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Original article

Effect of chronic cigarette smoking on intraocular pressure and audio-visual reaction time

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ABSTRACT

Background:- Cigarette smoking can alter intraocular pressure [IOP] and hence the person becomes vulnerable to disease like Glaucoma. Nicotine is a factor affecting reaction time due to its stimulant property. **Aims-** To measure and compare the IOP, auditory and visual reaction time in control and smoker groups. **Methods:-** 100 males aged 40-60yrs were considered for the study. Out of them 50 non smokers were control group and 50 smokers were test group. IOP was measured by Schiottz tonometer after application of local anesthetic and 3 readings of both eyes were taken. The audio visual reaction time was recorded by Reaction Timer; 3 readings of each hand were considered and finally average of 3 readings was taken and student's "t" test was used. **Interpretation:-** We observed a significant effect of cigarette smoking on intraocular pressure of both eyes [$p > 0.001$]. In our study we found that the reaction time to green and red color is decreased in smokers group, compared to control group [$p > 0.001$]. We also found that the reaction time to high pitch and low pitch sound is decreased in smokers group in comparison to control group [$p > 0.001$]. **Conclusion:-** We observed that tobacco in the form of cigarette smoking increases the intraocular pressure. Cigarette smoking is known to cause a stimulant effect on central nervous system and produce a faster simple reaction time.

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1. Introduction

People smoke for several reasons, some smoke for enjoyment, social reinforcement and some to alleviate stress [1]. Once it becomes regular, the pharmacological properties of nicotine acts [2]. Tobacco can alter intraocular pressure and hence the person becomes vulnerable to disease like Glaucoma. Intraocular pressure [IOP] is determined by the balance between the rate of aqueous humor production by the ciliary body, resistance to the aqueous outflow at the angle of anterior chamber and the level of episcleral venous pressure. In most cases elevated IOP is caused by increased resistance to aqueous humor outflow.

The measure of reaction time has been used to evaluate the processing speed [3] of Central Nervous System and the coordination between the sensory and motor systems [4]. Cigarette

smoking has a stimulant effect on nervous system and nicotine causes decrease in reaction time due to its stimulant property [5]. This work is a step to study the evidence that cigarette smoking is injurious to health in general and vision in particular. **Aim:-** To measure and compare IOP, Auditory Reaction Time, Visual Reaction Time in smokers and non smokers group.

2. Materials and methods:

The study was conducted in the OPD of Department of Ophthalmology, Basaweshwar teaching hospital Gulbarga, after obtaining the permission of the Ethical committee of our institution. The present study includes healthy male subjects in the age group of 40-60 years of Gulbarga city. The inclusion criteria of study subjects are as follows Group A:- Non Smokers [control group] n=50 non alcoholic, non smokers. Group B:- Smokers [Smokers group] n=50, subjects who smoke more than 10 cigarettes for more than 2 yrs and non-alcoholic subjects. The smoking index was calculated by for the smokers group Smoking index is equal to multiplication of the average number of cigarettes/bidis smoked per day and duration (in years) of tobacco smoking. The exclusion criteria of our study are female subjects

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below 40yrs and above 60yrs of age, person with previous eye surgery, with severe ocular trauma in the past, Diabetics, alcoholics, colorblind, blind, deaf and subjects suffering from ear diseases were excluded from the study.

All subjects were of same socioeconomic status. Detailed history, name, age, sex, occupation, and personal history, personal habits of the subjects are taken. Smoking history was taken in detail. Family history of hypertension, diabetes, refractive errors and Glaucoma were enquired. These were noted in a personal Performa and following parameters concerned with the study were recorded.

1. IOP of both the eyes of both groups
2. Auditory Reaction Time [ART] of both hands of both groups.
3. Visual Reaction Time [VRT] of both hands of both groups.
4. Smoking Index [SI]

2.1.Procedure:

With the subject in supine position the cornea of both the eyes were anaesthetized with 4% topical Xylocaine. Then the lids were separated with the left hand and by keeping the foot plates of the Schiotz tonometer vertically on the centre of the cornea, the reading on the scale was recorded. A conversion table was used to derive the IOP in mm Hg from scale reading and the plunger weight. IOP was measured in both the eyes. IOP recorded first in the right eye and than in the left eye. 3 consecutive readings were taken in both right and left eye. The mean of 3 readings was computed separately for each eye.

The Auditory and visual reaction time was measured by using reaction time apparatus. This apparatus is a portable research reaction timer with 2 response choices from Anand agencies, Pune-2, which can measure VRT and ART.

Specifications of reaction timer:-

1. Inbuilt chronoscope-4 digit chronoscope with least count of 1/1000 seconds.
2. It works on 230 volts AC.

All the subjects are thoroughly acquainted with apparatus and 3 readings were taken after practice trials for Red and Green color for visual reaction time, Tone and Click for Auditory reaction time for both hands.

To test whether there was any significant difference between smokers and non smokers with reference to IOP, unpaired "t" test was applied.

3.Results

Out of 50 non-smokers 56% were in the age group of 40- 50 years and 44% were in age group of 50 - 60yrs and Out of 50 smokers 32% were in the age group of 40- 50 years and 68% were in age group of 50 - 60yrs. The percentage distribution of smoking index indicated that the maximum percentage (46%) of smokers have smoking index < 300, followed by (44% and 10%) of smokers have smoking index 301- 500 and >500 respectively.

Table 1: Comparison of IOP in two groups of subjects

IOP	Non-Smokinggroup	Smokinggroup	P value
Right side	18.36±2.48	23.89±2.77	<0.001
Left side	18.55±2.01	23.65±2.07	<0.001

Results are presented in Mean ± SD, P value obtained by student t test .

