Effect of β-phenylethylamine on intraocular pressure

S. Miyake, H. Ichikawa and K. Yagi[1]

Department of Ophthalmology, and Institute of Biochemistry, Faculty of Medicine, University of Nagoya, Nagoya 466 (Japan), 28 August 1978

Summary. Upon injection of β-phenylethylamine (PEA) into the subconjunctival space of rabbit, intraocular pressure increased. This effect went parallel with the amount of PEA transferred into the anterior chamber, which indicates that intraocular pressure was elevated by direct action of PEA.

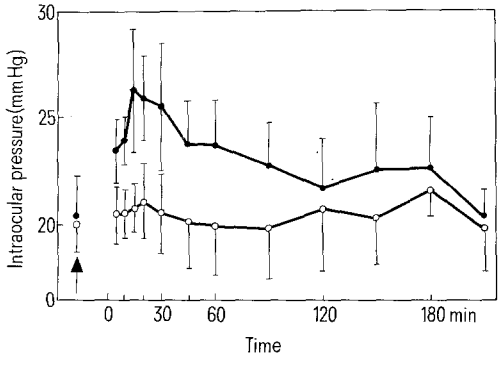
β-Phenylethylamine (PEA) has been considered as a member of the biogenic monoamines. Much evidence has been reported to suggest that PEA plays an important role in the central nervous system. Besides its occurrence in the brain[2-4], its clinical implications were suggested by the decrease in urine excretion in depressive patients[5], and the effect to increase the severity of a chocolate-sensitive migraine[6]. Furthermore, it was made clear that PEA is a specific biogenic substrate of type B monoamine oxidase[7].

In the field of ophthalmology, it is well-known that many monoamines such as norepinephrine and epinephrine decrease intraocular pressure. Recently, dopamine was also found to decrease the pressure[8]. Some of these amines are used practically for the treatment of glaucoma. Nevertheless, PEA has never been examined for its effect on intraocular pressure. The present investigation was carried out to examine this problem.

Animals used were adult rabbits weighing 2.5-3.5 kg. 3 solutions of 0.2 ml of sodium phosphate buffer (pH 7.4, 1/15 M) containing 0.4 mg, 4 mg or 10 mg of PEA (β-phenylethylamine hydrochloride: Nakarai Chemicals, Ltd, Kyoto), respectively, were prepared. Each solution was injected subconjunctivally into 1 eye, and sodium phosphate buffer (pH 7.4, 1/15 M), as control, into the other eye of the same animal. Intraocular pressure was measured with Schioetz tonometer and calibration table for the rabbit eyes reported by Best et al.[9] was used to convert the tonometric value. In the same manner as the experiments of tonometry, the solution containing 10 mg PEA was injected subconjunctivally. The amount of PEA transferred into the aqueous humor of the anterior chamber was measured quantitatively. The samples obtained were 0.2 ml before treatment, each 0.1 ml at 5 min, 15 min and 30 min after treatment, respectively. Quantitative measurement of PEA was carried out by a fluorometric assay reported by Suzuki and Yagi[10]. The fluorescence intensity was recorded on a Shimadzu corrected spectrofluorophotometer RF-502 with excitation at 390 nm and emission at 495 nm.

The figure shows the change in intraocular pressure after the injection of 10 mg of PEA. Intraocular pressure began to increase within 5 min and became maximum about 15 min after the injection. The increase was statistically significant: at every measurement until 30 min, $p < 0.01$; at 60 min, $p < 0.02$. High intraocular pressure continued for about 3 h. On the other hand, the amount of PEA transferred into the anterior chamber after subconjunctival injection of 10 mg of PEA was measured. The aqueous humor before treatment has little or no PEA. After the injection, PEA contents in the aqueous humor were 12.3±2.5 μg/ml at 5 min, 22.0±3.12 μg/ml at 15 min and 15.5±2.0 μg/ml at 30 min. The amounts of PEA in the aqueous humor went parallel with the values of intraocular pressure. In the group injected with 4 mg of PEA, the increase in intraocular pressure was less marked and its duration was also shorter than that of the group injected with 10 mg of PEA. In the group injected with 0.4 mg of PEA, the increase was minute. Accordingly, change in intraocular pressure by PEA is dose-dependent.

The present experiments proved that the injected PEA increased intraocular pressure. The relation between the concentration of PEA in the aqueous humor of the anterior chamber and the increase in intraocular pressure indicates that the increase in intraocular pressure was caused by direct action of PEA. Zeller et al.[11] reported that PEA existed at the level of 0.7-1.3 μg/g of tissue in rabbit iris, and predicted that PEA would play an important role in the iris. Accordingly, the present data may be interpreted to mean that the injected PEA could be incorporated into the irido-ciliar body where this monoamine acts to elevate intraocular pressure. If this assumption is valid, PEA would play some role in the regulation of intraocular pressure, since other biogenic monoamines such as norepinephrine, epinephrine, dopamine and tyramine all decrease intraocular pressure of rabbit.



Change in intraocular pressure of rabbit after subconjunctival injection of 10 mg of PEA. ●, injected with 0.2 ml of sodium phosphate buffer (pH 7.4, 1/15 M) containing 10 mg of PEA; ○, control, injected with 0.2 ml of sodium phosphate (pH 7.4, 1/15 M). The mean values were obtained with 6 experiments. The vertical bars show SD. The arrow shows the values of the intraocular pressure of the same animal before injection.

1 Correspondance to: K. Yagi, Institute of Biochemistry, Faculty of Medicine, University of Nagoya, Nagoya 466, Japan.

2 E. Fischer, H. Spatz, B. Heller and H. Reggiani, Experientia *28*, 307 (1972).
3 D.J. Edwards and K. Blau, Biochem. J. *132*, 95 (1973).
4 D.A. Durden, S.R. Philips and A.A. Boulton, Can. J. Biochem. *51*, 995 (1973).
5 A.A. Boulton and L. Milward, J. Chromatogr. *57*, 287 (1971).
6 M. Sandler, M.B.H. Youdim and E. Hanington, Nature *250*, 335 (1974).
7 H.Y.T. Yang and N.H. Neff, J. Pharmac. exp. Ther. *187*, 365 (1973).
8 R.P. Shannon, A. Mead and M.L. Sears, Invest. Ophthal. *15*, 371 (1976).
9 M. Best, R. Pola, M.A. Galin and M. Blumental, Archs Ophthal. *84*, 200 (1970).
10 O. Suzuki and K. Yagi, Analyt. Biochem. *75*, 192 (1976).
11 E.A. Zeller, P.A. Knepper and D. Shoch, Invest. Ophthal. *14*, 155 (1975).