

## Original Article



# Electrophysiological Evaluation of Common Peroneal Nerve in Chronic Cigarette Smokers.

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### Abstract

**Background:** Researchers have identified multiple negative health effects of smoking on the respiratory and cardiovascular systems. It was recently reported that substances in cigarette smoke also have pathological effects on peripheral nerves, which causes neuronal impairment. The common peroneal nerve conduction study is an essential electrodiagnostic test of the lower limb for the detection of peripheral motor nerve dysfunction.

**Objectives:** To assess the potential influence of smoking on the electrophysiological status of common peroneal nerve in young male chronic cigarette smokers.

**Materials and Methods:** This case-control study was conducted in the Department of Physiology, Sir Salimullah Medical College, Dhaka, from July 2017 to June 2018, including thirty male cigarette smokers aged 25 to 40 years. For comparison, another thirty age and BMI matched healthy male non-smoker subjects were selected in the control group. The electrophysiological parameters (distal latency, amplitude, and motor nerve conduction velocity) of the left common peroneal nerve were evaluated by standard methods in the Department of Neurology, Dhaka Medical College Hospital. For the statistical analysis, independent t test was performed.

**Result:** In this study, the mean distal latency of the common peroneal nerve was slightly prolonged, while the mean amplitude was slightly reduced in smokers. But these changes were not statistically significant. However, the motor nerve conduction velocity was significantly ( $p < 0.05$ ) slower in cigarette smokers in comparison to non-smokers.

**Conclusion:** Chronic cigarette smoking causes significant impairment of common peroneal motor nerve conduction, while it does not affect the amplitude in young individuals.

**Keywords:** Smoking, Common Peroneal Nerve, Peripheral Nerve Dysfunction, Motor Nerve Conduction Velocity, Nerve Conduction Study.

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### Introduction

Cigarette smoking is the practice of burning tobacco and inhaling the resulting smoke. It is the most popular method of consuming tobacco.<sup>1</sup> Studies have shown that initiation of smoking occurs predominantly among young individuals because they are more prone to addiction than middle-aged persons. Most smokers begin their habit between the ages of 14 and 25.<sup>2</sup> In Bangladesh, smoking starts at an average age of 18.6 years, and almost all habitual smokers start smoking before the age of 25.<sup>3</sup> Smokers have a significant impact on their quality of life, and their risk of developing smoking-related ailments

increases when smoking begins earlier in life.<sup>4</sup> Currently, there are about 1.5 million tobacco-related ailments in Bangladesh.<sup>5</sup> Globally, over 8 million people are killed by tobacco-related illnesses each year, and developing nations bear the brunt of this burden.<sup>6</sup>

Smoking is a prime factor in coronary heart disease, stroke and chronic pulmonary disease. It can also cause cancer of the lungs, mouth, esophagus, and bladder.<sup>7</sup> Several authors reported that exposure to tobacco smoke also induces multiple pathological effects on the peripheral nerves, which contribute to the

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development of peripheral nerve dysfunction.<sup>8-10</sup> With steady improvement of recording apparatus, nerve conduction studies have become the reliable tests of peripheral nerve function.<sup>11</sup> These studies can confirm the presence and extent of peripheral nerve damage and are useful in detecting subclinical changes in peripheral nerves.<sup>12</sup>

The common peroneal nerve, also known as the common fibular nerve, is derived from the lateral division of the sciatic nerve. It innervates the muscles of the anterior and lateral compartments of the lower extremity. The anterior muscular compartment is primarily responsible for the dorsiflexion of the foot. Therefore, patients with common peroneal neuropathy tend to present with weakness in ankle dorsiflexion and foot drop. Injuries to the peroneal nerve can also cause tingling, numbness, pain, and weakness.<sup>13</sup> In nerve conduction studies, the nerve is stimulated at two or more points along its course, and the compound muscle action potential (CMAP) is recorded with a pair of surface electrodes. The latency reflects only the fastest-conducting motor fibers, and the amplitude reflects the number of depolarized muscle fibers.<sup>14</sup>

Previously some studies were conducted to explore the causative role of cigarette smoking in the development of peripheral neuropathy in patients with chronic obstructive pulmonary diseases.<sup>15-17</sup> However, it is unresolved whether smoking has any influence on peripheral nerve function in subjects who do not have any preexisting pulmonary diseases. Recently, a few researchers have carried out nerve conduction studies of lower limb motor nerves in apparently healthy male smokers, though the results were inconsistent.<sup>18-20</sup> Therefore, we investigated the potential impact of smoking on the common peroneal motor nerve function in apparently healthy young men.

