Effect of vitamin C supplementations on hyperuricemic patients

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Abstract: ***Background*:** Hyperuricemiais a common metabolic disorder and it is a well-established causative factor for development of gouty arthritis, tophi formation, uric acid kidney stones and acute kidney failure and Supplementation with vitamin C has attracted a great deal of attention as an alternative dietary anti-hyperuricemic approach. *Objective*: to determine the effects of vitamin C supplementation on serum uric acid concentrations. *Methods*: The study was a prospective double-blinded Placebo-controlled randomized trial conducted in the Physical medicine, Rehabilitation and Rheumatology outpatient clinic and Internal Medicine outpatient clinic Ain shams University hospital. Study included 40 asymptomatic hyperuricemic patients, randomized to take allopurinol (100mg/day) and either placebo or vitamin C supplements (500mg/day) for 2 months. *Results*: At the end of the study period, serum uricacid levels were significantly reduced in the vitamin C group (mean change 2.1 ± 0.4 mg/dl), and in the placebo group (mean change 1.34 ± 0.3 mg/dl) with mean drop difference about 0.7mg/dl which was highly significant ($p < 0.001$) with percent drop in SUA in group one of about 50% more than group two. *Conclusion*: Supplementation with 500 mg/day of vitamin C for 2 months reduces serum uric acid, suggesting that vitamin C might be beneficial in the prevention of gout and other urate-related diseases.
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Key words: hyperuricemia; vitamin C.

1. Introduction

Uric acid is the final breakdown product of purine catabolism in humans [1]. Hyperuricemia (defined as serum uric acid more than 6 mg per deciliter in women and more than 7 mg per deciliter in men) [2-4]. is a very common biochemical aberration caused by an imbalance in the production and excretion of urate and can lead to gouty arthritis, tophi formation, uric acid kidney stones and acute kidney failure [5]. However, it is suggested that chronic mild hyperuricemia has a potential direct role in development of interstitial nephritis and progressive renal failure furthermore it is an independent risk factor for metabolic syndrome [6, 7].

Vitamin C (Ascorbic acid) has been regarded as the most potent natural antioxidant [8]. It is required for the prevention of scurvy and plays an important role as a cofactor in enzymes activation and immune function, also it has anti-inflammatory effects [9, 10]. Vitamin C likely modulates serum uric acid concentration via its uricosuric effect as Vitamin C and uric acid are reabsorbed through anion-exchange transport in the proximal tubule so, Increased vitamin C concentration in the filtrate may competitively inhibit uric acid reabsorption [11, 12].

The Aim of study was to determine the effect of vitamin C supplementation on serum uric acid concentration in hyperuricemic patients, in order to detect its possible effect as an adjuvant therapy in hyperuricemia.

2. Patients and Methods

This was a prospective double-blinded Placebo-controlled randomized study that included forty asymptomatic hyperuricemic nonsmokers and non alcoholic patients. patients were recruited from the Physical medicine, Rehabilitation and Rheumatology outpatient clinic and Internal Medicine outpatient clinic Ain shams University hospital. A written consent was taken from the patients after a detailed explanation of the study. Approval was obtained from Ain Shams Ethics Committee of Research Projects.

Inclusion criteria were willingness to provide written informed consent and to take study pills for 2 months. Exclusion criteria were Patients with clinical evidence of any inflammatory, renal, increased nucleic acid turnover diseases, Glucose-6-phosphatase deficiency, Patients on drugs cause uric acid under excretion as diuretics, cyclosporine, pyrazinamide, ethambutol, levodopa, nicotinic acid, and methoxyflurane, Patients on dialysis, Pregnant and Lactating women.

