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Analysis of Motor Nerve Conduction and Pain Threshold in Professional Drivers.

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ABSTRACT

Background: Professional drivers, who maintain the same sitting posture, a taut hand grip, erratic rotations of the trunk and holding the pedals in same place with foot makes them susceptible for sensory and motor nerve damage and its consequences. This study was aimed to assess the motor nerve conduction velocity and pain threshold for the professional drivers who are exposed to the constant vibration during driving. **Methods:** 40 professional drivers and 20 controls were included in the study for analysis of nerve conduction study and pain threshold in upper limb and lower limb. Drivers with significant medical illnesses, alcoholism, hypertension and diabetes were excluded from the study. **Results:** Among the study group, both in the upper limb and in the lower limb there is a significant reduction in the motor nerve conduction velocity when compared to the control group. Regarding pain threshold there is a significant statistical difference between control group and heavy motor drivers group. **Conclusion:** There is a significant decrease in the motor nerve conduction of upper limb in heavy motor vehicle drivers than low motor vehicle drivers and there is a significant decrease in the motor nerve conduction velocity in lower limb and decrease in pain threshold among the heavy motor vehicle drivers.We recommend that all the professional drivers, particularly heavy motor vehicle drivers, should have periodic medical screening to prevent neuropathic changes and its devastating complications.

Keywords: Professional drivers, Motor nerve conduction velocity, Pain threshold.

INTRODUCTION

Nowadays road traffic accidents have become an important public health issue, which has to be solved by a co-ordinated approach. Current scenario of the road traffic accident injuries and death is becoming alarming in both developed and developing countries including India. According to a census in 2010, more than 1.3 lakh people died on Indian roads. One of the many contributing factors for the increasing number of road traffic accidents is factors related to drivers.

Drivers, not like other professionals, work for a longer period of time on seat in shift basis. They do not have adequate breaks. As driving requires constant alertness, working for more than 12 hours at a stretch results in physical as well as mental fatigue and tiredness. The swiftness of the driving response requires an intact and faster conducting nervous system. There is a decline in the functioning of the nervous system with increasing age. Along with this, there is also an increased risk of nerve damage due to continuous exposure of the whole body to the engine heat and vibration during driving. The effect is more for heavy vehicle drivers. All these factors contribute to increased number of road traffic accidents. Than implementing more and more traffic rules, scientific measures have to be initiated earlier to prevent calamities.[1]

Constant vibration, work stress and poor nutrition will result in nerve damage. Nerve damage is associated with slower conduction velocity. Damage to the motor nerve results in muscle weakness and abnormal motor skills. Sensory nerve damage affects pain perception. To evaluate the functioning of motor and sensory nerves of the human body, Nerve conduction study is commonly done. It measures the speed of conduction of an electrical impulse through a nerve. It can determine nerve damage and destruction.[2]

Nerve damage also reduces pain sensitivity. In drivers, pain sensitivity has to be intact as otherwise they are at the risk of getting injured during the process of fixing mechanical glitches. Pain threshold is the point along a curve of increasing perception of a stimulus at which pain begins to be felt. It is the least stimulus intensity at which a subject perceives pain.[3]

Exposure to vibration, leads to peripheral nerve disorder such as vibration induced neuropathy.[4]

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Occurrence of features of peripheral neuropathy in the hands are common in people who are getting exposed to vibration.[5] The present study was done to assess the integrity of motor and sensory nervous system in professional drivers by analysing the nerve conduction velocity and pain threshold respectively.

MATERIALS AND METHODS

The study was approved by the Institutional Ethical board and study was done in accordance with the ethical standards suggested by the institutional body. Study was conducted in research laboratory of department of physiology, Velammal Medical College, Madurai. Study design is cross sectional study done on 40 male professional drivers and 20 controls over a period of three months. All the participants were male in the age group of 32-50 years. Subjects with driving experience of 10-20 years, with proper driving license were included in the study. Alcoholics, Smokers, individuals with Diabetes Mellitus, Hypertension and any other medical illnesses affecting nervous system were excluded from the study. Informed consent was obtained before initiating the study from all the participants. The participants were of three groups. Group I consist of 20 professional heavy vehicle drivers; Group II consist of 20 professional light vehicle drivers. Control group III consist of 20 volunteers of the same age group who are not involved in driving.

