Original Research Article

Effect of obesity on median and ulnar nerve conduction parameters

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Abstract

Background: The World Health Organisation(WHO) labelled obesity as obviously visible, but most neglected public health concern. Consumption of junk food, sedentary lifeand lack of physical exercise are the main factors causing a tremendous rise in incidence of obesity. Obesity is associated with many systemic diseases like Type 2 Diabetes mellitus, cardiovascular diseases, peripheral neuropathy etc., among the peripheral neuropathies is the most neglected complication. Obesity is an independent risk factor that influences prevalence of carpal tunnel syndrome and peripheral neuropathy. Therefore, this study is aimed at studying the effect of obesity on nerve conduction. **Aim:** To assess the effect of obesity on nerve conduction parameters of median and ulnar nerves in obese cases and controls. **Materials and Methods**: 100 healthy individuals, among them 50 had BMI (Body Mass Index) < 25 (controls) and 50 had BMI >25 (cases), were recruited for the study. The Latency(ms), nerve conduction velocity (m/s) and amplitude of median and ulnar nerves recorded and compared between obese and non-obese.**Results:** There was a significant increase in latency, reduction in amplitude and no change in conduction of velocity in obese individuals compared to non-obese individuals. **Conclusion:** The results show that obesity causes significant alteration in nerve conduction parameters indicating early signs of subclinical neuropathy. Hence early screening and lifestyle changes may be recommended to prevent neuropathy.

Keywords:BMI, obesity, peripheral neuropathy

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Introduction

Obesity is a medical condition with abundant adipose tissue mass having a multifactorial aetiology[1]. It has become a growing health concern in both developed and developing countries[2]. WHO recognised Obesity as aglobal epidemicsince 1997. Globally, 650 million people are found to be obese.

In India, 135 million people are found to be obese among them 12.1% are males and 16% are females.Body Mass Index(BMI) acts as an important parameter to gauge obesity and it is an indirect measure of adiposity[3]. WHO recommends BMI values as cut off points for classifying obesity[4]. BMI of≥ 30 is considered to be obese.

Unhealthy lifestyle practices and food habits are the main factors leading to the occurrence of obesity. It has been found to cause numerous alterations in hemodynamic and metabolic systems thereby affecting normal functioning of many organs[5,6].Itis a major risk factor for Type 2 diabetes, cardiovascular diseases, and is also an established risk factor for chronic kidney disease, heart failure, peripheral neuropathy and cancer. It is one of the most predominant and independent risk factors for peripheral neuropathy.

In India, 2400 person out of 10000 persons have been found to be affected with peripheral neuropathy.[7]Many systemic conditions like diabetes, thyroid disorders and amyloidosis may lead to peripheral neuropathy[7]. High BMI is anestablished risk factor for ulnar neuropathy and carpal tunnel syndrome.The functional status of peripheral nerves can be assessed using Nerve conduction studies which are simple electrophysiological tests. It aids in differentiating and diagnosing two main peripheral neural disease namely demyelination and axonal degeneration[8,9]. Conduction time prolongation is seen in demyelination and nerve potential amplitude is decreased in axonal degeneration[10-12]. The present study was done to establish the influence of obesity on nerve conduction parameters of median and ulnar nerves in obese and normal individuals.

Materials and methods

Clearance from Institutional Human Ethics committee was obtained. Study was conducted for a period of 6 months from June 2019 to December 2019. This Cross-sectional study wasdone in general population by random sampling.50 healthy volunteers with normal BMI and 50 healthy volunteers with BMI more than 25, in the age group of 18-40 years of both genders were chosen for study.

The subjects with Diabetes mellitus, Hypertension, IHD, Renal failure, Liver disease, Thyroid disorder, Leprosy, Tuberculosis, Raynaud, Amyloidosis, Pregnancy, Alcoholic abuse, Smoking or those who were on any medications causing neuropathy as adverse effect were excluded from the study.