All patients were subjected to history taking, clinical examination with measuring blood pressure

and calculating body mass index and laboratory Investigations including Complete blood count, Serum creatinine mg/dl by Synchcron CX5 method, liver function tests (alanine aminotransferase [ALT] and aspartate aminotransferase [AST]) U/L by Kinetic ultra violet optimized method, Erythrocytes Sedimentation Rate mm/hr by Westergren method, Fasting and postprandial blood sugar and Lipid profile including (cholesterol, triglycerides, HDL and LDL) Using standardized laboratory tests. Participants were randomly assigned to one of two equal groups, Group I (twenty patients with low purine diet and on allopurinol 100mg/d and vitamin C Supplements 500mg/day) Group II (twenty patients with low purine diet and on allopurinol 100mg/d and placebo) for 2 months.

Serum uric acid level was measured at the beginning and at the end of the 2 months for the two groups using colorimetric enzymatic method as uric acid in serum was oxidized by uricase to form allantoin and H2O2. In the presence of peroxidase, H2O2 reacts with N-ethyl-N-(2-hydroxy-3-sulfopropyl)-3-methylaniline and 4-aminophenazone to form quinonelmine dye.

Statistical Analysis:

Analysis of data was done by IBM computer using SPSS (statistical program for social science).

Description of quantitative variables as mean, SD and range. Description of qualitative variables as number and percentage.

The following tests was done:

1. Student t test (paired sample, independent sample) to compare between parametric data.
2. Wilcoxon rank sum test to compare non parametric data (SD> 50% mean).
3. Chi square test to study association between qualitative variables.
4. Correlation analysis (using pearson's methods) to assess the strength of association between two quantitative variables. The correlation coefficient denoted symbolically "r" defines the strength and direction of the linear relationship between two variables.
5. 5-Multivariate analysis (MVA): MVA is based on the statistical principle of multivariate statistics, which involve observation and analysis of more than one statistical outcome variable at a time.

In all tests:

If P value >0.05 means non significant (NS).

If P value <0.05 means significant (S).

If P value <0.001means highly significant (HS).

3. Results

Patients demographic data are shown in table (1,2,3).

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Table 1. Comparison between gr I and gr II as regards sex frequency distribution.

Sex	Groups						X^2	P-value
	Group I		Group II		Total			
	N	%	N	%	N	%		
Male	14	70.00	15	75.00	29	72.50	0.125	0.723
Female	6	30.00	5	25.00	11	27.50		
Total	20	100.00	20	100.00	40	100.00		

Table 2. Comparison between gr I and gr II as regards age.

Age/years	Groups						t	P-value
	Group I			Group II				
Range	45	-	68	49	-	77	-0.799	0.429
Mean ±SD	58.200	±	7.098	60.000	±	7.152		

Table 3. Comparison between gr I and gr II as regards BMI

BMI Kg/m²	Groups						t	P-value
	Group I			Group II				
Range	26.7	-	32	26.4	-	32	0.053	0.958
Mean ±SD	28.360	±	1.457	28.335	±	1.542		

BMI- Body mass index

As regards blood pressure, there were 33(82.5%) hypertensive patients (16 (80%) patients in group I and 17(85%) patients in group II).

There were 13 (32.5%) diabetic patients (7 (35%) patients in group I and 6 (30%) patients in group II) and 23 (57.5%) hypercholesterolemic patients (10

(50%) patients in group I and 13 (65%) patients in group II)

