

OPTOMETRY 699
Special Studies
THE EFFECT OF EXERCISE ON
INTRAOCULAR PRESSURE

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INTRODUCTION

Many factors have been shown to affect intraocular pressure. Among these factors of age, systemic or ocular health, diurnal variations, and either systemic or ocular medications, is a change in blood pressure.(1) This paper examines the affect of strenuous exercise, distance running, on intraocular pressure.

Fifteen subjects were tested comprising three groups. All those tested were in good health and had open, grade three or four, anterior chamber angles, as determined using the penlight shadow test.(2) Their age ranged between 23 and 33 years old. Five were members of the Ferris State University Track Team, five were recreational runners who run three to four times a week, and five were the control group. With the exception of the control group, all subjects tested ran five miles on the indoor track at Ferris State University. Intraocular pressures were measured before the running began, at the end of one-half mile, one and one-half miles, three miles, and five miles. Two measurements per eye were made using a noncontact tonometer. A comparison of the change in intraocular pressures of the three groups was made. Results showed little change in intraocular pressure in both the experimental groups and the control group.

THEORY

The pressure within the eye, termed intraocular pressure (IOP), varies directly with the rate of secretion of aqueous humor, the fluid in the anterior segment of the eye, which is produced by the epithelial cells of the ciliary processes, and varies inversely with the facility of aqueous outflow.(3) Secretion or inflow of aqueous humor takes place in the posterior chamber of the eye. It passes forward through the pupil into the anterior chamber. It leaves the eye through the trabecular meshwork to Schlemm's Canal and exits via the venous drainage system.(4)

Theories of aqueous secretion from the epithelial cells of the ciliary processes center on transport of electrolytic ions and fluid across the ciliary epithelium into the posterior chamber. The rate of transport of these substances depends in part on blood pressure in the ciliary body and permeability through the capillary walls. A reduction in blood pressure and blood flow, results in decreased aqueous humor production.(5) An elevation of systolic blood pressure also increases mean intraocular pressure.(6)

Therefore, the question is does a short term change in blood pressure, known to occur during strenuous exercising, such as distance running, have an affect on intraocular pressure?

METHODS

Noncontact applanation tonometry was used because there is no physical contact between the instrument and the eye. Five measurements of IOP were needed in the span of about 45 minutes, the time estimated to run five miles. It was felt that administration of topical anesthetic and physical applanation, used in Goldmann Tonometry, that often over a relatively short time, may have made the runners uncomfortable. Also the clinical results of noncontact tonometry and Goldmann Tonometry correlate well except at very high levels of pressure, which were not expected. (7)

Two measurements per eye were made with an average value being used to determine IOP changes. If one of the two readings appeared to vary unusually high or low, a third measurement was made and the two closest readings were recorded. Beginning IOP was recorded and again at intervals of one-half mile, one and one-half miles, three miles, and five miles. Runners began at about one minute intervals so waiting for IOP measurements could be avoided. The control group IOP measurements were made at timed intervals which approximated those times when the runners finished the appropriate distance. All changes in IOP were determined using the initial IOP measurement as the starting point.

RESULTS

Average IOP change for each group over the complete five miles.

-0.50 mm Hg. for the track members

-0.40 mm Hg. for the recreational runners

-0.20 mm Hg. for the control group

Percentage change in IOP for each group over five miles.

-3.70% for the track members

-3.94% for the recreational runners

-1.57% for the control group

Range of change in IOP for each group over the five miles.

6.5 for track members

4.0 for the recreational runners

2.0 for the control group

The greatest change in IOP was determined to occur in the first one-half mile of running showing an average change of 0.6 mm Hg. and the largest range in IOP change being 8 mm Hg.

DISCUSSION

Normal individuals with sufficient outflow facility do not show significant change in intraocular pressures associated with strenuous exercise and a temporary increase in blood pressure. The study showed changes averaging less than one mm Hg. which is insignificant. However, because all subjects tested were determined to have open anterior chamber angles and none were considered to be either glaucoma suspects or high risk patients, it should not be implied that all individuals undergoing a change in blood pressure following strenuous exercise, do not show a significant IOP change.

Just as the provocative tests of water drinking and dark room prone test do not show significant changes in IOP with a normal population, while giving positive results in individuals with suspect primary open angle glaucoma or angle closure glaucoma, (8) so to may narrow angle individuals or glaucoma suspects have IOP changes that are significant with blood pressures changes following exercise. The testing of the higher risk individuals may need to be done in future studies.

REFERENCES

1. Carter, R.L., O.D., The Pharmacological Treatment and Optometric Management of the Glaucomas, lecture notes, 1986.
2. Bartlett, J.D. and Jaanus, S.D., Clinical Ocular Pharmacology, Butterworth Publishers, Stoneham, MA 1984, pgs 434-436.
3. Kolker, A.E. and Hetherington, J. Jr., Becker-Shaffer's Diagnosis and Therapy of the Glaucomas, Fourth Edition, The C.V. Mosby Company, Saint Louis, MO, 1976, pg 60.
4. Bartlett and Jaanus, pgs 847-848.
5. Kolker and Hetherington, pgs 99-103.
6. Kolker and Hetherington, pg 59.
7. Kolker and Hetherington, pg 68.
8. Kolker and Hetherington, pgs 113-119.

AVERAGE CHANGE IN IOP BY GROUP

Right Eye: Red = track
Blue = recreational
Green = control

Left Eye: Cranberry = track
Black = recreational
Purple = control

Combined: Orange = track
Brown = recreational
Pink = control

