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Original Article

The Effect of Smokeless Tobacco on Intra-Ocular Pressure in a Nigerian Population

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Abstract

The study was conducted to find out the effect of smokeless tobacco (ST) on the intraocular pressure (IOP) among non-smokers and smokers. Thirty-seven healthy volunteers of between 19–30 years age, classified into two groups, non-smokers (n=22) and- smokers (n=15), were used. The IOPs of the right eyes were measured before (0min) and 1, 3 and 5mins after sniffing 40mg ST with Pulsair 2000 tonometer. Among non-smokers and smokers, the difference in mean IOP at different times (0min, 1min, 3mins and 5mins) was statistically significant by one-way ANOVA ($p<0.05$). *Post hoc* analysis using Duncan multiple range (DMR) test showed that the peak IOP was at 1min after sniffing ST. The difference in IOP before sniffing ST between smokers and non-smokers was statistically significant by Mann-Whitney test ($p<0.05$). Also the difference in the peak time of 1min between smokers and non-smokers was statistically significant ($p<0.05$). It was concluded that ST stimulates aqueous humour formation thereby tending to raise IOP and this could enhance the chances of developing ocular hypertension in patients that are predisposed to glaucoma.
Key words: Smokeless Tobacco, Intra Ocular Pressure

Introduction

Smokeless tobacco (ST) is an extremely addictive substance with a high rate of use in certain demographic groups, such as adolescents and native Americans especially as chewing tobacco or nicotine gum.(1) In Nigeria, ST is used often among the elderly as nasal snuff. In the past 20 years, the use of smokeless tobacco has almost tripled(1), rapidly increasing especially among young male athletes and students in high school and college.(2)

All tobacco use increases heart rate and blood pressure, with a tendency toward greater overall cardiovascular effects. This is in spite of evidence of development of some tolerance to effects of nicotine with use of ST.(3) The influence of varying doses of ST on resting heart rate and blood pressure and the performance of brief, high-intensity exercise has been investigated. It was found that snuff caused an increase in heart rate, systolic and diastolic pressure (4,5), however, snuff had no effect on performance of brief, high-intensity exercise.(4) The nicotine content of ST is equivalent to that of cigarette(6) and, therefore, will produce habituation and addiction. ST contains N-nitrosamines that have a potential carcinogenic effect on the tissues with which they come into contact in the oral cavity.(6)

It has been found that apart from oral effects including leucoplakia, oral cancer, loss of periodontal support (recession) and staining of teeth and composite restoration,(7) systemic effects such as dependence, transient hypertension and cardiovascular diseases may also result from ST use.(7-13)
Cigarette smoking has been shown to cause vasoconstriction and may lead to rise in episcleral venous pressure, thus inhibiting aqueous outflow from the angle.(14) This explains the transient increase in intra-ocular pressure (IOP) few minutes after smoking cigarette.(14) This transient increase in IOP after taking tobacco was used as a

provocative test for primary glaucoma patients. A rise of IOP of more than 5mmHg was taken as a positive result.

However, the study carried out by Bahna and Bjerkedal (15) showed that the difference in the IOP of smokers and non-smokers was not significant. Tobacco consumption, especially as cigarette smoking, is associated with glaucoma.(14) Nicotine from cigarette smoking is known to produce hemodynamic changes like increase in systolic blood pressure and finger blood flow.(16)

Materials and Methods

A total of 37 subjects (all volunteers) within age group of 19 to 30 years, mean age of 25.8 years (SD=3.10), were used for this study. Of them 22 were non-smokers (Group I) and 15 were smokers (Group II). Subjects with glaucoma, visual field defects, refractive errors or wearing contact lenses were excluded. The blood pressure (BP) was measured with digital sphygmomanometer and subjects with BP greater than 125/80 mmHg under an ideal condition were also excluded.

The IOP of the right eye of each subject was measured with a Keeler Pulsair 2000 non-contact tonometer (NCT) before and 1min, 3mins and 5mins after sniffing 40mg of ST (snuff). The IOPs were measured between 8am and 10am and smokers were asked to abstain from smoking a day before the test was carried out.

Results

A total of 37 subjects of age range of 19- to 30-years old, mean age of 25.8years (SD=3.10) were used for this study. The mean, standard deviation and 95% confidence interval of IOP at different times of measure among the non-smokers and smokers are presented in Tables 1 and 2 respectively.

Table 1: Mean, standard deviation and confidence interval of IOP at different times of measure among non-smokers

Times of measure (mins)	Mean ± SD (mmHg)	95% confidence interval
0	13.0 ± (3.75)	11.34 to 14.66
1	16.9 ± (3.45)	15.37 to 18.43
3	14.8 ± (3.42)	13.28 to 16.32
5	12.9 ± (3.56)	11.32 to 14.48

Fig 1: IOP at different times of measure (non-smokers)

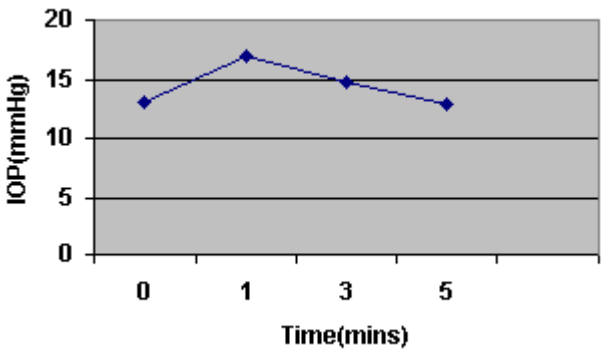
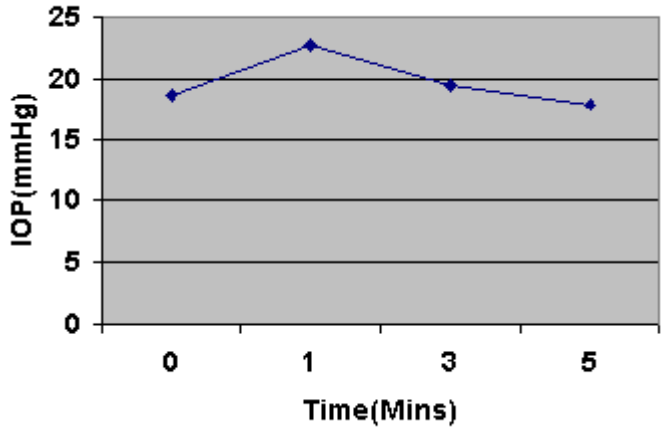


