

PLASMA AND AQUEOUS HUMOR ASCORBIC ACID LEVELS IN PEOPLE WITH CATARACT FROM DIVERSE GEOGRAPHICAL REGIONS OF NEPAL

B Badhu¹, N Baral², M Lamsal², H Das¹ and A Dhital (Badhu)³

¹Department of Ophthalmology, ²Department of Biochemistry, ³Department of Community Nursing, College of Nursing, B.P. Koirala Institute of Health Sciences, Dharan, Sunsari, Nepal

Abstract. Ascorbic acid in aqueous humor of the eye has a role as an antioxidant in delaying cataract formation. In a cross-sectional comparative study, ascorbic acid levels from aqueous humor and venous blood obtained from patients with cataracts in mountainous regions (1,300-2,000 meters) and subtropical lowlands (<100 meters) of Nepal were measured spectrophotometrically with the objective of comparing the levels of aqueous humor ascorbic acid in patients with cataracts from these two diverse geographical regions. Of 131 patients included in the study, 59 were from the mountainous region of Nepal (Group A) and 72 were from the subtropical lowlands (Group B). The mean (\pm SD) plasma ascorbic acid level (mg%) of the subjects in Group A was 0.65 (\pm 0.20) and Group B was 0.85 (\pm 0.31). The aqueous ascorbic acid levels ranged from 12-28 mg % (mean \pm SD = 17.5 \pm 4.52) and 14-50 mg % (mean \pm SD = 23.47 \pm 8.66) in Groups A and B, respectively. The difference of the plasma and aqueous humor ascorbic acid levels between the two groups was statistically significant ($p < 0.01$). The plasma and aqueous humor ascorbic acid levels in the people with cataracts from the mountainous region of Nepal were significantly lower than those from subtropical lowlands. This may be because of the effect of high altitude and ultraviolet rays on ascorbic acid metabolism.

INTRODUCTION

Senile cataracts are a leading cause of blindness in developing countries, including Nepal (Thylefors, 1998). The etiologies of senile cataracts are not known, but there is evidence to suggest that it is a multi-factorial condition. The various etiological factors result in oxidative damage of the lens (Varma, 1991). If a factor could be found to delay cataract onset by ten years, it is reported that the number of cataract surgeries would decrease by 45% (Kuper, 1984). Though there are controversies regarding the role of individual antioxidants in delaying cataract formation (Christen

et al, 1996), the role of ascorbic acid as an antioxidant and free radical scavenger is quite important to prevent or delay the development of senile cataracts (Valero *et al*, 2002; Hegade and Verma *et al*, 2004). It has been reported that higher plasma levels of ascorbic acid are associated with reduced prevalence of nuclear and posterior sub-capsular cataracts (Ferringo *et al*, 2005). It is a well known fact that high levels of ultraviolet rays, which influence cataract formation (Hollows and Moran, 1981; Collman *et al*, 1988; Taylor *et al*, 1988; Sasaki *et al*, 2003) are present at high altitude. It has been documented that people from highlands are 60% more at risk of developing cataracts than those from the lowlands of Nepal (Brilliant *et al*, 1983). There have been no reports on whether the ascorbic acid levels are different between these two areas.

Reports from developing countries may

Correspondence: Dr Badri P Badhu, Department of Ophthalmology, B.P. Koirala Institute of Health Sciences, Dharan, Sunsari, Nepal.
Tel: 00977-25-530119 (R); Fax: 00977-25-520251
E-mail: aabadhu@yahoo.com

not be consistent with those from developed countries with different dietary habits, lifestyles and environmental risk factors.

This study was designed with the objective of assaying the levels of plasma and aqueous humor ascorbic acid in subjects with cataracts from mountainous regions and subtropical lowlands of Nepal.

MATERIALS AND METHODS

A cross-sectional comparative study was carried out at the B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal including 131 consecutive subjects with senile cataracts. Those with complicated cataracts, post-traumatic cataracts, glaucoma, intra-ocular inflammation, diabetes mellitus, systemic hypertension, leprosy and tuberculosis were excluded from the study. Similarly, smokers, pure vegetarians and those receiving systemic supplementation with vitamins were also excluded. The subjects were divided into two groups according to their geographical distribution: Group A included inhabitants from the mountainous region (1,300-2,000 meters above sea level) and Group B included individuals living permanently in subtropical lowlands (<100 meters above sea level) of Nepal. Informed consent was obtained from all subjects after explaining the nature and purpose of the study.

