Does Physica1 Fitness Influence Intraocular Pressure?

Pages with reference to book, From 81 To 84

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Abstract

The effects of physical fitness on intraocular pressure, was studied. The study was conducted in two parts. Part 1 consisted of three groups of physically fit subjects, each consisting of 50 subjects. In Part 2 subjects were categorized into control and experimental groups, each consisting of 16 subjects. The experimental group took a supervised exercise programme of three months. Intraocular pressure was measured with the Goldmann applanation tonometer, As compared to sedentary subjects, intraocular pressures were lower in those who did moderate or severe exercises. In part one, the difference between group 1 consisting of sedentary and group 3 of physically fit subjects was 1.38±0.08 mmHg, ($p<0.001$). In part two of this study, after exercise training the experimental group showed a marked increase in their physical fitness, The first difference between control and experimental groups was 0.13±0.27 mmHg ($p>0.05$). After three months, this difference increased to 0.93±0.28 mmHg ($p<0.01$). This study concludes that physical fitness reduces intraocular pressure. It would seem reasonable at present not to discourage patients who have glaucoma from light exercise, perhaps, on the contrary, it should be encouraged (JPMA; 47:81, 1997).

Introduction

Blindness, a major health problem, has received relatively little attention in under-developed countries, where the vast majority of the world's blind live. About 2 million people are blind in Pakista.n. Glaucoma is the second most important cause of permanent blindness in Asia-Pacific region[1]. It causes about 3.9% dof total blindness in Pakistan[2]. It is well documented that improvement of physical fitness through regular exercise can produce profound physiological changes in the whole body, especially in the cardiovascular system[3]. However, regarding the relationship between physical fitness and intraocular pressure (lOP), the existing literature is controversial, with some associations inconsistent. Sargent et al[4], after six months of a supervised exercise programme, demonstrated that lOP values are not dependent upon changes in physical fitness. In contrast to this
Passo et al[5], alter an exercise programme of four months, demonstrated that physical fitness significantly reduces intraocularpressure levels. Thevariability in their results may be due to several factors.In recent years it has been noted that intraocular pressure is a dynamic function and is subject to many influences both acutely and over the long term: Many investigators have reported that lOP varies with age and sex[6] and diurnally[7].It has been reported that drinking of water, coffee, or alcohol before lOP measurement have significant effect on it[8]. Acute hyperglycaemia decreases[9], while chronic hyperglycaemia in diabetes increases IOP[10]. Moreover, seasonal variations also have significant effects on intraocular pressure.
Present study was planned to investigate the effects of physical fitness on intraocular pressure after taking into account the above mentioned factors, neglected by the previous studies.

Subjects and Methods

All experimental procedures adhered to the Declaration of Helsinki of the World Medical Association. The criteria met by all the participants of this study were: absence of ocular complaints including refractive errors; absence of any history of eye surgery and diabetes; normal body temperature and blood pressure and belonging to the same age group, ranged between 21 and 30 years. This study was conducted in two parts. Subjects of part 1 were categorized into three groups. Each group consisted of 50 healthy male subjects. Subjects of group 1 worked in offices as Clerks and none had done even light exercise atleast for the last six months, Subjects of group 2 were students of Karachi University and they did jogging daily in the morning. Subjects of group 3 were soldiers and they had their regular heavy exereises daily. Part 2 sub ects were categorized into control and experimental groups. Subjects of each group were 16 sedentary male students of Karachi University. They had not done any exercise for the last six months.

