IMPACT OF EXERCISE ON INTRAOCULAR PRESSURE IN RELATION TO BLOOD PRESSURE

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Abstract

Background and Objective: The physiological processes necessary for the functioning of the eye relate to the blood ocular barrier and circulation of intraocular fluid, maintenance of intraocular pressure and metabolism of the different ocular tissues. Hence, we wanted to investigate the effect of exercise on intraocular pressure changes in relation with Blood Pressure.

Materials and Methods: The present study was conducted at Kasturba Medical College Bejai, Mangalore after the institutional ethical clearance. After a resting period, the Blood pressure was recorded, Paracaine eye drops were instilled in both the eyes and intraocular pressure recorded using Schizont Tonometer after 2 min. Then they were asked to walk on treadmill with average speed till they were exhausted, again their blood pressure, intraocular pressure were noted as above with all aseptic precautions. The statistical analysis was done using students unpaired t-test using SPSS software Results were expressed in terms of mean and standard deviation. p value was taken significant at 5 percent confidence level (p<0.05).

Results: In our study SBP showed significant increase (p=0.003) after exercise irrespective of sex. Comparison of IOP, SBP before and after exercise showed very high significant (p <0.001). DBP showed significant change with a p value of 0.023. The IOP has declined after exercise and SBP increased after exercise and there was a slight decrease in DBP.

Conclusion: Our study showed that there was a significant rise of SBP after exercise and slight fall in DBP but, correlation with blood pressure and IOP did not reveal much significance which might be due to short duration of our study.

Keywords: Systolic Blood Pressure; Diastolic Blood Pressure; Intraocular Pressure; Exercise

1. Introduction

Maintenance of an ideal intraocular is required for proper visual functioning of the eye. Intraocular pressure is the fluid pressure inside the eye1. Impairment of this ideal equilibrium leads to a series of visual defects. The important physiological processes necessary for the functioning of the eye relate to the blood ocular barrier formation and circulation of intraocular fluid, maintenance of intraocular pressure and metabolism of the different ocular tissues2.

Intraocular pressure is mainly determined by the coupling of the production of aqueous humor and the drainage of aqueous humor mainly through the trabecular meshwork located in the anterior chamber angle. Intraocular pressure measurement is also influenced by corneal thickness and rigidity3. Ocular hypertension is defined by intraocular pressure being higher than normal, in the absence of optic nerve damage or visual field loss.

Current consensus in ophthalmology defines normal intraocular pressure as that between 10 mmHg and 20mmHg3. The average value of intraocular pressure is 15.5mmHg with fluctuations of about 2.75 mmHg. Hypotony, or ocular hypotony, is typically defined as intraocular pressure equal to or less than 5 mmHg. Such low intraocular pressure could indicate fluid leakage and deflation of the eyeball4. Intraocular pressure varies throughout the night and day. The diurnal variation for normal eyes is between 3 and 6mmHg and the variation may increase in glaucomatous eyes.

Physical exercise produced a decreased intraocular pressure without significant change in facility of outflow or episcleral venous pressure. The diminution in intraocular pressure was associated with an increased serum osmolarity, but it was believed that this did not account completely for the change. In the present study, we wanted to investigate the
effect of exercise on intraocular pressure changes in relation with Blood Pressure.

2. Materials and Methods
The effect of exercise on intraocular pressure and blood pressure was evaluated in our clinical laboratory in 30 voluntary 1st year Medical students of Kasturba Medical College Bejai, Mangalore after the institutional ethical clearance. All individuals were in the age group 18-25 years. Healthy subjects who were not suffering from any infectious diseases or any diseases of eye, non diabetic between age group of 18-25 years were included in the present study. Individuals with a history of eye diseases, history of diabetes, past history of medical illness and above 25 or below 18 years of age were excluded.

Materials used in the study were schizont tonometer, Sphygmomanometer, treadmill and Paracaine eye drops. The students arrived at clinical laboratory, Department of physiology in the morning between 10.00-11.0AM. They were requested to come in a relaxed condition and quiet mood. The temperature in the laboratory was between 25 degree Celsius. They were also asked to fill a questionnaire including type of diet consumed whether vegetarian or mixed and physical activity performed on a daily basis, their habit like alcohol etc were noted. After a resting period, the subjects were asked to lie down in supine position on couch and their Blood pressure was recorded, Paracaine eye drops were instilled in both the eyes and then intraocular pressure recorded using Schizont Tonometer after 2 min so that anesthetic acts. Then they were asked to walk on treadmill with average speed till they were exhausted, again their blood pressure, intraocular pressure were noted as above with all aseptic precautions then their results were noted.

2.1 Statistical Analysis: The statistical analysis was done using students unpaired t-test using SPSS software Results were expressed in terms of mean and standard deviation. p value was taken significant at 5 percent confidence level (p<0.05).

