ijcrr
Vol 04 issue 15
Category: Research
Received on:05/06/12
Revised on:22/06/12
Accepted on:04/07/12

EFFECT OF SMOKING ON NERVE CONDUCTION VELOCITY IN YOUNG HEALTHY INDIVIDUALS

Motilal C.Tayade, Nandkumar B. Kulkarni

Department of Physiology, Rural Medical College, Pravara Institute of Medical Sciences , Loni, Tal.Rahata, Dist. Ahmednager

E-mail of Corresponding Author: drmctayade@gmail.com

ABSTRACT

Introduction: Chemicals in cigarette smoke have been implicated in causing subclinical changes in myelin sheaths of peripheral nerves. This may contribute to nerve dysfunction particularly in the form of decreases in nerve conduction velocity. The degree of this effect has not been clearly established

Aim & Objective: To measure nerve conduction velocity in the median nerve in smokers and non-smokers. Study Design: This was a cross-sectional case-control study involving 80 normal healthy subjects (age range, 25-40 years). There were 40 apparently healthy smokers and 40 healthy non-smokers. Conduction velocities were measured in motor and sensory components of the median nerve under similar conditions. Data was analyzed by using appropriate statistical methods. Results: Statistically significant changes ($P < 0.05$) were found in the sensory nerve conduction velocity (Mean$\pm$ SD value in smokers was 55.11+ 2.32 m/s while in nonsmokers it was 57.09$\pm$ 4.21 m/s) whereas no such changes were found in Motor nerve conduction velocity (Mean$\pm$ SD value in smokers was 54.19 $\pm$6.35 m/s while in nonsmokers it was 54.97$\pm$ 7.33 m/s) in this study. Conclusion: We conclude that chronic smoking results in reduction of conduction velocities in sensory fibers of the median nerve.

Keywords: Nerve conduction velocity, smoking, Smoking Index, Median Nerve.

INTRODUCTION

More than 4,000 different toxic and carcinogenic chemicals have been found in the cigarette smoke.[1] Chemicals in cigarette smoke like nicotine, tar, carbon monoxide etc. are toxic to the peripheral nerves.[2] Tobacco smoke has a direct toxic effect on the myelin sheath . Smoking causes subclinical changes in the myelin sheath and the resulting demyelination causes poor electrotonic conduction .[3,4] This later results in decrease in the conduction velocity of nerves.

With this background in consideration, the present study was planned to assess the effect of smoking on nerve conduction velocity.

Study Design:

In present study, 80 male volunteer subjects in the age group 25 to 40 years comprising of 40 smokers and 40 nonsmokers as control group were selected. Participant subjects were from staff members, residents and patients from routine OPD. After explaining the procedure and purpose of study, a written informed consent was obtained. Case group included smokers with history of smoking filtered cigarettes for more than 5 years, with no history of major illness like Hypertension, Diabetes Mellitus, Peripheral Neuropathy in past or present.

Smokers were grouped on the basis of smoking index, to assess the severity of smoking both in duration of as well as average numbers of cigarettes smoked per day. [5] Smoking Index is used to determine smoking exposure of the body quantitatively. It is simply calculated by multiplying the average number of cigarettes smoked per day in last seven days & duration of smoking in years. This index is similar to 'Pack years' criteria, which is commonly used in developed countries. According to Smoking Index the smokers were classified into:

1. Light smokers: Smoking index < 100
2. Moderate smokers : Smoking index 101-200
3. Heavy smokers: Smoking index >201

(Table no.2)

The control group included subjects who have never smoked in life and were not having any other addiction related to tobacco (like tobacco chewing, gutakha, pan masala, mishri etc.) and with no history of major illness like Hypertension, Diabetes Mellitus, Peripheral Neuropathy in past and present. Subjects were included from routine OPD, a detailed history was taken regarding their previous illness as well as any drug treatment that may affect the study. The present study was approved by Institutional Ethical Committee.

Subjects were called in the morning at 9.00 a.m. after light breakfast. Subjects were asked to abstain from smoking for at least 3 hours prior to tests.

All the readings were taken in seating position at 25 ^{0} C. We measured median nerve conduction velocities using a 2-channel EMG equipment ('Octopus', Clarity Medical Pvt Ltd, Mohali,India) In the present study, motor and sensory nerve conduction velocity of median nerve was measured. For motor nerve conduction velocity, median nerve was stimulated supramaximally at two points along its course respectively at wrist and antecubital fossa (elbow). The stimulating electrodes were placed with anode 3 centimeters proximal to cathode. Recording and reference electrodes were placed over abductor pollicis brevis along thenar muscle border. Ground electrode was placed over forearm.

For sensory nerve conduction velocity, ring electrodes were placed at the proximal and distal interphalangeal joints of index finger. These served as recording electrodes. Stimulating electrodes were placed at the wrist , cathode distal to anode . Ground electrode was placed over the palm. With the help of stimulating electrodes a sub-maximal stimulation was given and antidromic conduction was recorded.

