EVALUATION OF VITAMIN C CONCENTRATION OF AQUEOUS HUMOR IN SENILE CATARACT

S. A. M. MIRATASHI*
M. R. BESHARATI*
M. R. SHOJA*
A. RASTEGAR*
M. R. MANAVIAT*

SUMMARY: Senile cataract is one of the most important preventable causes of blindness. Oxidative agents like ultraviolet (UV) are one of the most important causes of cataract. Vitamin C is an important water soluble antioxidant agent in the aqueous humor.

In a cross-sectional study, 85 patients admitted to Rah-Ahan Eye Hospital for cataract surgery were evaluated. The mean age of the patients was 64.3±1.2 yr of the 85 patients, 41 were men and 44 were women.

Under general anesthesia 0.2 cc of aqueous humor from anterior chamber and 5 cc of peripheral blood were taken just before operation. Concentration of vitamin C was measured in these samples and the data was analyzed by SPSS statistical program.

Mean concentration of vitamin C was 4.29±0.12 mg/dl (mean±SE) in the aqueous and 0.77±0.036 mg/dL in the plasma. The differences were statistically significant when compared with normal values. P ≈ 0.000 in both conditions. Vitamin C concentrations of aqueous humor were equal in both sexes, but vitamin C concentrations of plasma in women were higher than men (p=0.043). The concentration of vitamin C was not related to the type of cataract or job of patients.

Since vitamin C concentration of aqueous humor and plasma in senile cataract are lower than normal, it is better to advise fresh vegetables and fruits or other supplements to patients who are at risk of senile cataract.

Key Words: Senile cataract, aqueous vitamin C, plasma vitamin C.

INTRODUCTION

Cataract is one of the most important preventable causes of blindness in the world and now it is the cause of blindness of 15 million cases worldwide. Senile cataract is the most prevalent form of cataract and it is of the most social and economical importance (13). Many risk factors are known to cause senile cataract and the most important one is ultraviolet (UV) rays especially UV-B (8,14,16, 21,22). UV acts as an oxidant agent.

Light and oxygen are necessary for eye function but excessive and uncontrollable exposure of eye to them can cause cataract. The concentration of antioxidants of

*From Department of Ophthalmology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

the aqueous humor decreases as the age increases (22). Vitamin C is one of the most important antioxidant agents (10). There are life-long crystals and proteins with special structure in the lens that are important in the maintenance of lens transparency. A senile change of crystalline formations of the lens such as oxidation is the cause of their gloom and cataract (1). It is proved in animal studies that the diet without vitamin C and exposure to UV-B as an oxidative stress can cause cataract after some weeks (16). Certainly such an experiment can not be repeated on humans.

Many investigations in the medical texts show that the risk of cataract has been lower in people who consume 60 mg or more vitamin C daily (by food or its substitute) (3). The effects of this drug are also confirmed through epidemiological studies and clinical experiments. It is known that antioxidant vitamin C reduces the oxidative damages (15). Otherwise observed under these conditions since there is too much sunshine in Iran especially in Yazd, the prevalence of cataract is relatively high. There has been no research about vitamin C concentration of aqueous humor in patients who are at risk of cataract in Yazd so far. In a recent study it was shown that the vitamin C concentration of operated lenses was in harmony with the lens turbidity (23). Putting all these facts together, we thought that an answer for this question can be obtained and how much vitamin C exists in aqueous liquor in the patients who are at risk of cataract and how is its relation to vitamin C concentration of plasma.

MATERIALS AND METHODS

This cross-sectional study was done in Yazd Rah-Ahan Eye Hospital, Shahid Sadoughi Medical Science University, Yazd, Iran. Aqueous liquor specimens were collected from the patients with senile cataract admitted to ophthalmology ward for cataract surgery. The patients were between 40 and 85 years of age and were otherwise healthy. The data were obtained from the hospital records by interviewing the patients, from observations of surgeons. After general anesthesia and just before beginning of cataract surgery 0.2 cc of aqueous liquor was taken from the anterior chamber through limbus and the surgery continued by capsulotomy that was done by a needle connected to ringer serum. Simultaneously 5 cc of peripheral blood was collected and sent to the laboratory for measuring vitamin C concentration. Verified parameters of this study were age, sex, type of cataract and vitamin C concentration of aqueous and plasma in patients who were at risk of cataract.

Vitamin C concentration was measured by spectrophotometric and colorimetric methods. The absorption briefly figures thus obtained were changed to concentration figures by the help of 'absorption-concentration curves'.

RESULTS

In this study, totally 85 patients (41 men and 44 women) who were at risk of cataract were studied. The patients' senile slope was between 40 and 85, and the mean was 64.3±1.2 (mean±SE).

