

Taurine levels in human aqueous humour

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مستوى التورين في الخلط المائي لعين الإنسان

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الملخص: الهدف: يهدف البحث إلى التحقق من وجود التورين في الخلط المائي لعين الإنسان العادي وما إذا كان مستواه يتغير في المرضى المصابين بورم الجذيعات الشبكية. **الطريقة:** تم قياس مستوى التورين في الخلط المائي لعين ثلاثة أطفال مصابين بورم الجذيعات الشبكية وكذلك في مجموعة ضابطة تتألف من 12 مريضاً مصابين بالسد الهرمي (العسة الكرية) وخمسة أطفال مصابين بالسد الخلفي. **النتائج:** بالرغم من عدم وجود فروق مهمة بين مستويات التورين في الخلط المائي للمرضى البالغين والأطفال والمصابين بمرض السد الهرمي إلا أن مستوى التورين كان مرتفعاً بشكل ملحوظ في المرضى المصابين بورم الجذيعات الشبكية مقارنة بمجموعة المرضى المصابين بالسد الهرمي. **الخلاصة:** تدل النتائج على أن التورين موجود في الخلط المائي لعين الإنسان العادي ولكن بكميات أقل من مثيله في سوائل الجسم الأخرى.

ABSTRACT: Objective – To determine whether taurine is present in normal human aqueous humour and whether these levels are altered in patients with retinoblastoma. **Method** – Taurine levels were estimated in aqueous humour of 3 children with a clinical diagnosis of retinoblastoma and in a control group of 12 patients with senile cataract and 5 children with congenital cataract. **Results** – Though there was no significant difference in taurine levels in the aqueous humour of children and adults with cataract, the taurine levels were significantly elevated ($p < 0.0001$) in patients with retinoblastoma as compared with the control group of cataract patients. **Conclusion** – The results indicate that taurine is present in normal human aqueous humour, albeit in much smaller quantities than in other body fluids.

KEY WORDS: amino acids, aqueous humour, cataract, retinoblastoma, taurine

Taurine (2-amino ethane sulphonic acid) is one of the most abundant free amino acids in the human body, especially in the intracellular region, where its concentrations are among the highest of all amino acids. Taurine is also the most plentiful free amino acid in the leucocyte.¹ It is found in high concentrations in brain tissue, and it is the main free amino acid in all mammalian neural tissue.² Taurine has been demonstrated to be present in low concentrations in most body fluids. Its levels have been estimated in plasma³ and in urine⁴ and its content in CSF is known to be well regulated.²

In the retinal tissue, taurine is the most abundant free amino acid, accounting for 45% of all free amino acids in the retina.⁵ More than 50% of the retinal taurine is concentrated in the photoreceptive layer.⁶ In retinoblastoma, a tumour involving the photoreceptor layer, it is known that there is an increase in the amounts of certain intracellular enzymes like lactic dehydrogenase⁷ and that these enzymes seep through

by forward diffusion and become detected in high concentrations in the aqueous humour.⁸ Similarly, it seemed possible that the necrotic taurine-rich retinal neural cells of retinoblastoma patients could liberate taurine, elevating its level in the aqueous humour. However, no information was available in the literature regarding the presence or absence of taurine in human aqueous humour, normal or otherwise. It was therefore decided to estimate the taurine levels in human aqueous humour and investigate whether taurine levels are increased in the aqueous humour in retinoblastoma.

METHODS

The subjects were 4 children aged between 2 years and 5½ years, who presented at the Eye Hospital, Colombo with a clinical diagnosis of unilateral retinoblastoma. All were in the advanced stages of the disease with a white mass behind the pupils for more than six months. Aqueous humour was collected from

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each child's affected eye, just prior to enucleation, by aqueous puncture at the limbus, using an Amsler's needle connected to a dry 2 ml syringe. One of the specimens thus collected was contaminated with blood and had to be discarded. On ethical grounds the surgeons refused sampling aqueous humour from the better eye of the children. Therefore aqueous humour was also collected from a control group of 12 adults aged between 58 and 74 years (who had presented for cataract extraction) and 5 children aged between 3 and 9 (who had congenital cataract). The procedure for removal of aqueous humour from the tumour bearing eye prior to enucleation and from the cataractous eye prior to lens aspiration was explained to the mother of each child and her consent obtained. The specimens of aqueous humour were frozen overnight at -20°C and stored at -70°C , and were analysed within one week of collection. The samples were deproteinized by ultra-filtration and the standard taurine and the individual samples were dried under vacuum. After derivatization, the samples were injected for chromatographic analysis using a Waters M U6K universal liquid chromatographic injector. A Waters Pico Tag amino acid analysis system was used.⁹ Temperature was controlled at $40 \pm 1^{\circ}\text{C}$ and results were obtained using a Waters M 745 Digital Integrator.