## Materials and Methods

This case-control study was conducted in the Department of Physiology, Sir Salimullah Medical College, Dhaka from July 2017 to June 2018. The subjects were selected from the hospital staff members of Sir Salimullah Medical College and Mitford Hospital and also from Dhaka Medical College Hospital. According to a smoking questionnaire, 30 subjects were apparently healthy male daily cigarette smokers, aged 25 to 40 years, who consumed at least 10 sticks per day and had a history of cigarette consumption for more than 10 pack years. Another 30 healthy male subjects with similar age, BMI, and socioeconomic status were non-smokers who never had any addiction related to tobacco. A consecutive purposive sampling technique was used. Subjects with a history of any major illnesses like diabetes mellitus, hypertension, peripheral neuropathy, or other neurological disorders, cardiac, renal, or thyroid diseases, or a history of addiction to other tobacco products or alcohol were not included in the study. The study was performed and approved under ethical guidance of Institutional Ethics Committee (IEC) of Sir Salimullah Medical College. After a briefing about the nature, purpose, and benefit of the study, written informed consent was obtained from the participants at the onset of study. A detailed personal, occupational and medical history was taken. The cigarette smokers were interviewed about smoking duration and average daily cigarette

consumption. Then the smoking history was calculated in pack year by multiplying the number of packs smoked per day by the number of years the person has smoked.

After a thorough physical examination, the subjects were further evaluated by fasting blood glucose and serum creatinine tests to exclude other concurrent risk factors of peripheral neuropathy such as diabetes mellitus and chronic renal diseases. Then the common peroneal motor nerve conduction parameters were measured by standard methods in the Department of Neurology at Dhaka Medical College Hospital, and fully computerized NCS and EMG machines (Nihon Kohden Neuropack, Japan) were used. Each participant was provided a detailed explanation of the procedure to guarantee their comfort and compliance. They were instructed to lie supine on the bed in a comfortable position. The room temperature was kept between 25 and 28°C. The recording and stimulating areas were meticulously cleaned with spirit to achieve the maximum electrical conductivity.

The recording site was the extensor digitorum brevis muscle. The active recording electrode was placed over the muscle belly, and the reference electrode was placed over the tendon at the metatarsal-phalangeal joint of the little toe. The ground electrode was positioned at the dorsum of the foot. Stimulations were given in the left common peroneal nerve at two points: in the anterior ankle, slightly lateral to the tibialis anterior tendon and below the fibular head; and at the lateral calf, one or two fingerbreadths inferior to the fibular head. A compound muscle action potential (CMAP) was recorded. Latencies were measured at the initial deflection of action potential and amplitude was measured from baseline to negative peak. Then the motor nerve conduction velocity was calculated by measuring the distance between proximal and distal stimulation sites.

The results of all measurements were expressed as mean  $\pm$  SD (standard deviation). All statistical analyses were performed with unpaired t test using the statistical package of social science (SPSS) Windows version 22 and the differences between groups were regarded as statistically significant if the p value was  $\leq 0.05$ .

## Results

Table I presents the general characteristics of non-smokers and cigarette smokers. Age, BMI, and blood pressure were almost similar in both groups, and statistically no significant differences were observed among them.

Table II shows the motor nerve conduction parameters of the common peroneal nerve in both groups. In this study, the mean distal latency of the common peroneal nerve was slightly prolonged, whereas the mean amplitude was slightly reduced in smokers in comparison to those of controls. But the differences were not statistically significant. However, the motor nerve conduction velocity of the common peroneal nerve was significantly ( $p < 0.05$ ) slower in cigarette smokers compared to non-smoker subjects.

**Table I:** General characteristics of the subjects in both groups (N=60)

Parameters	Non - smokers (n=30)	Cigarette smokers (n=30)	p value
Age (years)	33.27 ± 4.70 (25 - 40)	32.77 ± 4.30 (25 - 40)	0.669
Weight (kg)	68.86 ± 4.12 (60 - 75)	67.22 ± 3.94 (58 - 74)	0.118
BMI (kg/m <sup>2</sup> )	23.48 ± 1.32 (19.82 - 25.35)	22.97 ± 1.17 (20.55 - 24.91)	0.115
Systolic BP (mm of Hg)	120.17 ± 7.71 (100 - 130)	122.83 ± 5.52 (110 - 130)	0.129
Diastolic BP (mm of Hg)	70.67 ± 6.91 (60 - 80)	73.00 ± 6.77 (60 - 85)	0.192

Data were expressed as mean ± SD. Figure in parentheses indicate ranges; N = total number of subjects; n = number of subjects in each group.