Each subjectwas tested between 0800 and 0900 hours to minimize the effect of diurnal variations. A transport service was provided to each subject to avoid any delay orexertionand they were asked not to do any hard work after awakening. To avoid the effect of acute hyperglycaemia, the subjects were asked not to have breakfast or any form of drink before the test. Testing was perfonned after a complete rest of 15 minutes in supine posture. Heart rate and blood pressure were measured in supine posture. lOP was measured with the Goldmann applanation tonometer, after installation of 0.25% fluorescein sodium and 0.4% benoxinate hydrochloride (fluress) eye drops, first in the right eye and then in the left. Three consecutive readings of each eye were taken. After each reading the tonometer was removed from the contact and the measuring scale returned to 10 mmHg. The practice of returning the tonometerto 10 mmHg, aftereach reading would minimize observer bias. The mean of the three readings was computed separately for each eye. No statistical difference was found between fellow eyes of each pair, so the data were pooled for statistical analysis. Physical fitness was evaluated by the measurements of maximum oxygen uptake (mI/kg/min) with a Bechman 02 analyzer. The experimental group was organized into two hockey teams, eight players each. They took a supervised exercise programme of three months, included nmning for one hour in the. morning and playing hockey in the evening for one hour, atleast five times per week. Afterthree months, all the measurements were taken again in both control and experimental groups, using the same protocol as described above. The significance ofthedifference between the two groups was calculated by applying the two-tailed paired Student’s t-test. Differences are regarded as significant when the P value is less than 0.05. Actual P values are given where appropriate.

Results

Table. Effects of physical fitness on intraocular pressure.

Groups#	Mean age (Years)	Maximal O_2 uptake (ml/kg/min)	IOP (mmHg)
Group 1	27.32±0.30	34.1±0.94	15.66±0.26
Group 2	23.06±0.19	35.7±1.30	15.52±0.27*
Group 3	25.18±0.39	40.2±2.40	14.28±0.25**
Control group			
1st reading	22.56±0.37	36.8±1.72	15.12±0.59
2nd reading (after 3 months)		36.5±0.86	14.81±0.57
Experimental group			
1st reading	23.31±0.36	35.9±1.88	15.25±0.60
2nd reading (after 3 months)		38.7±0.88	13.88±0.53$

All values are expressed as mean±S.E.M.

*p<0.01 & **p<0.001 as compared to group 1.

$p<0.01 as compared to reading before exercise training

#All demographic factors, age, blood pressure and Body Mass Index were insignificant among the groups.

Results summarized in Table show that in both parts of this study, intraocularpressures were lower inpersons who did moderate or severe exercises as compared to sedentary subjects. Inpart one of this study, the differencebetweengroup 1 and 2 was 0.14±0.04 mmHg, which was statistically significant (p<0.01). The difference between group 1 and 3 was 1.38±0.08 mmHg, (p<0.001). The difference between group 2 and 3 was 1.24±0.09 mmHg, (p0.05). Afterthree months, this difference increased to 0.93±0.28 mmHg (p<0.01). Inthe experimental group, after exercise training of three months the marked increase in maximal 02 uptakes indicates improvement in the subjects' physical fitness.

Discussion

This paper reports a rarely studied phenomenon and the results are relevant to planning trials in glaucoma where intraocular pressure is amajoroutcome measure. Inboth parts of this study, as compared to sedentaiy subjects, intraocular pressures were significantly lower in those subjects that did moderate or severe exercises. Similar findings have been reported by Passo et al[5], but in their study there was no completely sedentary control group, so the effect of seasonal variations on IOP cannot be excluded. Inparttwo of this study, after three months, the intraocular pressure decreased in both control and experimental groups. If we consider that decrease in the control group is due to seasonal variations, then the net effect of physical fitness is 1.06 mmHg. Similar decreases in both control and experimental groups have been reported by Sargent et al[4]. However, in their study the difference between control and experimental groups was not significant, while in this study it is significant. This difference between the two studies may be because these investigators did not control for diurnal variations or fluid intake, nor did they evaluate prior physical fitness among subjects. They also selected a group of individuals with intraocular pressure greater than 18 mmHg.

Numerous studies have demonstmted that intraocular pressure in normal volunteers decreases after exercise ranging from walking to exhaustion[5,11-14]. The amount of decrease reported differs from study to study because of several variables, including age and sex[6], diurnal[7]and seasonal variations. This study concluded that physical fitness also plays a very important role indetennmation of lOP and needs to be controlled in future research.