Table 4 Comparison between gr I and gr II as regards laboratory data

		Groups			t	P-value
		Group I	Group II			
ESR mm	**Range**	8 - 38	10 - 38		-1.101	0.278
	Mean ±SD	20.650 ± 10.122	23.900 ± 8.478			
HGB g/dl	**Range**	9.7 - 13.6	9.1 - 13		1.459	0.153
	Mean ±SD	11.840 ± 1.140	11.350 ± 0.978			
RCC 10^6/cmm	**Range**	3.8 - 5.6	3.8 - 5.4		0.290	0.773
	Mean ±SD	4.530 ± 0.554	4.480 ± 0.537			
WBC 10^3/cmm	**Range**	4.4 - 10.1	4.3 - 10.4		-0.919	0.364
	Mean ±SD	6.632 ± 1.540	7.079 ± 1.536			
PLT 10^3/cmm	**Range**	157 - 410	189 - 400		0.015	0.988
	Mean ±SD	302.900 ± 73.121	302.600 ± 47.613			
S. Cret mg/dl	**Range**	0.6 - 1.3	0.7 - 1.2		-0.089	0.929
	Mean ±SD	0.920 ± 0.196	0.925 ± 0.155			
AST U/L	**Range**	8 - 28	12 - 31		-0.282	0.780
	Mean ±SD	17.450 ± 5.698	17.900 ± 4.303			
ALT U/L	**Range**	8 - 30	9 - 33		-0.757	0.454
	Mean ±SD	16.750 ± 6.340	18.250 ± 6.197			
HDL mg/dl	**Range**	30 - 65	29 - 66		-0.112	0.911
	Mean ±SD	42.100 ± 11.562	42.550 ± 13.667			
LDL mg/dl	**Range**	140 - 300	120 - 290		0.193	0.848
	Mean ±SD	204.550 ± 47.333	201.500 ± 52.543			
Triglyceride mg/dl	**Range**	120 - 600	150 - 500		-0.231	0.819
	Mean ±SD	329.000 ± 171.982	340.000 ± 125.530			
Cholesterol mg/dl	**Range**	170 - 400	170 - 360		-0.397	0.693
	Mean ±SD	248.650 ± 73.084	257.250 ± 63.462			
FPG mg/dl	**Range**	70 - 190	70 - 190		0.664	0.510
	Mean ±SD	118.000 ± 41.762	109.400 ± 40.083			
PPG mg/dl	**Range**	100 - 290	90 - 320		0.232	0.818
	Mean ±SD	177.500 ± 70.403	172.050 ± 77.789			

Serum Cret - Serum Creatinine, ESR - Erythrocyte Sedimentation Rate, HGB - Haemoglobin, RCC-red cell count, WBC - White Blood Cell, PLT - Platelets, AST - Aspartate Aminotransferase, ALT - Alanine Aminotransferase, HDL-high dinesty lipoproteins, LDL –low dinesty lipoproteins, FBG-fasting blood glucose, PPG-post prandial glucose SD - standard deviation.

Correlation studies

Table 5. The correlation between starting SUA and demographic and laboratory data of 2 groups

Correlations		
	Start SUA	
	R	**P-value**
Age/years	0.531	<0.001*
ESR mm	-0.053	0.747
HGB g/dl	0.299	0.061
RCC10^6/cmm	-0.058	0.721
WBC 10^3/cmm	-0.183	0.258
PLT 10^3/cmm	0.253	0.115
S. Cret mg/dl	0.217	0.178
AST U/L	-0.035	0.830
ALT U/L	-0.259	0.107
BMI Kg/m^2	0.741	<0.001*
SBP mmgh	0.643	<0.001*
DBPmmgh	0.755	<0.001*
HDL mg/dl	-0.684	<0.001*
LDL mg/dl	0.826	<0.001*
Triglyceride mg/dl	0.722	<0.001*
Cholesterol mg/dl	0.712	<0.001*
FBG mg/dl	0.793	<0.001*
PPG mg/dl	0.813	<0.001*

There was a statistically highly significant positive correlation between starting serum uric acid in all participants and age, BMI, systolic, diastolic blood pressure, LDL, Triglyceride, cholesterol, fasting blood glucose and post prandial glucose ($p < 0.001$). (Table 5) and statistically highly significant negative correlation with HDL ($p < 0.001$).

Serum Cret - Serum Creatinine, ESR - Erythrocyte Sedimentation Rate, HGB - Haemoglobin, WBC - White Blood Cell, PLT - Platelets, AST - Aspartate Aminotransferase, ALT - Alanine Aminotransferase, HDL-high dinesty lipoproteins, LDL –low dinesty lipoproteins, FBG-fasting blood glucose, PPG-post prandial glucose, BMI- Body mass index, SBP -systolic blood pressure, DBP -diastolic blood pressure, SUA -Serum uric acid, *- highly significant.