A brief explanation of procedure was given andinformed and written consent was taken. An Interviewer administered questionnaire was used to get basic information of volunteers. Basic anthropometric measurement was taken. BMI was calculated and the volunteers were divided into cases and controls. The study participants were taken to the Research laboratory of department of Physiology to record Nerve conduction parameters. The participants were made to lie down comfortably in supine position on the bed.Nerve conduction parameters were recorded using RMS EMG EP Mark-II equipment.

Machine settings

The duration was kept 100µs, filter was between 2Hz-5KHz and sweep speed was 5ms/D for motor nerve study of upper limb. The duration was 100 µs with filter of 2ms/D and sweep speed was 20-3KHz for sensory nerve study of upper limb.

Placement of electrodes

The recording and reference electrode were placed using belly tendon montage. Stimulation sites: The motor stimulation sites were the wrist and elbow and the recording sites were motor point of abductor pollicis brevis and abductor digitiminimi for median and ulnar nerves respectively. Reference electrode was placed 4cm distally over 1st metacarpophalangeal joint and over 5th metacarpophalangeal joint for median and ulnar nerve respectively.

Parameters recorded

Latency (ms), Nerve conduction velocity (m/s) and amplitude(mV)

Statistical analysis

The data collected were first noted in Microsoft Excel sheet and later were statistically analysed using the SPSS 16.0 version. The baseline characteristics between cases and controls were compared using chi-square test. The correlation between obesity and NCS variables were assessed by student's 't'-test. A p value of <0.05 were considered to be statistically significant.

Results

Table 1 representsthe baseline characteristics of the study participants. The average age was 32.3±4.5 in the study population. Among the 100 participants, 55 were males and 45 were females.

Table 1 :Baseline characteristics of study participants

Variable	Study (Obese) N = 50	Comparison (Normal BMI) N = 50	Total N = 100
Age(years)	32 ± 4.4	32.6 ± 4.6	32.3 ± 4.5
Gender **Male** **Female**	 29 (58%) 21 (42%)	 26 (52%) 24 (48%)	 55 (55%) 45 (45%)
Weight(in kg)	70.5 ± 8.7	57.3 ± 5.2	63.9 ± 9.7
Height(in cm)	57.4 ± 5.14	166.8 ± 5.13	157.4 ± 5.1
BMI (kg/m2)	33.4 ± 2.5	23.1 ± 1.43	25.7 ± 3.3

Table 2: Motor and sensory parameters of ulnar nerves in both groups. The latency was prolonged and amplitude was reduced significantly in the obese group when compared to non-obese group. No significant difference in nerve conduction velocity was found.

Table 2: Motor and Sensory parameters of ulnar nerves

SENSORY NERVE CONDUCTION					
PARAMETER	**STUDY GROUP**		**COMPARISON GROUP**		**P value**
	RIGHT	**LEFT**	**RIGHT**	**LEFT**	
Latency (ms)	3.53 ± 0.61	3.38 ± 0.34	2.45 ± 0.13	2.46 ± 0.22	**<0.001**
Amplitude(mV)	5.87 ± 0.72	5.81 ± 0.14	7.51 ± 0.23	7.55 ± 0.17	**<0.001**
NCV(m/s)	49.73 ± 1.64	49.72 ±2.01	53.6 ± 0.71	53.2 ± 1.01	**0.812**
MOTOR NERVE CONDUCTION					
Latency (ms)	3.31 ± 0.31	3.37 ± 0.52	2.84 ± 0.17	2.83 ± 0.13	**<0.0001**
Amplitude(mV)	4.95 ± 0.65	4.88 ± 0.74	6.51 ± 0.33	6.52 ±0.23	**<0.001**
NCV(m/s)	52.59 ± 2.3	52.52 ± 2.03	54.45 ± 0.82	54.05 ±0.91	**0.369**

Table 3: Motor and sensory parameters of median nerves in both groups. The latency was prolonged and amplitude was reduced significantly in the obese group when compared to non-obese group. No significant difference in nerve conduction velocity was found.