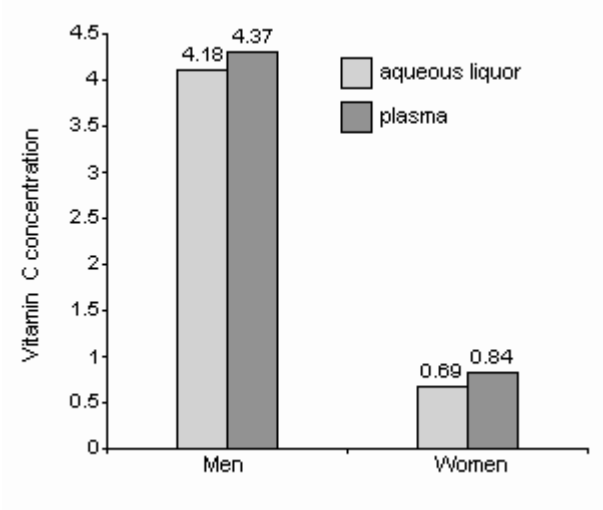
Mean vitamin C concentration of aqueous liquor was 4.292±0.12 mg/dl, the range was 0.76 to 6.06 mg/dl and

Table 1: Vitamin C concentration of aqueous liquor and plasma in patients who are at risk of cataract according to the age.

		Vitamin C concentration of aqueous liquor		Vitamin C concentration of plasma	
Age	Studied numbers	Mean (mg/dl)	S.D	Mean (mg/dl)	S.D
40–59	27	4.62	1.00	0.72	0.22
60–69	27	4.2	1.1	0.83	0.39
70–85	31	4.08	1.2	0.76	0.36
Total	85	4.29	1.14	0.77	0.33

P=0.179, P=0.446

Figure 1: Vitamin C concentration of aqueous liquor and plasma in patients according to sex.



confidence interval CI was 95% from 4.05 to 4.54. Vitamin C concentrations of aqueous liquor according to the patients' age are shown in Table 1. It seems that vitamin C concentration of aqueous liquor decreases as the age increases, but this reduction was not statistically significant (p=0.179). Figure 1 shows vitamin C concentration of aqueous liquor according to the sex although these values are a little more in women but the difference is not statistically significant (p=0.461). Table 2 shows vitamin C concentration of aqueous liquor according to the patients' professions and the differences are not statistically significant (p=0.735). Figure 2 shows vitamin C concentrations of aqueous liquor in different types of cataracts. Even though vitamin C concentrations of aqueous liquor samples are varied in different kinds of cataracts, these differences were not significant.

Mean vitamin C concentration of plasma in patients was 0.77±0.036 (mean±SE) whose changes slope was from 0.26 to 2.2 mg/dl, confidence interval was 95% and vitamin C concentration of plasma was 0.7–0.84 mg/dl. As Table 1 shows, these values are not related to the age (p=0.446). But as Figure 1 shows, they are significantly higher in women than men (p=0.043), also these parameters are not related to the patients' professions (p=0.135) (Table 2). Figure 2 shows the different vitamin C concentrations of blood in patients with significantly different kinds of cataracts but statistical results do not reveal significant differences.

The relation between vitamin C concentrations of aqueous and plasma was accounted by Pierson relation coefficient and r=0.175 that with (p=0.11), its difference with zero is not significant. This means that there is a positive relation as the mean vitamin C of plasma increases, vitamin C density of aqueous increases too.

DISCUSSION AND CONCLUSION

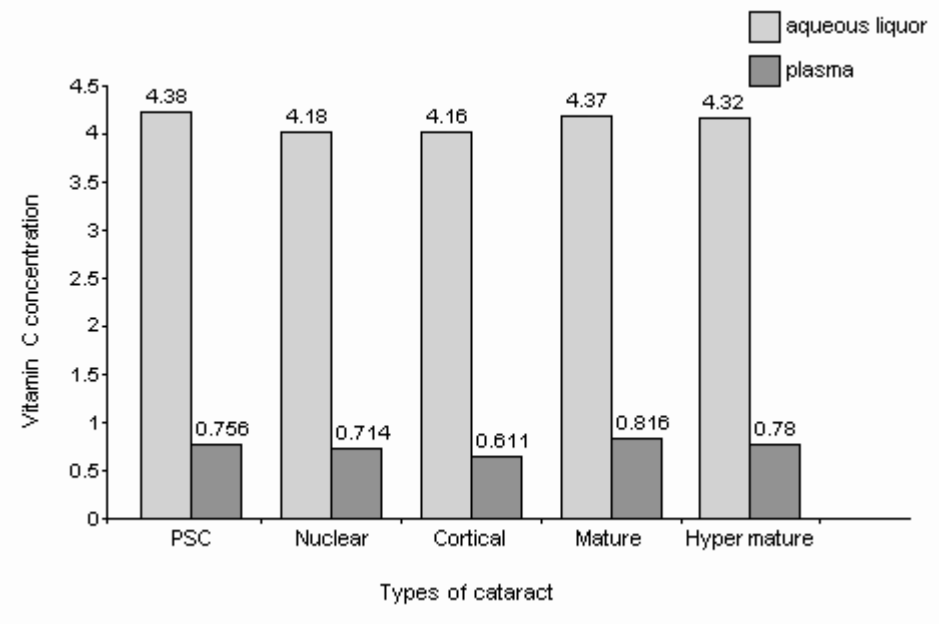
Recently non-surgical approaches to delay progress of cataract have been taken into consideration. If formation of cataract could be delayed for 10 years, the number of patients who need surgery will be reduced 45% (6). Antioxidant foods such as those which are rich in vitamin C have protection effects against some chronic diseases such as cancer, cardiac diseases and cataract (3, 7, 12, 15-17, 19, 23). Vitamin C is one of the most important antioxidants existing in aqueous liquor. The vitamin C concentration in serum is 0.6–2 mg/dl in normal individu-