In a multivariate variable study we found that LDL and cholesterol had a significant independent risk on the level of serum uric acid (Table6)

Table 6. The multivariate variable study between SUA and risk factors.

	Unstandardized Coefficients		Standardized Coefficients	T	P-value
	B	Std. Error	Beta		
Age /years	0.018	0.013	0.132	1.346	0.192
S. Cret mg/dl	0.045	0.440	0.008	0.103	0.919
ESR mmh	-0.002	0.008	-0.019	-0.256	0.801
HGB g/dl	0.117	0.063	0.131	1.865	0.076
WBC 10^3/cmm	-0.044	0.050	-0.070	-0.883	0.387
PLT 10^3/cmm	0.001	0.001	0.080	1.070	0.296
AST U/L	-0.033	0.019	-0.174	-1.750	0.094
ALT U/L	0.037	0.018	0.239	2.023	0.055
BMI Kg/m^2	0.057	0.090	0.088	0.637	0.530
SBP mmgh	0.013	0.014	0.107	0.917	0.369
DBP mmgh	0.030	0.016	0.228	1.839	0.079
HDL mg/dl	0.009	0.011	0.112	0.805	0.430
LDL mg/dl	0.007	0.003	0.339	2.241	0.035*
Triglyceride mg/dl	-0.001	0.001	-0.130	-0.902	0.377
Cholesterol mg/dl	0.004	0.002	0.299	2.215	0.037*
FBG mg/dl	0.004	0.011	0.159	0.339	0.738
PPG mg/dl	0.001	0.006	0.088	0.187	0.853
Dependent Variable: Start SUA					

Serum Cret - Serum Creatinine, ESR - Erythrocyte Sedimentation Rate, HGB - Haemoglobin, WBC - White Blood Cell, PLT - Platelets, AST - Aspartate Aminotransferase, ALT - Alanine Aminotransferase, HDL-high dinesty lipoproteins, LDL –low dinesty lipoproteins, FBG-fasting blood glucose, PPG-post prandial glucose, BMI- Body mass index, SBP -systolic blood pressure, DBP -diastolic blood pressure, SUA -Serum uric acid, *- significant.

Comparison between gr I and gr II at start of the study and at the end of the study as regards serum uric acid

On comparing group I at the start of the study and at the end of the study as regards SUA there was a highly statistically significant difference i.e reduction ($p < 0.001$) (table 7).

On comparing group II at the start of the study and at the end of the study as regards SUA there was a highly statistically significant difference i.e reduction (($p < 0.001$) (table 7).

On comparing group I and group II as regards SUA at the start of the study and at the end of the study there were no statistically significant difference ($p > 0.05$) (table8, fig2).

Table 7. Comparison of each group at start and at the end of the study and % of Drop of SUA.

		Groups					
		Group I			Group II		
Start SUA mg/dl	**Range**	6.8	-	10	6.5	-	10
	Mean ±SD	8.305	±	0.882	8.030	±	1.034
End SUA mg/dl	**Range**	5	-	7.8	5.2	-	8.9
	Mean ±SD	6.245	±	0.732	6.690	±	1.021
% of Change		24.66 ± 4.3			16.88 ± 3.8		
P-value		<0.001*			<0.001*		

SUA -Serum uric acid, SD - standard deviation, *- highly significant

However the percent of change in group I was about 24.66 % ± 4.3 and in groups II 16.9% ± 3.8.the difference was highly statistically significant (p < 0.001) (table7, fig1)