Baseline demographic data were collected before the beginning of the study using questionnaire. Motor nerve conduction velocity was recorded using Physiopac (Medicaid - Neurostim – NS2). Subjects were instructed to lie down on a couch and then skin over the placement of recording electrode was cleaned thoroughly with rubbing alcohol. The electrodes with conduction gel were fixed on the skin and secured with tape. Recordings were performed in the peripheral nerves: median nerve for the upper limb and common peroneal nerve in the lower limb. Recording electrode and reference electrode were placed distally in the course of the nerve and ground electrode was placed in between recording electrode and stimulating electrode. Nerve conduction velocity (in meter per second) was calculated by dividing the distance between the two points of stimulation by the difference of latency.[6]

Before starting the study, informed written consent was obtained from the participants. Vital signs were checked before the procedure. Room temperature was kept constant throughout the procedure. Subjects were asked to restrain themselves from drinking caffeinated drinks 1 hour before the procedure. Before the recording they were explained about the procedures clearly and made to lie down on the couch comfortably. Stimulation were made and the action potentials were recorded using surface electrodes, placed at the Right arm and Right leg (dominant side) in the median nerve and the common peroneal nerve respectively. Distance between the two points was measured and latent period was noted. Nerve conduction velocity (in meter per second) was calculated by dividing the distance between the two points of stimulation by the difference of latency. Calculations are performed by the following formula,

NCV= Distance (elbow-wrist) / latency (elbow) – latency (wrist).[10]

Pain sensitivity also was recorded after a brief period of rest. Pain sensitivity was recorded using Digital Algometer instrument (Medicaid, Pune). Probe was placed on the flexor aspect of the forearm and then the intensity of the stimulus was increased very slowly till the subject felt the pain. This value was taken as the pain threshold for that particular individual.[3]

The data were entered in to Microsoft Excel spread sheet. Mean and standard deviation was calculated in the spreadsheet. The data was then exported to SPSS version 21 and the three set of values were compared using ANOVA and student's unpaired t test for inter-group statistical significance.

RESULTS

The following table shows the mean ± SD of height and weight of three groups:

Table 1: Comparison of height and weight of three groups

	Control	Light motor vehicle drivers	Heavy motor vehicle drivers
Height (in cms)	160.1±5.51	167.78±4.91	162.7±5.49
Weight (in Kgs.)	55.45±4.42	72.35±5.12	68.3±9.39

The following table shows the comparison of motor nerve conduction velocity among the groups:

Table 2: Comparison of motor conduction velocity and pain threshold in three groups

		Control	Light motor vehicle drivers	Heavy motor vehicle drivers
Motor conduction velocity (in meter per second)	Upper limb	57.77±3.23	55.02±2.94	53.9±3.63
	Lower limb	60.13±2.62	59.99±3.86	42.14±5.72
Pain threshold	Fore arm	42±3.77	42±5.57	39±5.88

On applying ANOVA to the three groups of data, there was statistically significant difference ($p<0.05$) in both conduction velocity and pain threshold parameters. To identify the inter-group difference,

post-hoc test in SPSS and student's unpaired 't' test in EXCEL was applied.

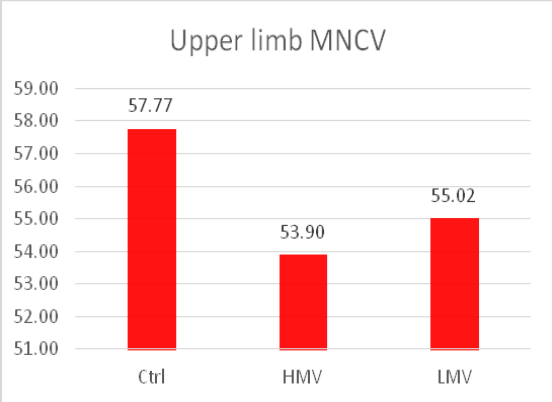

Figure 1: Comparison of motor conduction velocity – Upper limb

Table 3: Statistical comparison of motor conduction velocity – Upper limb

p value	LMV	HMV
Control	0.00384	0.00062
LMV	-	0.150

The motor nerve conduction velocity in upper limb is statistically decreased ($p<0.05$) in upper limb of light and heavy motor vehicle drivers when compared to control group. The decrease in motor nerve conduction velocity in heavy motor vehicle derivers when compared to light motor vehicle drivers is not statistically significant ($p=0.15$).