The physiological mechanisms responsible for the decrease of intraocular pressure in physically fit subjects are not clearly known[4,5,14]. A numberof possible mechanisms can be postulated. Exercise produces significant changes in systemic vascular dynamics and could possibly alter episcieral venous pressure. Podos et al[15] reported that a direct relationship exists between intraocular pressure and episciemi venous pressure. However, Stewart et al[16] did not note any significant change inepiscleral venous pressure afterexercise. Passo et al[5] have attempted to associate decreased intraocular pressure with pre and post- exercise hemodynanuc factors such as heart rate or maximum systolic or diastolic blood pressure, but no such relationship has been confirmed. The decrease in lop after exercise has been attributed to increase in blood lactate and decrease in blood ph level[17]. However, Kielar et al[14] found no significant differences in intraocular pressure reduction when comparing standardized aerobic and anaerobic exercise, despite signiflcantdifferences inbloodpH and lactate measurements .Intraocular pressure is known to be altered by sudden changes in plasma osmolarity[18] Following exercise, a consistent increase in serum osmolarity occurs[19] However, Stewart et al[17] noted that exercise induces greater changes in intraocular pressure than does oral doses of glycerin forthe same change in serum osmolarity.

The hormones also influence the intraocular pressure. Coiticotropin, vasopressin, thyroxin, insulin, glucocorticoids and minemlocorticoids may play a role in the physiologic regulation of intraocular pressure. Growth honnone, melanocyte stimulating honnone, progesterone, estrogen, chorionic gonadotropin and relaxin may influence intraocular pressure when administered inphannacologic doses. Some of these honnones increased, while other decrease intraocular pressure[20]. Stimulation of the sympathetic nervous system in anticipation of and during the stress of exercise is well documented. This causes release, of large quantities of epinephrine and norepinephrinp from adrenal medulla[21]. Epinephrine, anadrenergic agonist, is widely used as anocular hypotensive drug for the treatment of glaucoma. The fact that epinephrine lowers intraocular pressure in humans is undisputes but the mechanism whereby it does so is not yet clear[22]. Epinephrine produces many of its effects by stimulating the synthesis of cyclic adenosine monophosphate (c- AMP). The c-AMP regulates the activity of protein kinases. These, in turn, phosphorylate and thereby activate or inhibit key enzymes that control intra cellular metabolic pathways[23]. It has been shown that activation of c-AMP decreases intraocular pressure by decreasing aqueous humor production[24]. As mentioned above, in this study physical fitness decreases lOP, it Is quite possible that in physically fit subjects, enzymes such as adenylate cyclase become more sensitive to hormones and this may be the cause of lower intraocular pressure as compared to sedentary subjects. It is amazing that almost any type of stress, whether physical or neurogenic, will cause an immediate and marked increase in ACTH secretion. Even a small amount of ACTH is enough to permit the adrenal glands to secrete whatever amount of aldosterone is required[21]. The effects of ACTH, aldosterone and important catecholamines, including norepinephrine, have not been investigated and since exercise changes their blood concentrations, they are more likely

to affect intraocular pressure.
It is possible that a decrease in intraocular pressure during exercise is effected through hormonal mechanism; an effect on electrolytes or electrolyte transport enzymes may be involved. Two enzymes systems are involved in the aqueous humor secretion, which am NaIK-ATPase and carbonic anhydrase[25]. Therefore, the antagonists of these enzyme systems can reducethe aqueous formation and hence, lower the lOP. Hormonal changes and metabolites produced during exercise can act as the antagonists of these enzyme systems.It is also quite possible that some antagonists may work for longer time and thus may be the cause of lower intraocular pressure value in physically fit subjects. It would seem reasonable at present not to discourage patients who have glaucoma from light exercise such as walking; perhaps, on the contrary, it should be encouraged.

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