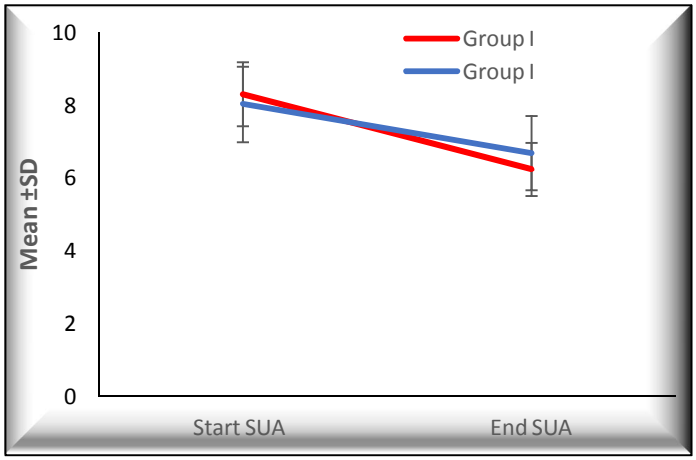

Fig 1. The drop of serum uric acid in both groups

Table 8. Comparison between gr I and gr II at start of the study and at the end of the study as regards serum uric acid

		Groups		t	P-value
		Group I	Group II		
Start SUA mg/dl	**Range**	6.8 - 10	6.5 - 10	0.905	0.371
	Mean ±SD	8.305 ± 0.882	8.030 ± 1.034		
End SUA mg/dl	**Range**	5 - 7.8	5.2 - 8.9	-1.584	0.121
	Mean ±SD	6.245 ± 0.732	6.690 ± 1.021		

SUA -Serum uric acid, SD - standard deviation

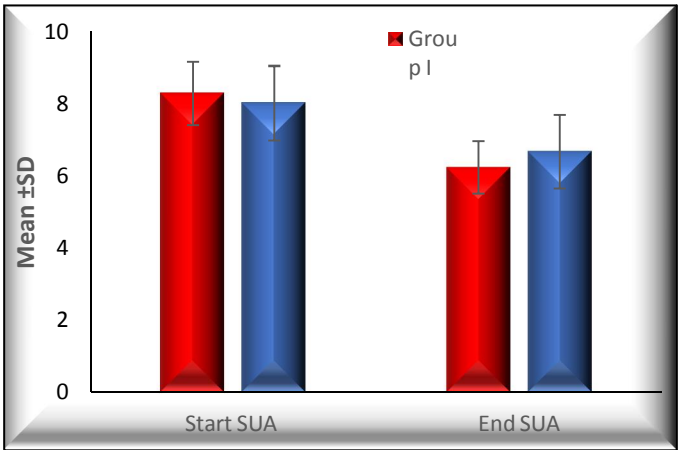

Fig2. The starting and end levels of SUA in both groups

The difference in SUA in group I ranged from 1 to 2.5 with mean of 2.05 ± 0.398 while the difference in SUA in group II ranged from 0.7 to 1.9 with mean of 1.340 ± 0.289 which indicated a highly significant drop change in SUA in group I by about 50% more than group II (P < 0.001) (Table 9, fig 3)

Table.9. Mean difference between the two groups.

		Groups		t	P-value
		Group I	Group II		
Difference SUA	**Range**	1 - 2.5	0.7 - 1.9	6.455	<0.001*
	Mean ±SD	2.050 ± 0.398	1.340 ± 0.289		