3. Results
In our study 30 subjects were taken whose blood pressure, height, weight, intraocular pressures were recorded. Systolic and diastolic blood pressure was also recorded both before and after exercise, Systolic blood pressure showed significant increase (p=0.003) after exercise (Table-1). The significance was irrespective to sex (Table-2). Comparison of Intraocular pressure, Systolic blood pressure before and after exercise showed very high significant (p <0.001, Table-4). Diastolic blood pressure showed significant change with a p value of 0.023(Table-3). The intraocular pressure has declined after exercise and systolic blood pressure increased after exercise and there was a slight decrease in diastolic blood pressure.

| Parameter | Gender | N   | Mean   | Std.Deviation | t & p value |
|-----------|--------|-----|--------|---------------|-------------|
| SBP BEFORE| MALE   | 16  | 120.8750 | 7.6930        | t=1.1980, p=0.241 NS |
|           | FEMALE | 14  | 117.7143 | 6.6033        |             |
| SBP AFTER | MALE   | 16  | 134.1250 | 5.9539        | t=3.2330, p=0.003 HS |
|           | FEMALE | 14  | 125.8571 | 8.0178        |             |

Note: NS=Non Significant, HS=Highly Significant

| Parameter | Gender | N  | Mean   | Std.Deviation | t & p value |
|-----------|--------|----|--------|---------------|-------------|
| DBP BEFORE| MALE   | 16 | 79.5000 | 4.4721        | t=0.518, p=0.608 NS |
|           | FEMALE | 14 | 78.5714 | 5.3452        |             |
| DBP AFTER | MALE   | 16 | 78.000  | 4.000         | t=1.7860, p=0.085 NS |
|           | FEMALE | 14 | 75.000  | 5.1887        |             |

Note: NS=Non Significant
Table No.3: Genderwise comparison of intraocular pressure before and after exercise

| Parameter | Gender  | N  | Mean  | Std.Deviation | t & p value |
|-----------|---------|----|-------|---------------|-------------|
| IOP BEFORE | MALE    | 16 | 15.0313 | 2.1127 | t=0.2340 p=0.815 NS |
|           | FEMALE  | 14 | 15.2021 | 1.8596 |             |
| IOP AFTER  | MALE    | 16 | 12.6688 | 2.2365 | t=0.9350 p=0.358 NS |
|           | FEMALE  | 14 | 11.9764 | 1.7434 |             |

Table No.4: Comparison of systolic blood pressure diastolic blood pressure and intraocular pressure before and after exercise

| Parameters | Paired Differences | t value | p value |
|------------|-------------------|---------|---------|
|            | Mean               | Std.Deviation |
| SBP        | -10.8667           | 5.79377  |
| DBP        | 2.4667             | 5.64913  |
| IOP        | 2.7653             | 1.25294  |
|            | -10.273            |          |
|            | 2.392              |          |
|            | 12.089             |          |

Fig-1: Gender wise comparison of intraocular pressure before and after exercise

4. Discussion
This study was conducted with the aim of determining whether acute exercise has any effect on intraocular pressure. Intraocular pressure is governed by a delicate balance between the production of aqueous humor by the non-pigmented ciliary epithelial cells and its egress, or outflow, from the eye. Most aqueous humour exits via the traditional aqueous outflow pathway comprised of the trabecular meshwork and the Canal of Schlemm, which are located in the anterior chamber in the anterior or corneoscleral part of the angle formed by the cornea and peripheral iris. Smaller amounts of aqueous exit through non-traditional pathways, which include iris vessels and posterior uveoscleral outflow via the ciliary body and the vortex veins. Previous studies have shown a reduction in intraocular pressure (IOP) from many means of exertion, ranging from walking to exhausting exercise in both normal and glaucoma subjects. Podos et al. reported that a direct relationship exists between intraocular pressure and episcleral venous pressure. However, Kielar et al. found no significant differences in intraocular pressure reduction when comparing standardized aerobic and anaerobic exercise, despite significant differences in blood pH and lactate measurements. Intraocular pressure is known to be altered by sudden changes in plasma osmolarity, following exercise, a consistent increase in serum osmolarity occurs. Passo et al. have attempted to associate decreased intraocular pressure with pre-and
post-exercise hemodynamic factors such as heart rate or maximum systolic or diastolic blood pressure, but no such relationship has been confirmed. Mcleod et al. showed that change in IOP was positively correlated with change in systolic blood pressure over both one and two year periods. However, change in diastolic blood pressure was negatively correlated with change in IOP for two year period 7.

The cardiovascular response to isometric exercise has been studied extensively since first described by Lindhard in 1920. There is a gradual increase in blood pressure until exhaustion occurs7-10. The current view is that the blood pressure set point is continuously regulated upward as long as the isometric exercise persists 11,12. During isometric exercise, it has been demonstrated that blood pressure in the ophthalmic and brachial arteries rise in parallel. The major finding in the present study is that IOP changed transiently in parallel with blood pressure during isometric exercise. Blood pressure increase during exercise is shown to be related to the strength of contraction13 and probably also the size of muscle mass involved 14.

Hence in our study blood pressure was also taken as a parameter for our study the result showed that there was a significant rise of systolic blood pressure after exercise and slight fall in diastolic blood pressure but, correlation with blood pressure and intraocular pressure did not reveal much significance which might be due to short duration of our study.

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