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Study of nerve conduction amplitude in Peroneal and Sural nerves in smokers

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Abstract:
Background: *Smoking is the most common method of consuming tobacco which can hamper impulse conduction of sensory and motor nerves. Nerve conduction amplitude is an important parameter of sensory and motor nerve conduction studies. The present study was undertaken to assess nerve conduction amplitude in Sural and Peroneal nerves in apparently healthy male smokers.*
Methods: *Study was carried out in 120 male subjects belonging to age group 25-45 years. Sensory and motor nerve conduction amplitude was tested in Sural and Peroneal nerves respectively by standard method in apparently healthy male smokers, who were subdivided into mild, moderate and heavy smokers group (30 subjects/group) according to smoking index. Control group comprised of 30 age & BMI matched non-smokers. Mean value of nerve conduction amplitude of various groups was compared statistically by one way Anova test and Bonferroni's test.*
Results: *The difference in mean values of nerve conduction amplitude (m/sec) in Sural (sensory) nerve of smokers was statistically significant among all the compared groups. The difference in mean values of nerve conduction amplitude (m/sec) in Peroneal (motor) nerve was statistically non-significant among all the compared groups.*
A significant negative correlation was observed between smoking index and Sural (sensory) nerve conduction amplitude. A non-significant correlation was observed between smoking index and peroneal (motor) nerve conduction amplitude.
Conclusions: *Smoking decreases nerve conduction amplitude in Sural(sensory) nerve while it does not significantly affect nerve conduction amplitude in Peroneal(motor) nerve in apparently healthy smokers.*
Keywords: *Nerve conduction amplitude, Smokers, Sural nerve, Peroneal nerve.*

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I. Introduction

There were 100 million premature deaths due to tobacco in the 20th century, and if the current trends of tobacco use continue, this number is expected to rise to 1 billion in the 21st century.[1]Smoking is a major risk factor for many serious health ailments and the effects depend on the number of years that a person smokes and on how much the person smokes. Starting smoking earlier in life and numbers of smoking cigarettes (higher in tar) increases the risk of these diseases.[2] Most smokers develop impairments in impulse conduction of sensory and motor nerves.[3] Nerve conduction studies are there for better diagnosis of various neuropathies.[4] Nerve conduction study (NCS) is a medical diagnostic test for the study of peripheral nerve function and it involves the surface stimulation of motor & sensory nerves and recording of the elicited action potential. Nerve conduction amplitude is an important parameter of sensory and motor nerve conduction studies.Amplitude reflects the number of axons and muscle fibers that depolarize. The present study was undertaken to assess nerve conduction amplitude in lower limbs in male smokers.

II. Material and Methods

The present study was of comparative cross-sectional nature. The study was approved by the institute's ethics committee. The subjects were thoroughly questioned using a standard questionnaire. Details of participants were recorded on record form. Detailed history was taken about past health ailments and treatment. Preliminary clinical examination was done after obtaining written informed consent from all the subjects.

Participants in the study with age below 25 years and more than 45 years; having history of diabetes; having symptoms and signs of peripheral neuropathy; giving history of renal problems; having history/signs of Chronic Obstructive Pulmonary Disease; having hypertension; showing signs of anaemia; giving history of consumption of neurotoxic drugs; having history/signs of peripheral vascular diseases and Carpal tunnel syndrome; givinghistory of hepatitis and giving history of consumption of alcohol, Gutaka or chewing tobacco were excluded from the study.

Participants having normal BMI (19-24.9 kg/m^2) and subjects who gave a wilful consent for the study, were selected for the study.

Total 120 subjects were selected for the present study. History of smoking (numbers of cigarettes/day) and duration was asked. Smoking index was calculated by the formula: Smoking index = (frequency x duration in years).[5]

Based on Smoking index, subjects were then classified into following subgroups

Table 1 – Division of various groups with reference to smoking index

Group	Smoking Index	Description	Sample size
Group I	0	Nonsmokers	30
Group II	1 to 100	Light/Mild	30
Group III	101 to 200	Moderate	30
Group IV	>200	Heavy	30

Subjects were informed in detail about the nerve conduction study procedure and written informed consent was taken. They were all subjected to nerve conduction test in an air-conditioned room maintained at temperature of 21^0-23^0 C.[3] RMS Salus 2C Electromyograph recorded on HP monitor equipment was used for finding nerve conduction amplitude.