SUA -Serum uric acid, SD - standard deviation, *- highly significant

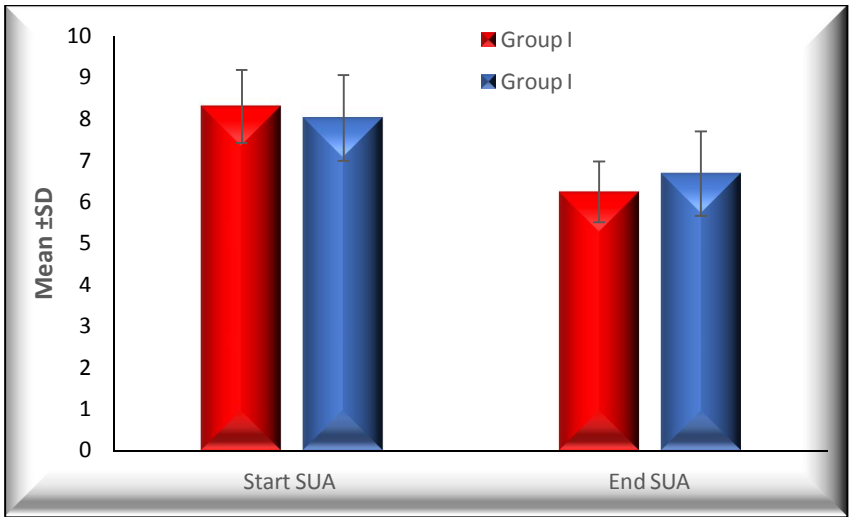

Fig 3. The drop difference in SUA in 2 groups

4. Discussion

This prospective study included 29 males (72.5 %) and 11 females (27.5%).

These results were similar to ***Lokanath and Chandrashekariah*** [13] as hyperuricemia was 69% in males and 31% in females and in contrast to ***Kensarah and Azzeh*** [14] in which female's percent was equal to males due to the patient's selection.

Male predominance in hyperuricemia is due to the increased renal clearance of uric acid in women by higher plasma estrogen levels, estradiol suppresses the protein levels of URAT1 and Glut9 and menopause is associated with higher serum uric acid levels [15].

The patients age ranged from (48 to 68) years in group 1 with mean of (58.2± 7.1), and from (49 to 77) years in group 2 with mean of (60.0 ± 7.2) and there was a statistically highly significant positive correlation ($p < 0.001$) between starting serum uric acid and age.

Our results were in similar to ***Huang et al.*** [16] that performed their study on patients with a mean age of (56.8 years ± 14.1) for group 1 and (59 years ± 13.2) for group 2. Furthermore ***Kensarah and Azzeh*** [14] worked on 30 adults with a mean age of (58 years ± 12.03, 44.18years ± 15.99 and 42.04 years ± 8.23) for group1, group 2 and group 3 respectively.

The age-associated increase in serum uric acid may be due to age-related factors such as increased endogenic synthesis of purines, reduced excretion of uric acid, declining renal function, diuretic use and hypertension [17].

As regards BMI (body mass index), it ranged from (26.7 to 32) kg/m2 in group 1 with mean of (28.4 ± 1.5), and from (26.4 to 32) kg/m2 in group 2 with mean of (28.3 ± 1.5). Moreover there was a statistically highly significant positive correlation between starting serum uric acid in all participants and BMI ($p < 0.001$).

These results were in accordance with ***Huang et al*** [16] that performed their study on patients with a mean BMI of (28.8 ± 5.7) kg/m2 for group 1 and (28.8 ± 5.0) kg/m2 for group 2. In addition; ***Perlstein et al.*** [18] found that there was a significant positive correlation between baseline SUA and BMI.

Obesity and overweight may be linked to SUA levels by excessive SUA production and poor SUA excretion as visceral fat accumulation (VFA) induces an elevated influx of plasma free fatty acids into the hepatic portal vein and liver. This stimulates triglycerides synthesis which will need NADPH so it resulted in increased uric acid production. Furthermore adiposity has been associated with insulin resistance [19, 20].

This study included 33(82.5%) hypertensive patients; 16 (80%) in group 1and 17(85%) in group 2 and there was a statistically highly significant positive correlation between starting serum uric acid and Systolic and diastolic blood pressure.

These results are in agreement the research done by ***Perlstein et al.*** [18] which demonstrated a significant positive correlation between SUA and Systolic and diastolic blood pressure. However, ***Huang et al.*** [16] study which was on 184 hyperuricemic patients randomized to take either placebo or vitamin C supplements (500mg/day) for 2 months. had 47% hypertensive patients in group 1 and 53% in group 2.

The percentage of dyslipidemic and overweight patients in our study in addition to hyperuricemia may explain the high percentage of hypertensive patients.