Table 2: Vitamin C concentration of aqueous liquor and plasma in patients who are at risk of cataract according to the professions.

		Vitamin C concentration of aqueous liquor		Vitamin C concentration of plasma	
Professions	Studied numbers	Mean (mg/dl)	S.D	Mean (mg/dl)	S.D
House hold	43	4.4	0.96	0.84	0.36
Industrial and agricultural workers	18	4.22	1.12	0.68	0.3
Other professions	24	4.20	1.38	0.73	0.24

P=0.735, P=0.135

Figure 2: Vitamin C concentration of aqueous liquor and plasma in patients with different types of cataract.



PSC: Posterior subcapsular

als (18). Maximum concentration of vitamin C in aqueous liquor is 1.5 milli-mole or 60–85 mg/dl which is 20–30 times, in some references 50 times of the normal figures (5,11,18). The lens must be in the reduced state to be transparent. According to the results of this study the mean concentration of vitamin C in aqueous liquor was 4.29±0.12 (mean±SE) mg/dl and in plasma it was 0.77±0.036 (mean±SE) mg/dl. These figures especially those of aqueous liquor are significantly different.

In the study of Bates *et al.* (2) 7 patients who were at risk of bilateral cataract were operated on one eye and then the materials of operated lenses were analyzed. After operation, 3 were put on vitamin C and 4 on placebo for 3 months and then the cataract of other eye was operated. Consequently vitamin C density of aqueous liquor and lens of those which were put on vitamin C had increased (21).

In the study of Jacques and his colleagues, plasma of 77 cases of cataract and 35 controls were examined. They concluded that vitamin C concentration in patients who were at risk of cataract was lower than control group ($p<0.05$) (18). This result is in harmony with our study. In addition, in our study vitamin C concentration of aqueous liquor is also accounted and the proportion of aqueous to plasma vitamin C concentration is lower than normal population.

In our study, vitamin C concentration of plasma was not related to the age. This point was proved in the study of Birlouez-Aragon *et al.* (4) who measured vitamin C concentration of plasma in old persons living at nursing home and home. They concluded that lack of vitamin C in the first group was related to environmental factors rather than their age (22). In our study vitamin C density decreases as the age increases, but the decrease was not statistically significant ($p=0.179$).

Although in some references, it is noted that senile cataract is more prevalent in women than men (1) but in our study this difference was not statistically significant, but when vitamin C concentration of plasma was compared in both sexes, the difference was significant and it was more in women than in men ($p=0.043$). One reason for this difference could be this fact that in our group women were at home more than men and so foods with higher content of vitamin C are more available for them.

There were not statistically significant differences between vitamin C concentration of plasma and aqueous among different professions in our study. Receiving equal amounts of vitamin C among these groups may be cause of it or perhaps distinction among professions is not done correctly in this study because cataract is more prevalent in profession in which persons are exposed to UV-B and infrared rays (13).

Tessier *et al.* (23) studied vitamin C concentration of operated lenses and its relation to the intensity of lens turbidity. They found that vitamin C concentration decreases as lens turbidity increases and concluded that vitamin C of lens is a good indicator for cataract intensity (23). We compared to relation of all kinds of mature and hyper mature cataract, cortical, posterior sub-capsular and vitamin C density of aqueous and plasma but our findings did not show statistical valuable numbers.

Epidemiologic studies proved that antioxidants such as vitamin C have prevention role from chronic diseases such as cataract (2, 5–7, 9, 11, 16, 20, 21) and daily dose of 90-100 mg of vitamin C for women and nonsmoker men is advised to prevent these diseases (cataract, coronary and cancer diseases). Furthermore this study showed that vitamin C density of aqueous and plasma in patients who are at risk of cataract is lower than normal. This fact that there is too much sunshine in Iran especially in Yazd, foodstuffs which are rich in vitamin C, should be advised in diet for prevention and to delay cataract. This approach is cheep, reliable and practical.

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Correspondence:
Ali Mohammad Miratashi
Shahid Rejaie Ave,
Yazd, IRAN.
e-mail: mrbesharaty@yahoo.com.uk