Before carrying out the study, the subjects were familiarized with the procedure. Nerve conduction examination test was done in lying down position on Sural and Peroneal nerves. Electrode placement was done for the test according to the standard technique.[6]

For Sural sensory nerve conduction study, the leg was relaxed and placed in lateral position. The recording electrode was placed on motor point between lateral malleolus and tendoachillis. The reference electrode was placed 3cm distal to recording electrode. The ground electrode was placed above the lateral malleolus of ankle. Stimulating electrode's cathode was placed at distal gastrocnemius at the junction of middle and lower third of the leg while the anode was placed 3cm distal to the cathode. The low frequency filter was set at 5 Hertz (Hz) and high frequency filter at 3 kiloHertz (kHz).

For Peroneal nerve conduction study, the recording electrode was placed on motor point of Extensor Digitorum Brevis, on the dorsum of foot. The reference electrode was placed 3cm distal to recording electrode. The ground electrode was placed below the lateral malleolus of ankle. The stimulating electrode's distal stimulation point was placed over ankle while the proximal stimulation point was placed behind the neck of fibula.The Current given was 5-30 mA for Sural (sensory) and 20-50 mA for Peroneal (motor) nerve conduction study. The sweep speed was set at 2 milliseconds/division.

Readings were taken for nerve conduction amplitude (m/s). Mean values of nerve conduction amplitude were compared between all the groups by one way Anova test. Mean values of nerve conduction amplitude were also compared among different subgroups by bonferroni's test. p value <0.05 was taken as statistically significant (for both the tests).

III. Results

Table 2: Table showing comparison of study and control group with respect to Sural nerve conduction amplitude

Groups	Conduction amplitude in Sural nerve (m/sec) [mean ± SD]	"p" Value (One way ANOVA Test)
I	7.17±1.59	
II	7.14±1.61	
III	7.02±1.45	
IV	6.09±1.33	p< 0.05

Table 3: Bonferroni's multiple comparison test for Sural nerve conduction amplitude (Post HOC Test)

Group comparison	t value	"p" value	Significance
GR I vs GR II	0.2931	P > 0.05	Non significant
GR I vs GR III	0.9202	P > 0.05	Non significant
GR I vs GR IV	3.815	P < 0.05	Significant
GR II vs GR III	0.6271	P > 0.05	Non significant
GR II vs GR IV	3.522	P < 0.05	Significant

GR III vs GR IV	2.895	P < 0.05	Significant

Graph 1: Correlation graph between smoking index and Sural nerve conduction amplitude

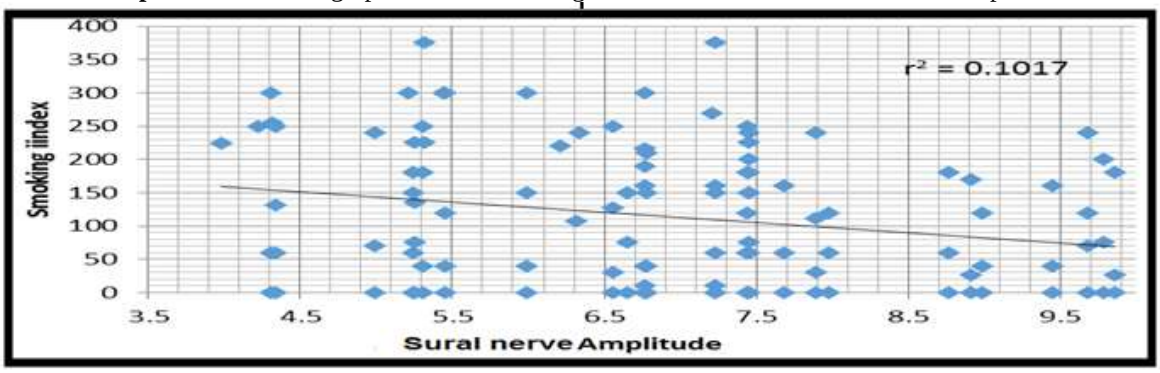


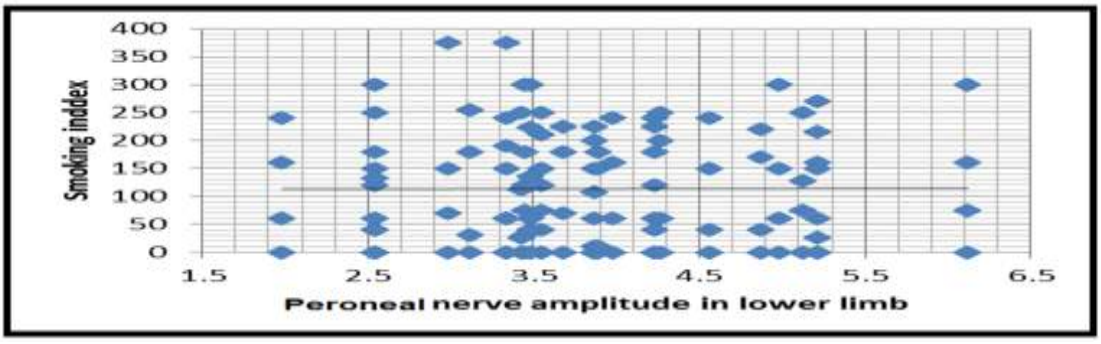
Table 4: Table showing comparison of study and control group with respect to Peroneal nerve conduction amplitude