During surgery for the cataract, 0.15-0.20 ml of aqueous humor was aspirated peripherally through the cornea by a disposable 1 ml syringe from each individual in the study. At the same time, 5 ml of blood was collected from an antecubital vein.

The aqueous humor and blood samples obtained were kept in an icebox after collection and during transport to the biochemistry laboratory of the B. P. Koirala Institute of Health Sciences, Dharan, Nepal. Ascorbic acid was measured spectrophotometrically using standard techniques as described by McCornick

Table 1

Ascorbic acid level in plasma of the subjects with cataracts from the mountainous region (Group A, n=59) and the subtropical lowlands (Group B, n=72) of Nepal.

Category	Range (mg%)	Mean (mg%)	SD	p-value
Group A	0.5-1.5	0.65	±0.20	<0.01
Group B	0.5-1.6	0.85	±0.31	

and Greene (1999) on the same day of sample collection. Briefly, ascorbic acid in the sample (plasma or the aqueous humor) was oxidized with Cu^{+2} to form dehydroascorbic acid which reacts with acidic 2,4- dinitrophenyl hydrazine to form a red bis- hydrazon which is measured at A_{520} . This study was approved by the Institutional ethical review board of BPKIHS, Dharan, Nepal.

RESULTS

A total of 131 patients were included in the study, of which 59 were from the mountainous region (Group A) of Nepal and 72 from the subtropical lowlands (Group B). The means (\pm SD) of ages for Groups A and B were 59.32 ± 8.33 and 57.86 ± 9.23 years ($p > 0.05$), respectively. The plasma ascorbic acid levels (Table 1) from the subjects from the mountainous region ranged from 0.5 to 1.5 mg % (mean \pm SD = 0.65 ± 0.2) and that of the patients from sub-tropical lowlands ranged from 0.5 to 1.6 mg % (mean \pm SD = 0.85 ± 0.31). The difference between the two groups was statistically significant ($p < 0.01$). The aqueous ascorbic acid levels (Table 2) were also significantly lower in the individuals from the mountainous region compared to those from the sub-tropical lowlands.

DISCUSSION

The level of ascorbic acid in the aqueous

Table 2

Ascorbic acid levels in the aqueous humor of subjects with cataracts from the mountainous region (Group A, n=59) and subtropical lowlands (Group B, n=72) of Nepal.

Category	Range (mg%)	Mean (mg%)	SD	p-value
Group A	12-28	17.5	±4.52	<0.01
Group B	14-50	23.47	±8.66	

humor must be adequate to prevent the damaging effects to the lens of free radicals. It has been reported that people from the hill country are 60% more at risk of developing cataracts compared to those from lowland of Nepal, presumably due to the effects of ultraviolet rays (Brilliant *et al*, 1983). It has not been reported whether the levels of ascorbic acid in the plasma and aqueous humor of those individuals with senile cataracts from the mountainous regions and subtropical plains of Nepal are significantly different from each other or not. Because the population of Nepal is distributed both in hilly and lowland areas, it gives us an opportunity to carry out a comparative study between the two groups.

The results of this study reveal the plasma and aqueous humor ascorbic acid levels among the patients with senile cataracts from the subtropical plains are significantly higher than those from the mountainous region. The dietary habits of the people may also contribute to the differences in the levels of ascorbic acid. The main food in Nepal is rice and vegetables with cereals. It is less likely to influence the ascorbic acid levels in the studied population. It has been reported that adaptation to a high altitude environment is accompanied by various metabolic changes. Use of essential nutrients (vitamins) to optimize adaptation to this environment and to maintain adequate work capacity and good health have been recommended (Belakovskii *et al*, 1983,

1984). It is plausible that the difference in ascorbic acid levels found in this study could be due to environmental factors, such as altitude and UV rays.

Although there are many factors attributed to cataractogenesis, our results suggest a possible role of high altitude and UV rays on ascorbic acid metabolism and cataract formation. This information can be useful for future research in the biochemical aspect of cataracts.

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