Table 2: Mean, standard deviation and confidence interval of IOP at different times of measure among smokers

Time of measure (mins)	Mean ± SD (mmHg)	95% confidence interval
0	18.6 ± (1.35)	17.85 to 20.10
1	22.7 ± (1.5)	21.90 to 23.56
3	19.5 ± (1.6)	18.64 to 20.42
5	17.9 ± (1.62)	17.03 to 18.83

Fig 2: IOP at different times of measure (smokers)



In Group 1, the one-way analysis of variance (ANOVA) showed that the difference in mean IOP as measured at different times (0min, 1min, 3mins and 5mins) was statistically significant ($F_{3,84}$=6.14, P=0.001). A *post hoc* analysis was done using Duncan's multiple range test. The source of the significance was the mean IOP 1min after administration of ST.

In Group II, ANOVA showed that the difference in mean IOP at different times of measure was statistically significant ($F_{3,\ 56}$ = 29.4, P< 0.05). *Post hoc* analysis also showed that the peak IOP was at 1min after sniffing ST. The IOP measured at different times for non-smokers and smokers are represented in Figs 1and 2 respectively. The difference in mean IOP between smokers and non-smokers before inhaling ST was statistically significant by Mann-Whitney test (p<0.05). The differences in mean IOP before and 1min after inhaling snuff for smokers and non-smokers were 4.1 and 3.9mmHg respectively. The difference in IOP between smokers and non-smokers at peak time of 1min after sniffing ST was statistically significant by Mann-Whitney U statistic (p<0.05).

Discussion

This study involved the measurement of IOP in 37 healthy male volunteers before sniffing, and 1, 3 and 5mins after the sniffing of 40mg nasal snuff. 22 of these subjects were non-users, with a mean age of 26.2 years while 15 were cigarette smokers, with mean age of 25.4 years. The results showed that at time zero, that is before sniffing ST, the difference in IOP between the two groups was statistically significant by Mann-Whitney test (P< 0.05). This is in spite of the fact that smokers had not smoked cigarette for 24 hours. Higher blood pressure and IOP have been demonstrated among smokers compared to non-smokers in other studies as well.(9,14) The reason we have adduced for this slight but significant increase is that habitual smokers have some level of nicotine in their plasma which could sustain some amount of vasoconstriction of episcleral vessels, thus leading to a slight decrease in facility of aqueous out of the anterior chamber angle.

Most of the works done were on subjects who used oral snuff as well as chewing tobacco, but not nasal snuff. In this study, we were unable to find young subjects who were habitual users of nasal snuff, so cigarette smokers were used.

A one-way ANOVA showed that there was a significant increase in IOP before sniffing, and 1min, 3mins and 5mins after sniffing ST. ANOVA *post hoc* test using Duncan's multiple range test located the source of the difference to be 1mins after sniffing ST. This means that there is a very rapid absorption of Nicotine from nasal snuff following inhalation, such that peak effect on IOP is achieved within one minute. This appears to be faster than what happens with cigarette smoking and other forms of tobacco use, where peak plasma concentration is in about 10mins. This may be attributed to the fact that other forms of tobacco use require a gradual intake of the nicotine content of the tobacco over time, leading to a gradual build up, while in the use of nasal snuff all of the nicotine is usually taken at time zero. In addition, the tobacco inhaled through the nose is almost entirely absorbed through the nasal mucosa into blood vessels supplying the head. The close proximity to the eye, may well be responsible for the rapid increase in IOP seen. The rapid fall on the other hand, may be attributed to the distribution of the nicotine to other parts of the body.

This increase in IOP due to the use of nasal snuff, though transient as shown in this study, may play an important role in glaucoma patients, as well as in people who are on the higher range of normal IOP. This is particularly important in the Nigerian situation where the use of ST is more common among the elderly who are also more likely to have higher IOP and develop glaucoma. The transient increase in IOP that occurs each time nasal snuff is taken, may be enough to cause destruction of the optic nerve fibres, with continuous use of ST. Also, because of the rapid decline back to normal, this IOP increase may not be detected during clinical measurements, preventing early detection of glaucoma.

Various studies have shown that ST snuff products are capable of delivering high levels of nicotine (11,13) and that the nicotine content of ST is equivalent to that of cigarettes, so it can produce habituation and dependence. It may also expose the long-term user to a number of adverse physiologic effects, similar to those attributable to smoking, such as transient hypertension and cardiovascular disease.(7) Smokers demonstrated significantly higher IOP change at peak time of 1min after inhalation of ST using Mann-Whitney test, indicating that each exposure to nicotine predisposes the individual to higher IOP values in comparison to non-smokers.

We conclude that smokers have higher IOP than non-smokers, and therefore may have a higher risk of developing primary glaucoma than non-smokers. We also conclude that ST use causes a significant but transient increase in IOP. Further studies are required to determine if this increase will be sustained after prolonged use of ST. This will enable the eye care practitioner to educate the patient better on the effects of ST use.

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