Hyperuricemia is a durable marker of risk for hypertension as it can induce arteriosclerosis and conecutively hypertension by the effects of oxidative

stress during uric acid production, uratetransporter disorders, and vascular disorders [21].

This study included 13 (32.5%) diabetic patients; 7 (35%) in group 1and 6 (30%) in group 2, Moreover there was a statistically highly significant positive correlation between starting serum uric acid and fasting and post prandial blood glucose.

These results was similar to ***Woyesa et al.*** [22] as the hyperuricemic diabetic patients in their study were 33.8% and there was a positive correlation between uric acid and fasting blood glucose.

Hyperuricemia is closely linked to diabetes since insulin resistance is associated with decreased urinary uric acid clearance and, therefore, increased SUA concentrations [21].

On the other hand ***Andrade et al.*** [23] pointed out that Diabetic patients with glycosuria might have a null prevalence of hyperuricemia and higher urine excretion of uric acid than those without glycosuria. These might be due to due to enhanced proximal tubule reabsorption in the kidney in the early course of dysglycemia, which is mitigated when manifest glycosuria becomes present due to saturation of the glucose transport at this nephron segment in association with perturbation of uric acid reabsorption along the nephron.

As regard lipid profile in our study there were 23 (57.5%) hypercholesterolemic patients, 30 (75%) patients had elevated triglycerides,32 (80%) patients had elevated LDL and 17(42%) patients with low level (high risk) of HDL. Furthermore there was a statistically highly significant positive correlation between starting serum uric acid and lipid profile (LDL, Triglyceride and cholesterol). Whereas serum HDL level was inversely correlated with SUA ($p < 0.001$). In addition in a multivariate variable study we found that LDL and cholesterol had a significant independent risk on the level of serum uric acid.

These results were in accordance with ***Osgood et al.*** [24], ***Shelmadine et al.*** [25] and ***Perlstein et al.*** [18] who found a positive correlation between lipid profile and SUA.

Increases in uric acid have been postulated to cause a decrease in lipoprotein lipase and/or hepatic triglyceride lipase activity, a primary enzyme associated with lipolysis of triglycerides. Furthermore, Uric acid is a major cause of oxidative stress and reduced nitrous oxide release leading to oxidation of LDL (ox-LDL) so, when hyperuricemia is combined with oxidized LDL there could be an increase in triglyceride levels due to impairment of triglyceride storage and secretion by ox-LDL [26,27]. Moreover, hyperuricemia may impair endothelium dependent vasodilatation via lipid oxidation which normally is thought to be associated with increases in total cholesterol levels [28].

In addition, there was a positive correlation between SUA and serum creatinine. Hyperuricaemia may be caused secondarily by renal impairmentas urate handling by the kidneys involves filtration at the glomerulus, reabsorption, secretion and, finally, post-secretory reabsorption at tubules which are handled by multiple organic anion transporters. Consequently, elevated serum uric acid levels may result secondary to decreased glomerular filtration, decreased tubular secretion or enhanced tubular reabsorption [29].

According to serum uric acid level this study showed significantly reduction in the two groups after the two months (p value for each group is < 0.001). On the other hand, in comparison between the drop difference of the level of SUA in two groups, we found that the group one (vitamin C group) showed a mean drop of 2.1 ± 0.4 and the mean drop in group two (placebo group) of 1.34 ± 0.3, so mean difference is about 0.7mg/dl which was highly significant ($p < 0.001$) with percent drop in SUA in group one of about 50% more than group two.

These results may be due to the uricosuric properties of Vitamin C through acting specifically at uric acid reabsorption sites in the apical brush border of the proximal tubule, such as urate transporter 1 (URAT1), and a sodium-dependent anion cotransporter, SLC5A8/A12. It is also possible that vitamin C increases the glomerular filtration rate by reducing glomerular microvascular ischemia and increasing dilatation of afferent arterioles. Furthermore, as an effective antioxidant, vitamin C decreases free radical-induced damage to body cells, thereby reducing production and ultimately serum concentration of uric acid [30].