Groups	Conduction amplitude in Peroneal nerve (m/sec) [mean ± SD]	"p" Value (One way ANOVA Test)
I	4.01±0.96	
II	3.83±0.93	
III	3.74±1.05	
IV	3.76±0.83	p > 0.05

Table 5 - Bonferroni's multiple comparison test (Post HOC Test)for Peroneal nerve conduction amplitude

Group comparison	t value	p value	Significant
GR I vs GR II	0.8044	>0.05	Non Significant
GR I vs GR III	1.163	>0.05	Non Significant
GR I vs GR IV	1.067	>0.05	Non Significant
GR II vs GR III	0.3584	>0.05	Non Significant
GR II vs GR IV	0.2626	>0.05	Non Significant
GR III vs GR IV	0.09586	>0.05	Non Significant

Graph 2: Correlation graph between smoking index and Peroneal (motor) nerve conduction amplitude



IV. Discussion

There was a significant difference in mean values of Sural (sensory) nerve conduction amplitude amongst all the groups.(Table 2)

There was no statistical difference in Sural nerve conduction amplitude between non-smoker and mild smoker group; between non-smoker and moderate smoker group and between mild and moderate smoker groups. However there was significant difference in Sural nerve conduction amplitude between non-smoker and severesmoker group, between mild smoker and severe smoker group, between moderate smoker group and severe smoker group (p value <0.05).(Table 3)

A significant negative correlation was observed between smoking index and Sural (sensory) nerve conduction amplitude of lower limb. (Graph 1)

There was no significant difference in mean values of Peroneal (motor) nerve conduction amplitude amongst all the groups. (Table 4)

There was no statistically significant difference in Peroneal (motor) nerve conduction amplitude when all the groups were compared individually to one another. (Table 5)

Non-significant correlation was observed between smoking index and peroneal nerve conduction amplitude. (Graph 2)

Thus Sural (sensory) nerve conduction amplitude is decreased but Peroneal (motor) nerve conduction amplitude doesn't show significant change as smoking index increases.Low nerve conduction amplitudes most often result from loss of axons (as in a typical axonal neuropathy).

In the present study, all the groups were age and BMI matched. The correlation between increased BMI and lower sensory/mixed nerve amplitudes should be taken into account in clinical practice.[7]

In 1984 G. VALLI et al conducted a study to investigate 19 patients with history of smoking and found reduced amplitude in nerve conduction.[8]

AGARWAL et al in 2007 observed decreased amplitude in all examined sensory nerves in the patients. These findings suggested predominant sensory axonal polyneuropathy.[9]

In 1981, FADEN A. et al. noted peripheral nervedysfunction in COPD patients having the history of smoking since many years. Sensory nerve conduction in nerves like sural nerve more commonly than motor in smokers. Common peroneal nerve was the most frequently affected motor nerve which correlated with cigarette consumption.[10] However in the present study, no significant change in motor nerve amplitude in peroneal nerve was observed as the study included healthy smokers (without COPD).

It has been observed that in smokers long nerves such as sural nerve are more commonly affected.[11] Also the blood supply to the sural nerve is different in that there are no arterial pedicles to it.[12] As reduction of blood supply to nerve is important in pathogenesis of nerve function, hence sural nerve is more commonly affected.

Sensory nerves are thinner than motor nerves and have lesser internodal distance. Hence sensory nerves are affected earlier than motor nerves.[13]

Nerve conduction amplitude in sensory nerves showed changes in mild smokers, however those changes are not statistically significant when compared with non-smokers (p value >0.05). This indicates that the sural (sensory) nerve are not affected significantly in mild smoker, and any pathogenesis which may have occurred can be easily reversed.

This signifies that, this is the ideal time, where smoking if stopped, would prevent further functional impairment of peripheral nerves and cause reversal of pathological and functional changes, if any.

The findings of present study conclude thatsmoking decreases conduction amplitude in Sural(sensory) nerve while it does not significantly affect conduction amplitude in Peroneal(motor)nerve in apparently healthy smokers.

Early detection of peripheral nerve damage by nerve conduction studies should be carried out in smokers and followed by proper counselling which will help in prevention and progression of peripheral nerve damage.

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