RESULTS

The taurine levels found in the aqueous humour of the cataract patients and the three retinoblastoma patients are shown in table 1. The taurine levels in the aqueous humour of the 12 patients with senile cataract varied from 0.082 to 4.66 nmol/l (mean 0.82 ± 1.39). The mean taurine level in the 5 patients with congenital cataract was 1.29 ± 1.3 nmol/l. The mean taurine level of the 3 patients with retinoblastoma was 99.69 ± 47.23 nmol/l. Analysis of variance procedure SAS¹⁰, used to test the significance of the different groups, showed that the mean of the retinoblastoma patients was very significantly different from the means of the cataract controls ($P < 0.0001$).

Pathological examination of the enucleated eyeballs of all the 3 children confirmed the diagnosis of retinoblastoma.

DISCUSSION

The retina is very rich in taurine where its concentration is as high as $50 \mu\text{mol/G}$.¹¹ The retina accumulates taurine both by synthesis and by uptake from the circulation¹² and is able to concentrate the amino acid against a 400 fold gradient.¹³

The exact function of taurine in the human retina

is not known but taurine has been reported to act as an inhibitory neurotransmitter¹³ and as a stabilizer of excitable membranes.¹⁴ Also, light is known to cause taurine release from the retina.¹⁵ In addition, taurine exerts a protective effect on the photoreceptors and taurine deficiency has been shown to produce retinal degeneration in cats.¹⁶

TABLE 1

Taurine levels in the aqueous humour (nmol/l)

	Senile cataract patients	Congenital cataract patients	Retinoblastoma patients
	0.16	0.42	141.96
	0.89	3.46	108.42
	0.10	1.28	48.71
	0.15	0.16	
	4.66	1.14	
	0.15		
	0.18		
	0.12		
	1.99		
	0.08		
	0.25		
	0.12		
Mean	0.82	1.29	99.69
SD \pm	1.39	1.3	47.23

Taurine has been identified in most body fluids, though in low concentrations. Its level in normal plasma has been estimated at between $41\text{--}82 \mu\text{mol/l}$, its mean value in CSF being $5.7 \mu\text{mol/l}$ and its level in the urine has been reported as being $579 \pm 258 \mu\text{mol/G}$ of creatine.³ There have been no reports in the available literature of the taurine concentration in normal aqueous humour. Since it was not possible to estimate the taurine levels in the aqueous humour of normal human eyes, it was estimated in 17 patients with cataract, where the aqueous humour was collected prior to making the corneal incision. Our study shows that the mean taurine levels in the aqueous humour of the 12 patients with senile cataract was 0.82 ± 1.39 n

mol/l. The mean taurine level in the 5 children with congenital cataract was 1.29 ± 1.3 nmol/l. The taurine concentration in the aqueous humour of this control group was thus much lower than in other body fluids. The Duncan's Multiple Range Test for Variable showed that there was no significant difference in the taurine levels in the aqueous humour of the patients with senile cataract and the children with congenital cataract ($p < 0.068$). The mean taurine concentration in the aqueous humour of the 3 patients with retinoblastoma was 99.69 ± 47.23 nmol/l. When compared with the cataract controls, the patients with retinoblastoma had much higher ($p < 0.0001$) taurine levels in the aqueous humour of their affected eye. The reason for the significantly lower value of 48.71 nmol/l in the aqueous humour of one of the retinoblastoma patients is not clear. There was no relationship between the taurine levels and the duration of the tumour or the extent of tumour necrosis seen on histology. An interesting finding in nearly all the patients with senile cataract was the presence of high levels of the amino acids serine and leucine in the aqueous humour. While significance of this is not clear, these amino acids might be among the end products of the metabolism of the cataractous lens fibres or the disintegrating cataractous lens fibres could be releasing these amino acids into the aqueous humour.

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