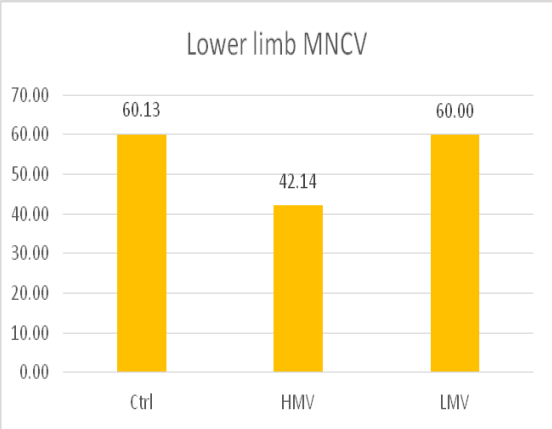

Figure 2: Comparison of motor conduction velocity – Lower limb

Table 4: Statistical comparison of motor conduction velocity – Lower limb

p value	LMV	HMV
Control	0.45	0.0003
LMV	-	0.0016

The motor nerve conduction velocity in lower limb is statistically decreased ($p<0.05$) in heavy motor vehicle drivers when compared to control group and light motor vehicle group drivers. Mean and p value of motor conduction velocity in controls and light motor vehicle drivers do not show significant difference.

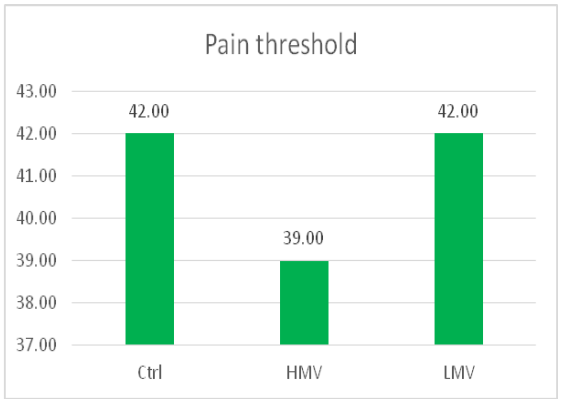

Figure 3: Comparison of pain threshold

Table 5: Statistical comparison of pain threshold

p value	LMV	HMV
Control	0.5	0.032
LMV	-	0.053

Pain threshold of control group and light motor vehicle drivers do not show significant difference in terms of mean or statistically. The pain threshold of heavy motor drivers showed significant decrease ($p<0.05$) in comparison with controls. Even though mean of pain threshold in heavy motor drivers were decreased it is not statistically significant with light motor drivers.

DISCUSSION

In this ever growing modern world, transportation has become one of the inevitable need. Professional drivers, who works for prolonged hours in a day are exposed to the continuous vibration produced by the motor vehicle, in that particularly hands and legs are getting affected commonly, and are at a risk of developing vibration induced neuropathic changes. There are very few studies done in the past to assess the vibration induced motor and sensory neuropathic changes in the professional drivers. Median nerve and common peroneal nerve are important for the motor and sensory functions of the limbs and commonly studied.[7] In the present study, we have assessed the long term exposure of vibration in the motor and sensory functions of these nerves.

Nerve conduction study is essential in the diagnosis of focal neuropathy.[8] Also studies had proven that motor nerve conduction velocity is an important forecaster in the onset of new foot ulcers in diabetic population.[9]

Our present study revealed that when compared to Control group and low motor vehicle group, Heavy motor vehicle group were having reduction in the motor nerve conduction velocity and increase in the pain threshold, so they are at more risk of developing long term hazards due to exposure to vibration for a longer period in a day. Indian Council for Medical

Research stated that the professional drivers are suffering from numerous health problems.[11] Symptoms like weakness, burning pain, tingling, pins and needles have to be reported and treated early.[12]

Regular rotatory shifts, periodic relaxations and life style modifications will be helpful in reducing the incidence of increased motor vehicle accidents and also will prevent later development of complications like chronic ulcers, It also reduces the incidence of sickness absenteeism.[13] These simple and cost effective electrophysiological test can predict the neurological complications on its earlier stages and proper treatment can be initiated earlier to avoid major neurovascular complications.[14] The median nerve is highly susceptible to damage by metabolic disturbances, entrapment neuropathies etc.[15] But, its abnormalities are often remain undiagnosed in a vast majority of patients, but with Nerve conduction study, more subclinical cases can be diagnosed at subclinical stages itself.[16]

CONCLUSION

- In upper limb, there is a significant decrease in motor nerve conduction for light and heavy motor drivers than in controls.
- In lower limb, the motor nerve conduction showed a significant decrease in heavy motor drivers.
- Pain threshold is significantly decreased only in heavy motor drivers.

Values implies a significant difference in motor nerve conduction velocity and decrease in the pain threshold values in the professional drivers who are occupationally exposed to the vibration than the controls, explaining the effects of vibration in motor nerve conduction.

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