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Study of intraocular pressure among individuals working on computer screens for long hours

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Abstract

In today's world computers are ubiquitous and found in different forms which can effect intraocular pressure (IOP). Present study was undertaken to find out effect of day-to-day exposure to computer screen on IOP in normal individuals. 70 individuals (who met the screening conditions and devoid of obvious ocular pathology and systemic diseases) had their IOP's checked before and 4 hour after computer session on same day, all working in general day shift, involving reading English printed material. The results showed significant ($p<0.005$) increase with IOP values before exposure being 17.89±3.25 and 16.99±2.84 and after exposure being 19.67±3.4 and 18.70±2.4 in left and right eye respectively. Increase in IOP was noted in 70% and 67% individuals in left and right eye. Differences in IOP of right and left eye may be due to dominance of eye or direction of script from left to right.

Introduction

Digital / electronic screens are found everywhere in different forms, in desktop computer, laptop, tablet to mobile phone. All requiring closed focused vision. Use of computers has become a necessity in various professions and sometimes requires prolonged sessions which produce strain on the eyes, liable to effect IOP. Normally, humans blink about 15 times a minute, but studies show we blink less often while using computers and other digital screen devices, whether for work or play, this increases risk of harmful effects of exposure to screen.[1]

Studies have been conducted to find out the effect of exposure to visual display terminals (VDTs) or computer screens on refractive power of the eyes but reported no significant effect on refraction or worsening of myopia.[2,3] There is a dearth of literature on the effects of VDT on intraocular pressure (IOP) especially in the young adults employed in professions which require continuous exposure to digital screens.

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Intraocular pressure (IOP) is the fluid pressure inside the eye due to presence of aqueous humor. The normal range of IOP is 10 to 20 mm of Hg and is maintained at this level throughout life and between both sexes, showing seasonal variations. Normal IOP have been reported to vary in both eyes even in same individuals.[4]

The risk of slowly rising IOP is gradual damage to the optic nerve. The cornea adapts to the changing pressure slowly, without swelling; therefore there are no clear symptoms. As damage to optic nerve increase, black spots called scotomas begin to appear in the field of vision, usually beginning at the side leading to glaucoma.

Increased IOP presses on the retina causing blockade of axonal flow in ganglionic cells and also causes compression of retinal artery and its branches (ischemic injury) thus leading to degeneration of optic nerve (optic neuropathy).[5] Thus leading to deepening of physiological cup or pathological cupping of optic disc along with damage to retina or ganglion cells; clinically manifesting as defects or scotomas in visual field ultimately leading to blindness.

Elevated pressure in young persons' is a cause of worry as they have longer expose time to high IOP over lifetime and a greater possibility of optic nerve damage. Thus, this study was done to assess the changes in IOP after considerable exposure to computer screens in young individuals.

Materials and Methods

This study was conducted after taking ethical clearance from the Institutional Review Board (Reference number: 2014/6/009) of this institution. Young volunteers were enrolled from a Multinational company (MNC) after taking permission from the company manager. Consent was taken from all the individuals.

70 individuals (58 males and 12 females) between the ages of 20 and 40 years whose work involves spending at least 4 hours continuously in a day on computer screens were recruited for the study.

Those individuals with established ophthalmological disorders like history of penetrating injury, current infections, lacrimal gland/duct inflammation and blockade, external and internal hordeolum, retinopathy, sudden or gradual loss of vision due to any cause, Graves disease (exophthalmos) were excluded. Also, intraocular pressure was not taken in individuals who had just finished exercise or who were involved in activity causing lot of strain.

Subject's height, weight, body mass index, blood pressure, refractive errors, past medical and surgical history related to eye was taken.

IOP was measured by ophthalmologist from Owaisi Hospital using Shiotz Tonometer.[6] IOP was measured in both the eyes after giving information about IOP and explaining the procedure to the individuals, in lying down position, before and after 4 hours computer session, involving reading English printed material. 2% xylocaine was used as a topical anesthetic with a drop of antibiotic instilled at the end of procedure. The footplate and lower end of plunger of Schiotz tonometer was sterilized in absolute alcohol. The procedure was repeated thrice and the average was taken.

At the end of the procedure instructions to avoid eyestrain guidelines (Occupational Safety and Health Administration, Washington, DC; American Academy of Ophthalmology, San Francisco)[7] and other techniques were explained and also were emailed to the individuals. Those individuals who were having very high IOP were counselled separately by ophthalmologist.

Statistical analysis

Statistical analysis was done using EpiData version 3.1. Before and after comparison was done by paired sample Student's 't' test.

Results

Table 1: Intra ocular pressure after work shift

Difference in IOP	Left eye	Right eye
Increased	49	47
No Change	11	16
Decreased	10	07
Total	70	70

Table 1 clearly shows that increase in IOP after computer work was found in 70% cases for left eye and 67% cases for right eye.