These results were in accordance with ***Huang et al.*** [16] which was a study on 184 hyperuricemic patients randomized to take either placebo or vitamin C supplements (500mg/day) for 2 months. Serum uric acid levels were significantly reduced in the vitamin C group (mean change 0.5 mg/dl), but not in the placebo group (mean change 0.09 mg/dl) ($p < 0.0001$).

Our study was in agreement with ***Gao et al.*** [11] who examined associations between vitamin C intake and serum uric acid in a population-based study included 1,387 men. They found that intake of vitamin C 500 mg/d or higher is associated with 0.6–0.7 mg/dL lowering in the level of serum uric acid relative to those with the intake < 90 mg/d (P for trend<0.001)

They also found SUA level was about 6.0 mg/dl in patients on vitamin C with intake of 250–499 mg/d and 5.7 mg/dl with intake of 500–999 mg/d these results is in agreement with our results as mean of SUA level after vitamin C intake was $6.2 \text{ mg/dl} \pm 0.7$.

Furthermore in study done by ***Choi et al.*** [31] about Vitamin C Intake and the Risk of Gout in men over 20 years; a significant decrease in the

multivariate relative risk of gout in vitamin C intake groups in comparison with men who did not use supplemental vitamin C ($p< 0.001$) was found.

Moreover, another study done by ***Juraschek et al.*** [32] that studied the effect of Vitamin C on the uric acid of 556 patients. They showed reduction in SUA level (-0.35 mg/dl) in vitamin C group but less than ***Huang et al.*** [16], ***Gao et al.*** [11] and our study. The short duration of this study which has mean of 30 days (half duration of our study) may explain this difference as this duration may be not enough to reach more decrease in SUA level like other studies. Also different study design, it was Meta analysis. Even though, the results is still significant as $P = 0.032$.

On the other hand**,** ***Kensarah and Azzeh***. [14] studied a group of 30 Saudi adults aged between 20-70 yrs old with hyperuricemia or diagnosed with gout. They aimed to determine the effects of high vitamin C intake from diet and supplements on serum uric acid concentrations during a period of 2 months. Participants were divided into 3 groups; high vitamin C supplements (500mg/day) with purine restricted diet, high dietary vitamin C with purine restricted diet and control group (low purine diet with normal vitamin C intake). The overall mean reduction of uric acid for supplemented group was -0.28 mg/dl and for dietary treated group was -0.77 mg/dl. In the control group, the average uric acid was increased after 2 months by 0.51 mg/dl. Reduction in serum uric acid was statistically significant for dietary treated group but not for supplemented one.

The difference in results between ***Kensarah and Azzeh*** [14] study and ours may be due to the elevated mean of serum creatinine level in vitamin C supplemented group in their study which was (3.11±2.74) while it was (mean 0.9±0.2) in our study and these may affect the excretion of uric acid in kidneys [29]. Furthermore inclusion of renal diseases and gouty patients in study which were excluded in our study as this diseases affect uric acid excretion in kidneys [29].

Conclusion,

Vitamin C supplementation could significantly decrease serum uric acid level in asymptomatic hyperuricemic patients.

Recommendation

- Screening test for asymptomatic hyperuricemia in people above 40 years is essential.
- Control of traditional risk factors such as D. M., hypertension and hypercholesterolemia may be beneficial in reducing risk factors related disease like gout and chronic kidney disease.
- Proper approache with antihypertensive therapy that don't affect SUA is useful in control SUA.
- Vitamin C supplements can be used in treatment of asymptomatic hyperuricemia so can prevent its complications.
- Life style modification like low protein diet, exercise, quit smoking, reduction body weight is helpful in reducing complication of hyperuricemia.
- Other future studies are recommended including larger number of patients to confirm the efficacy of vitamin C in uric acid related diseases like gout, nephrolithesis and chronic kidney disease.

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