Table 3: Motor and sensory parameters of median nerves

SENSORY NERVE CONDUCTION					
PARAMETER	**STUDY GROUP**		**COMPARISON GROUP**		**P value**
	RIGHT	**LEFT**	**RIGHT**	**LEFT**	
Latency (ms)	3.3 ± 0.78	3.26 ± 0.64	2.44 ± 0.16	2.49 ±0.13	**<0.001**
Amplitude(mV)	7.8 ± 0.85	7.76 ±0.88	9.5 ± 0.32	9.5 ± 0.41	**<0.001**
NCV(m/s)	52.5 ± 2.2	52.62±2.4	54.4 ± 0.81	54.1 ± 0.66	**0.1769**
MOTOR NERVE CONDUCTION					
Latency (ms)	4.31 ± 0.40	4.48 ± 0.32	3.8 ± 0.15	3.8 ± 0.21	**<0.001**
Amplitude(mV)	4.12 ± 1.09	4.04 ±1.12	7.3 ± 0.28	7.2 ±0.19	**<0.001**
NCV(m/s)	52.9 ± 2.16	52.8 ± 2.34	53.9 ± 0.56	54 ±0.01	**0.1330**

Discussion

The present study compared the nerve conduction parameters of upper limb nerves between obese and non-obese individuals. The results showed a significant prolongation of latency, reduction in amplitude and no significant difference in conduction velocity, in the obese group compared to non-obese group.Similar results were reported in the study conducted by Pawar MS et al[9]. Study done by deshmanes et al[14] also showed significant difference in latency and amplitude among obese. Radecki et al[14,15] reported a prolongation of median nerve latency with increasing BMI.

Buschbacher RM et al[17]observed that there was no latency decrease with higher BMI in median nerve. They proposed that this might be due to the fact that median nerve is independent of the subcutaneous fat thermal insulation to maintain the perineural temperature as it is found in deeper location. They also reported no significant association between BMI and nerve conduction variables. Nair DS et al[2] and Baqai HZ et al[18] also proposed that there is no association of nerve conduction variables with BMI.In contrast to this study, Awang et al[10]study reported a slowing in conduction velocity with increasing BMI.

In general, the Nerve conduction velocity which is the transmission time in largest myelinated fibres, is mainly a reflection of myelin sheath integrity. Amplitude mainly depends on number of functioning axons. Thus the amplitude measurement has been made an important tool for evaluating neuropathy and axonal dysfunction.

In this study, the NCV remains in normal range possibly due to intact myelin sheath and epineural adipose accumulation which does not interfere with conduction. In contrast to this, Dumitru et al[19] described that in obese individuals, epineural adipose tissue abundance acts as better insulator of nerves, conducting impulses more rapidly. Also, amplitude &

latency were found to change significantly with BMI in this study. Thicker subcutaneous tissue in obese might be attributed for the attenuation in amplitude. Obesity has become one of the risk factors causing metabolic derangement[20]. Alteration in Nerve cell metabolism mainly on Na-K channels found in the Nodes of Ranvier might be the reason for prolongation of latency[21].

Accumulation of adipose tissue predominantly in carpal tunnel or volar sheaths of upper limb leads to compression of median and ulnar nerves. This compression produces axonal injury causing decrease in both axonal fibres number and stimulated fibres number. Thus the decrease in functioning axons number may be attributed to the latency prolongation and amplitude reduction in this study.

Conclusion

This study shows that in obese subjects in both median and ulnar nerves, there is increase in latency, decrease in amplitude and no change in the conduction velocity. All the three findings are sign of subclinical neuropathy. Nerve conduction study which is a simple primary test to assess the both physiological and pathological status of peripheral nerves, can be done as an early screening of peripheral neuropathy in obese individuals. Thereby early measures like lifestyle modifications can be made to prevent peripheral neuropathy in obese individuals.

Limitation

This study was carried out in small sample size. Age and gender were not matched in study population. Further study with large population for a long duration may be done to obtain better results.

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Conflict of interest: Nil

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