Table 1 depict the comparison of IOP in both smokers and non smokers group. This table shows that there is difference of right eye IOP of both non smokers group (18.36±2.48) and smokers group (23.89±2.77)with p <0.001. This table also shows that there is highly statistical significant difference of left eye IOP of both non smokers group (18.55±2.01) and smokers group (23.65±2.07) with p<0.001.

Table 2: Comparison of reaction time in two groups of subjects studied

Reaction time	Non-Smokinggroup	Smokinggroup	P value
Right hand	0.280±0.027	0.244±0.03	0.001
	0.223±0.03	0.196±0.029	0.001
	0.173±0.024	0.159±0.016	0.001
Left hand	0.170±0.023	0.154±0.024	0.002
	0.219±0.033	0.201±0.029	0.003
	0.210±0.037	0.202±0.026	0.236
	0.170±0.026	0.166±0.016	0.289
	0.165±0.025	0.161±0.025	0.395

Results are presented in Mean ± SD, P value obtained by student t test .

Table 2 depict the comparison of reaction time in both non smokers group and smokers group. The reaction time for right hand in non- smokers group is more than the smokers group which is highly significant [p<0.001]. The reaction time for left hand in non- smokers group is more than the smokers group but it is highly significant [p<0.001] only for Green color.

4.Discussion

Previous studies show conflicting effects of cigarette smoking on IOP and Reaction time, so we have taken up this study to see the effects. In our study we found IOP of smokers to be significantly elevated (p< 0.001) compared with controls. Our studies were in accordance with findings of C.O.Timothy , Yutaka Takashima, Maneli Mozaffarieh and others.

In the study conducted by C.O.Timothy to determine the effects of cigarette smoking on intraocular pressure and arterial blood pressure of normotensive young male adults , their result showed an increase in IOP which is statistically significant [p<0.001][6]

In the study by Yutaka Takashima et.al investigated the association of smoking habits with blood pressure and IOP in smokers of 25 or more cigarettes/day with IOP. They found that heavy smoking is specifically related to high IOP [7].

Okoro observed the increase in intraocular pressure due to cigarette smoking [8].

Barclays found the increase in intraocular pressure and arterial blood pressure after smoking cigarette in the normotensive young male adults [9].

Maneli Mozaffarieh observed that Smokers have on the average a higher intraocular pressure, cataract at earlier ages and a higher risk for arterial/venous occlusions as well as for age-related macular degeneration [10,11,12,13].

In a study by M.Roy.Wilson regarding the relationship between primary open angle Glaucoma and potential toxic exposures in people found that cigarette smoking was associated with Glaucoma [14]. On the other hand, Sami.L, Shephard, Klein et.al reported no relationship between cigarette smoking, elevated intraocular pressure and Glaucoma. Sami.L [15], conducted a study in which it was found that the 3 groups composed of smokers, ex-smokers and non smokers had the same distribution of IOP, and had no relationship to the smoking habit. Shephard. R.J et al [16], reported no relationship between cigarette smoking, elevated intraocular pressure and Glaucoma.

In our study we found that the reaction time to green and red color is decreased in smokers group compared to control group. We also found that the reaction time to high pitch and low pitch sound is decreased in smokers group in comparison to control group. Cigarette smoking produces a faster auditory reaction time. Our studies were in accordance with findings of Froeliger, I, MacDonald and others. Froeliger [5] found that smokers who were abstaining from cigarettes had faster reaction times when they were wearing a nicotine patch, and even nonsmokers had increased accuracy when they were wearing nicotine patches. MacDonald found that reaction time variability in older adults was usually associated with slower reaction times [17]. Myerson found that older adults were as adept as younger people at assimilating information, but they did take longer to react [18]. In a study conducted by Ichaporria R, there was a significant decrease in the visual and auditory reaction times in smokers as compared to healthy controls of the same age [19]. The acute effect of smoking one cigarette was also studied in the same group of smokers and a statistically significant reduction was found, as compared to their basal VRT and ART. Welford speculates on the reason for slowing reaction time with age [20]. It is not just simple mechanical factors like the speed of nervous conduction. It may be the tendency of older people to be more careful and monitor their responses more thoroughly. Brebner reported in a study that fingers tremble up and down at the rate of 8-10 cycles/sec, and reaction times are slower if the reaction occurs when the finger is already on the 'upswing' part of the tremor [21]. Gillian Leigh reported that smoking a cigarette may lead to the maintenance of a higher level of efficiency in the simple reaction time [22]. P.J. Fay

5. Conclusions

We observed a significantly higher effect of cigarette smoking on intraocular pressure of both eyes. This increase in intraocular pressure of normotensive subjects after habituated to cigarette

smoking showed that it could be an important risk factor in occurrence of Glaucoma and Ocular hypertension including other chronic ocular disease such as cataract, macular degeneration, Amblyopia.

It is concluded that acute or chronic cigarette smoking leads to systemic ailments and ocular disease. Among many drugs, tobacco is also included as an agent causing increasing intraocular pressure.

In our study we found that the reaction time to green and red color is decreased in smokers group compared to control group. We also found that the reaction time to high pitch and low pitch sound is decreased in smokers group in comparison to control group. Cigarette smoking is known to cause a stimulant effect on central nervous system and produce a faster simple reaction time.

We conclude our study with the observation that Tobacco in the form of cigarette smoking is affecting the Intraocular pressure and the Reaction time. Further studies on a larger sample with longer follow up are needed to substantiate our findings before firm conclusion can be drawn that there is an increase in IOP and decrease in Reaction time with prolonged use of tobacco in the form of cigarette smoking.

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