respectively, which were significantly higher as compared with the control groups. (P=0.0001).

The results in this study showed significant decrease in plasma Vitamin C levels in hypertensive patients as compared to controlled normotensive group ($p = 0.001$) as shown in Table 2. There was a significant increase in the levels of serum MDA levels in hypertensive subjects as compared to normotensive ($P < 0.05$) .

Table 2:- Mean of Plasma Vitamin C and serum MDA levels in cases and Controls.

Parameter	Hypertensive Cases (n=30)	Normotensive Controls (n=30)	p-value
Plasma Vitamin C (mg/dl)	0.22±0.39	1.34±0.21	0.001
Serum MDA (nmol/ml)	4.69±0.76	1.15±0.17	0.004

Values are given as mean ± SD.
p-value <0.05 considered as statistically significant.

Discussion:-

Vitamin C in humans must be ingested for survival. Vitamin C is an electron donor, and this property accounts for all its known functions. (Darko et al., 2002) As an electron donor, vitamin C is a potent water-soluble antioxidant in humans. Antioxidant effects of vitamin C have been demonstrated in many experiments in vitro. In our study also the levels of vitamin C were less in hypertensive subjects. (Jacques et al., 1992; Jackson et al., 1998) There is substantial biologic rationale for a causal role of ascorbic acid in maintaining normal BP. In our study MDA levels were higher in hypertensive group as compared to controls. Bautista found a progressive increase in blood pressure with increases in high-sensitivity C-reactive protein (hsCRP), a sensitive marker of inflammation. In many studies it has been shown, that vitamin C significantly lowers hsCRP, to an extent equivalent to that seen with statins. (Nightingale et al., 2007)Thus, vitamin C may have a beneficial effect on BP by mitigating the adverse effects of inflammation and oxidative stress. Mechanisms by which antioxidant vitamins influence vascular function could be

through free radical scavenging, which decreases NO quenching by O2−, thereby increasing bioavailability of the potent vasodilator NO. Vitamin C have also been shown to directly stimulate activity of NOS by increasing intracellular tetrahydrobiopterin, which would further increase NO synthesis. Studies demonstrated that antioxidant vitamins increase NOS activity and NO generation in arteries (Magen et al., 2004). Free radicals cause extensive cellular damage, facilitate lipid peroxidation and stimulate inflammation. These processes could contribute to vascular structural changes associated with hypertension, especially because O2− and H2O2 stimulate hypertrophy and hyperplasia.(Taddei et al., 1998)

Specific functions of vitamin C have shown effects on smooth muscle contractility of peripheral blood vessels and improvement of vasomotor dysfunction prevention of nitric oxide inhibition of release of endothelium-derived relaxing factor (Osilesi et al., 1991) , and prevention of free radical inhibition of prostacyclin synthetase.(Darko et al.,2002) Ascorbic acid may also influence BP by maintaining the normal production and biological activity of nitric oxide through enhanced recycling of tetrahydrobiopterin, a cofactor that stabilizes and sustains the activity of endothelial nitric oxide synthase.

In our study ,our findings point to the important aspect that vitamin C may influence BP even among healthy adults. This finding is of importance because lowering BP or attenuating increases in BP may reduce the risk of age-associated vascular events.

Conclusion:-

We found plasma ascorbic acid concentration to be inversely associated with systolic and diastolic BP in hypertensive subjects. The subjects with higher Vitamin c level showed a lower incidence of hypertension than did the subjects with lower Vitamin C level. It is concluded from the results of this study that hypertension is responsible for the mechanisms of the generation of reactive oxygen species and the vascular effects of oxidative stress. Vitamin C acts as antioxidant in hypertensive patients.

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