**Table II:** Motor nerve conduction parameters of common peroneal nerve in both groups (N=60)

	Non - smokers (n=30)	Cigarette smokers (n=30)	p value
Distal latency (ms)	3.84 ± 0.65 (2.9 - 5.72)	3.93 ± 0.67 (2.92 - 5.83)	0.600
Amplitude (mV)	5.33 ± 2.27 (2.00 - 9.70)	5.14 ± 2.21 (2.00 - 9.60)	0.744
MNCV (m/s)	50.12 ± 3.05 (44.5 - 54.9)	48.42 ± 3.21 (43.6 - 54.3)	0.040*

Data were expressed as mean ± SD. Figure in parentheses indicate ranges; Statistical analysis was done by unpaired t test; N = total number of subjects; n = number of subjects in each group; MNCV = motor nerve conduction velocity; \* = p < 0.05.

## Discussion

Cigarette smoke contains approximately 5,000 different chemicals, many of which have deleterious effects on health.<sup>21</sup> While the adverse effects of cigarette smoke on lung and cardiac health are well established, the effects on peripheral nervous system are not clarified well. Therefore, the aim of this study was to assess the potential impact of cigarette smoking on electrophysiological status of the common peroneal nerve in

young male population. The motor nerve conduction studies of the common peroneal nerve performed on cigarette smokers showed slight prolongation of distal latency and slight reduction of amplitude. But these changes were statistically not significant. Similar results were observed by other investigators.<sup>22</sup> However, very recently

Arora et al. studied motor nerve conduction parameters in mild, moderate, and heavy smokers where smokers were subdivided into groups on the basis of the smoking index of study subjects.<sup>23</sup> Though they did not find significant differences between the non-smoker and mild smoker groups, significant prolongation of distal latency and significant reduction of amplitude were noted in heavy smokers. In our study, smoking exposure was measured in pack years, and the electrophysiological findings were compared between two groups: non-smokers and chronic cigarette smokers. Therefore, the discrepancy in results might have occurred due to variations in inclusion criteria and large sample size of that study.

Again, in our study, significantly slower motor nerve conduction velocity was observed in smokers in comparison to non-smokers. An almost similar finding was reported by other authors.<sup>23</sup> In contrast, Chavan et al. did not find significant changes in motor nerve conduction velocity among cigarette smokers.<sup>24</sup> This discrepancy might have occurred due to selection of study subjects with less smoking exposure.

From the neurophysiological findings of this study, it has been revealed that smoking does not cause marked axonal damage of peroneal motor fibers in young adults as there was no significant change observed in amplitude. However, it causes significant slowing of motor nerve conduction velocity. The direct mechanism responsible for this pathogenesis remains uncovered. One potential explanation would be oxidative stress induced demyelination of motor neurons. Exposure to cigarette smoke causes formation of free radicals that activate inflammatory cells which generate high levels of reactive oxygen metabolites. Therefore, smokers are subjected to an increased oxidative stress situation, which can result in an imbalance between oxidants and antioxidants.<sup>25</sup> In vitro studies found that the lipid components of myelin sheath are highly vulnerable to oxidative stress.<sup>26</sup> Therefore, it is possible that damage to myelin sheath has caused the reduction in axonal conductivity. Moreover, the literature strongly suggests that cigarette smoke accelerates early onset atherosclerosis and thrombus formation in adolescents and young adults.<sup>27</sup> Diminished blood supply and oxygen delivery to the nerve fibers cause neural ischemia.<sup>28</sup> It has been reported that neural ischemia can directly reduce nerve conduction velocity.<sup>29</sup>

## Conclusion

From the electrophysiological evidence of this study, it can be concluded that chronic cigarette smoking causes significant impairment of common peroneal motor nerve conduction. Therefore, nerve conduction studies could be helpful for early detection of peripheral motor nerve dysfunction in young smokers. However, the amplitude is not influenced by smoking in young individuals.

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