Statistical analysis:

Data was tabulated by using mean + standard deviation for both motor and sensory nerve conduction velocity. (Table no.1) Standard error of difference between two means was taken, Z test was used. (For motor nerve conduction velocity & sensory nerve conduction velocity)

RESULT

Statistically significant changes ($P < 0.05$) were found in the sensory nerve conduction velocity (Mean+ SD value in smokers was 55.11+ 2.32 m/s while in nonsmokers it was 57.09+ 4.21 m/s) whereas no such changes were found in Motor nerve conduction velocity (Mean+ SD value in smokers was 54.19 +6.35 m/s while in nonsmokers it was 54.97+ 7.33 m/s) in this study. (Table no.1)

It was also observed that nerve conduction velocity was reciprocally related to smoking index; greater the smoking index, lesser was conduction velocity. (Table no.2)

DISCUSSION

From the result, it is seen that statistically significant changes were found in conduction velocity of sensory nerves but not in motor nerves. (Table no 1) When smokers were classified according to smoking index criteria changes were observed in the moderate and heavy smokers only;

however such changes were not seen in light smokers. (figure no.1)

Nerve conduction studies provide a means of demonstrating the presence and extent of a peripheral neuropathy. [6] Conduction velocity is usually reduced in demyelinative neuropathies , including smoking. Nerve conduction velocity tests can precisely measure the degree of damage in large nerve fibres like median nerve, revealing whether symptoms are being caused by degeneration of the myelin sheath.[2]

In the present study we recorded sensory and motor conduction velocities using surface electrodes which require less precision in placement and are therefore quicker to use. Also using low noise amplifier and signal averaging minute potentials can be recorded from nerve trunks by using these electrodes. Uncertainty of exact site of stimulation, lack of precision of measured conduction distance and uncertainity as to the temperature of the nerve can introduce errors in velocity measurements.[7] By using computerised technique, majority of these errors can be eliminated giving more reliable and reproducible results. The conduction velocity values found in this study are seen similar to those observed by Agarwal et.al , who studied subclinical peripheral neuropathy in chronic obstructive pulmonary disease patients.[8]

Cigarette smoking affects neural function by various mechanisms. Smoking causes vasoconstriction and damages blood vessels by atherosclerosis, plaque formation etc. As a result the blood supply and amount of oxygen delivery to the nerve fibers decreases. (neural ischemia) Smoking also increases cholesterol level in the circulating blood stream which predisposes to the atherosclerosis. [9]

The body's overall vascular and neural functions are closely related. The initial change which occurs as a result of smoking is constriction of microvasculature. Such microvascular function impairment occurs early in smoking. Hence smoking affects peripheral ends of nerves and then slowly proceeds towards the centre.[10]

Carbon monoxide released during smoking also damages tunica intima of blood vessels and endothelial cells, which further leads to deposition of fats in the vessel walls.[11] Nicotine present in smoke worsens these effects.

Myelin, forming a layer around the axon , is essential for the normal functioning of the nervous system. [12] Smoking initially induces subclinical changes in the myelin sheath.[13]This results in demyelination . This can also cause the blockage of the nerve conduction and decrease in conduction velocity. [14]

Also the higher carboxyhemoglobin levels in the circulating blood found in smokers leads to slowing of nerve conduction by its direct action over the myelin sheath.[15] Nicotine too has a direct effect on the myelin sheath. In clinical practice, a high frequency of neuropathies of different varieties has been reported in more than 60 percent smokers.[16]

In our present study, we found no statistically significant changes in motor nerve conduction velocity while significant changes were seen in the sensory nerve conduction velocity. This may be due to the fact that sensory nerves are thinner than the motor nerves and are having shorter internodal distances. As a rule the thinner nerves are early affected than the thicker nerves by any damage. Hence the sensory nerves may be more affected than the motor nerve.[17]

Further in this study, we also found more severe changes in sensory nerve conduction velocity in smokers whose smoking index is higher. This may be due to greater smoking exposure either in the form of high daily numbers of cigarettes smoking or longer duration of smoking which affects the various neural mechanisms. Both these factors may be responsible for changes which occur at level of nerve fibers. Demyelination process, occurring at the myelin sheath, which covers the nerve fibers is also slowly progressive. As these

changes are slow initially, they may not be evident in early smokers or those with less smoking index.

Limitations of Present study: An important limitation in present study is that other confounding factors that may influence nerve conduction (like diabetes, nutritional deficiencies, and atherosclerosis) have not been conclusively excluded.

CONCLUSION

From this study we conclude that chronic smoking is associated with reduction in conduction velocity in median nerve sensory fibers.