Table 2: Comparison of IOP in all 70 cases before and after computer session

IOP (mm Hg)	Left eye	Right eye
N	70	70
Before	17.89±3.25	16.99±2.84
After	19.67±3.4	18.70±2.4
p	<0.05*	<0.05*

Data is presented as mean±SD, *Statistically significant

Table 2 shows that the mean value of initial IOP in right eye (16.99) was lower than left eye (17.89) but this difference was not significant statistically (p=0.08). There was a significant rise in IOP after computer work as these values increased to 18.70 (p<0.05) and 19.67 (p<0.05) in right and left eyes respectively. Change was more significant in right eye than the left eye.

Table 3: Comparison of IOP in those cases where increase was noted after computer session

IOP (mmHg)	Left eye	Right eye
N	49	47
Before	17.38±3.06	15.85±2.18
After	20.56±3.01	18.77±2.53
p	<0.05*	<0.05*

Data is presented as mean±SD, *Statistically significant

If we consider those cases only that showed increase in IOP after computer work, the results are highly significant. For left eye (n=49) the mean IOP values before and after computer work were 17.38 and 20.56 respectively (p=0.0004), for right eye (n=47) the mean IOP values before and after computer work were 15.85 and 18.77 respectively (p=0.002). Rise after computer work is more significant in left eye than in the right (Table 3).

Discussion

Extended reading, writing or other intensive "near work" can cause eye strain due to increased work of accommodation muscles. Computer vision syndrome (CVS) is a condition resulting from focusing the eyes on a computer or other display device for protracted, uninterrupted periods of time. Some symptoms of CVS include headache, tiredness and burning sensation, watering, redness, blurred vision, neck pain, eye strain (asthenopia), double vision and difficulty refocusing the eyes. These symptoms can be further aggravated by improper lighting conditions, wrong posture or wrong distance.[8-10] There are few Asian studies which reported risk factors associated with CVS. A Sri Lankan study reported that the risk factors as pre-existing eye disease, female gender, higher daily computer usage, longer duration of occupation, not using a visual display terminal (VDT) filter, use of contact lenses, etc; among these duration of occupation and presence of pre-existing eye disease is associated with severity of CVS.[11] An Indian study reported that there was female preponderance for asthenopia and the occurrence was significantly associated with early age of starting use of computer, pre-existing of refractive error, distance from the VDT, level of top of the computer screen with respect to eyes, use of antiglare screen and adjustment of contrast and brightness of monitor screen, etc.[12]

A Russian study focused on changes in visual functions in computer users.[13] In our study, there was no significant difference in IOP between the two eyes before and after the work shift which was in accordance with previous study.[14] A Polish study investigated effects of short-term (1 hour), intermediate-term (6 hour) work duration as well as lighting conditions at the work place and reported significant decline in accommodation (near vision).[15] Pas-Wyroślak et al reported that the corneal surface temperature increases and IOP decreases after visual work with display monitors at short distance. The decrease in IOP was attributed to improved aqueous humor outflow.[16] Our study revealed increase in IOP after working on computers which is contrary to the findings of Pas-Wyroślak et al.[16]

According to the National Institute of Occupational Safety and Health, USA, computer vision syndrome affects about 90% of the people who spend three hours or more a day at a computer.[7] One study in Malaysia was conducted on 795 college students aged between 18 and 25 years. The students experienced headaches along with eyestrain, with 89.9% of the students surveyed feeling any one type of symptoms of CVS.[17]

Raised IOP is a big concern especially in young individuals as it may lead to glaucoma and vision loss leading to economic burden on the nation in the form of loss of productivity, dependence on others, cost of healthcare, etc.

As IOP remains the only modifiable risk factor in glaucoma, public awareness and appropriate measures must be taken to manage rising IOP. Present study was carried out in young computer professionals to assess the effect of occupational exposure of computer screens on IOP in day-to-day work. Mean pre-work values of IOP were not significantly different in both eyes. Our findings revealed that there was a significant increase in IOP in both eyes after exposure to computer screens (p<0.005).

When only those cases in whom IOP increased were noted, there is a greater rise in the left eye. This may be explained by the fact that right eye is the dominant eye in majority of persons. Another

reason may be the direction of script e.g. left to right in English language.

Working on computer screens requires the eye to focus on near object for which accommodation of eye occurs. During accommodation anterior part of lens becomes protruded and diameter of lens changes from 10mm to 6mm which pushes iris forward which may cause temporary hindrance to trabecular meshwork due to which slight rise in IOP can be appreciated.[17]

Moderate elevation of IOP for long time or severe elevation for short time damages ganglion cells of retina and optic nerve fibers which lead to deepening of physiological cup or pathological cupping of optic disc along with damage to part of retina which clinically manifests as defects/scotomas in visual field which can lead to blindness.

Suggestions

The study can be repeated on a larger group. Due consideration can be given to other scripts like Urdu and Arabic which are written from right to left. Also, type of computer work can be changed e.g. instead of script, games or pictures can be displayed.

Conclusion

Use of computers has a significant effect on IOP. Basal values of IOP are not significantly different in both eyes from one another. There was a significant rise in IOP after computer work in both the eyes compared to pre-shift values. Considering the cases in which IOP was raised, when we compare the right eye with left eye, we find that there is a greater rise in IOP in the left eye.

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