REFERENCES

1. David M. Burns, Nicotine Addiction, Harrison's Principles of Internal Medicine: Vol.II, 2008, 17th Edition; Page no. 2736-2739, McGraw Hill , USA,
2. Stanley Berent, Neurobehavioral Toxicology: Neuropsychological & neurological perspectives : Vol.II, 2005, First Edition; 495, Psychology Press, USA.
3. Richardson JK, Jamieson SC. Cigarette smoking and ulnar mononeuropathy at the elbow: Am J Phys Med Rehabil. 2004 ; Sep;83(9):730-4.
4. Sabyasachi Sircar .Conduction of nerve impulses. (page 90-95) : Principles of Medical Physiology. 2008; First Edition, Thieme, New Delhi.
5. Sanjay P. Zodpey, Suresh N. Ughade . Tobacco smoking and risk of age related cataract in men . Reginal Health Forum ; WHO South –East Asia Region ; September 2006; Vol.3; 336-341.
6. Michael J.Aminoff, Electrodiagnostic Methods for the study of Nerve and Muscle, Pages 1-7 ; Electromyography in clinical Practice : Third Edition ,2008, Churchill Livingstone , New York.
7. Ray cooper, Measurement of nerve conduction, page 61-74: Techniques in Clinical Neurophysiology: Practical manual, First edition, 2003, Elsevier, Edinburgh.
8. Agrawal D, Vohra R, Gupta P, Sood S, Subclinical peripheral neuropathy in stable middle aged patients with chronic obstructive pulmonary disease, Singapore Med. Journal, 2007; 48(10) : 887-894.
9. Effects of diabetes. Diabetes management 101.com , Cited on : 15 May 2011, From: http://www.diabetesmanagement101.com.
10. John R. Polito.whyquit.com, How smoking destroys blood circulation . Cited on : 16 May 2011, From http://whyquit.com/whyquit/LinksJBlood.html .
11. Ijzerman RG, Serne EH, van Weissenbruch MM, de Jongh RT, Stehouwer CD. Cigarette smoking is associated with an acute impairment of microvascular function in humans : Clinical Science (2003); 104, 247–252.
12. Wikipedia contributor , Wikipedia – the free encyclopedia , Myelin, Page Version ID: 438016640, Cited on 15 May 2011, From: http://en.wikipedia.org/wiki/Myelin_sheath
13. Gerhard Scherer. Carboxyhemoglobin and thiocyanate as biomarkers of exposure to carbon monoxide and hydrogen cyanide in tobacco smoke: Experimental and Toxicologic Pathology, Nov.2006; 58, Issues 2-3, 15, Pages 101-124.
14. Nowak D, Brüch M, Arnaud F, Fabel H, Kiessling D, Nolte D et.al . Peripheral neuropathies in patients with chronic obstructive pulmonary disease: a multicenter prevalence study: Lung 1990; 168: 43.51.
15. Faden A, Mendeza E, Flynn F. Subclinical neuropathy associated with chronic obstructive pulmonary disease, possible pathophysiologic role of smoking : Arch Neurol 1981; 38: 639-42.
16. Jennifer Noble, Months Çakan , Ahmet Emin Erbaycu, Sevket Dereli, Ayse Özsöz ,

Hakan Edipoğlu, Behind Özer. Chronic obstructive pulmonary disease in electromyographic evaluation of peripheral nerves: Turkish respiratory Journal , Aug.2003 ; Vol.4, Issue- 2, Page 51-56.

17. Arthur K. Asbury, Dr. David R. Cornblath . Assessment of current diagnostic criteria for Guillain-Barré syndrome: Annals of Neurology, 1990 ; Volume 27, Issue Supplement 1, pages S21–S24.

Table no.1 Motor and Sensory nerve conduction velocity in smokers and nonsmokers

	Nonsmokers (n = 40)	**Smokers (n = 40)**
Motor nerve conduction Velocity (m/sec) Mean±S.D.	54.97± 7.33	54.19±6.35
Sensory nerve conduction Velocity (m/sec) Mean± S.D.	57.09±4.21	55.11±2.32

(S.D.= Standard Deviation) (m/sec = meter per second)

Table no.2 Motor and sensory nerve conduction velocity in smokers with reference to smoking index.*

Smoking Index	Smokers (40)	Motor nerve conduction velocity (mt/sec) (Mean)	Sensory nerve conduction velocity (mt/sec) (Mean)
1-100 (Light)	10	54.27±6.29	57.38±3.32
101-200 (Moderate)	22	54.22±6.13	54.73±2.49
>201 (Heavy)	8	54.08±6.46	53.22±3.41

(mt/sec = meter per second)

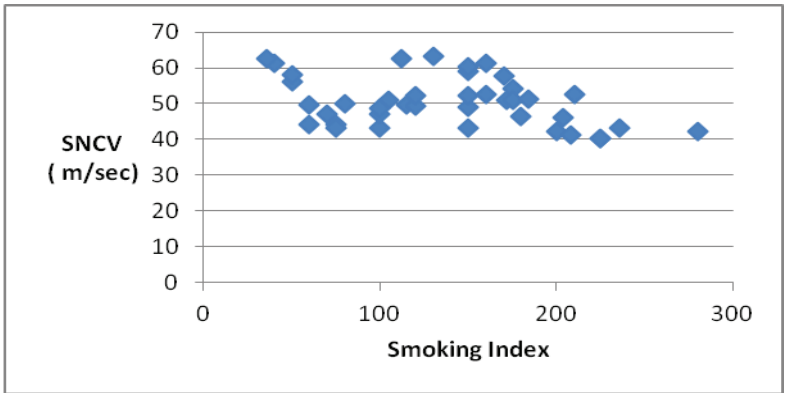

Figure no.1 Smoking index is plotted over X- axis while sensory nerve conduction velocity is plotted over Y –axis.