ORIGINAL ARTICLE

AGE RELATED CHANGES IN ULNAR AND MEDIAN NERVE CONDUCTION PARAMETERS: A CROSS SECTIONAL STUDY

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Background: Nerve conduction study (NCS) is an important method to assess integrity of peripheral nervous system. It helps in diagnosis, treatment and prognosis of diseases of peripheral nerves. Nerve conduction study parameters, like conduction velocity (NCV), latency and amplitude are affected by several different physical factors like temperature, demography, and ethnicity. It can also be affected by age, gender, height, weight, and BMI. This study was conducted to find out the age-related changes in median and ulnar nerve conduction parameters. **Methods:** This was a cross-sectional study with a total of 75 participants 40–70 years of age, conducted at Khyber Medical University, Peshawar, from July 2021 to July 2022. Participants were divided into three groups: 40–50 years, 51–60 years, and 61–70 years. The inclusion criteria were normal neurological examination, normal blood sugar, urea, creatinine, LFTs and ESR. Pregnant women and patients with bleeding disorders were excluded from study. NCS was recorded on Nihon Kohden Neuropack. Data was analysed using SPSS-22. One-way ANOVA with Tukey Post Hoc analysis for multiple group comparisons was done between groups. **Results:** There was a decline in nerve conduction study parameters associated with advancing age ($p<0.05$). The amplitude of both nerve impulses decreased while latency increased with advancing age. There was decline in motor and sensory NCV with advancing age. **Conclusion:** The nerve functioning decreased with advancing age. This decline was more marked in motor conduction compared to sensory conduction.

Keywords: Median nerve, Nerve conduction, Nerve conduction velocity, Ulnar nerve

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INTRODUCTION

Electrodiagnostic (EDX) studies are an important tool for diagnosis and evaluation of neuromuscular disorders.[1] These studies include nerve conduction studies (NCS) and needle electromyography (EMG). The basic principle of nerve conduction study is to apply an external electrical pulse that produces a propagated nerve action potential (NAP) which can be recorded at a distal point in the same nerve. The NAP produces a compound muscle action potential (CMAP) which arises from activation of muscle fibres of a specific muscle. Sensory action potential is recorded in the form of Sensory Nerve Action Potential (SNAP). These potentials can be recorded with the help of a needle or surface electrodes.[2]

Neurological disorders are most common in old age which are responsible for about 50% debility after 65 years of age. There is a profound effect of aging on peripheral nerve structure and function. Central Nervous System being protected by blood brain barrier is less vulnerable to environmental insults than Peripheral Nervous System which is more likely to be affected by trauma, injury and infections.[3]

The nerve fibres are basically composed of axons and myelin sheath, therefore, the decline in nerve function is also attributed mainly to these two factors although there may be other contributing factors present as well like non-neural cells and nutritional factors like vitamin B_{12} deficiency and vitamin E deficiency.[4] Alterations in myelin sheath can cause decline in nerve conduction velocity. With advancing age, there may be decreased number of functional axons which leads to decline in amplitude of CMAP or SNAP.[5]

The proportion of elderly population over 50 years is rising especially in developed countries due to improvement in life expectancy, it is therefore important to identify the disease early and screen for curable causes.[6] Polyneuropathy affects about 7% of elderly population and NCS is the most important tool to diagnose polyneuropathy.[7]

We don't know how much decline occurs in NCS parameters with advancing age in our population. We are still applying values of US, Europe and Canada on our population. This study will help to assess the NCS values and age related changes in ulnar and median nerve conduction parameters in our population.

METHODOLOGY

It was a cross-sectional study with a sample size of 75 who were selected through consecutive sampling. The sample size was calculated through STAT UBA (Used Better than Aged) by keeping the power of 0.80 and α value of 0.05.[8] The study was approved from ASRB and KMU Ethical Board (Reference No. DIR/KMU-EB/AR/000532) and was carried out at Institute of Basic Medical Sciences, KMU Peshawar from July 2021 to July 2022.

The participants were divided into 3 groups of 25 each based on age. Group I were aged 40–50 years, Group II were 51–60 years, while Group III were 61–70 years old. Those people were included in the study who had no confounding medical or surgical illness like diabetes or hypertension, no history of previous upper limb injury/myopathy/ neuropathy. Pregnant women, people aged >70 or <40 years, those with bleeding disorders or on anticoagulant therapy and patients with compression symptoms of median or ulnar nerve were excluded from the study.

The nerve conduction studies were performed on Nihon Kohden Neuropack M1 EP/EMG measuring system MEB-9200/MEB-9300. Temperature was set at 25 °C (room temperature). The sensory and motor nerve conduction studies were recorded for both median and ulnar nerves both proximally (elbow) and distally (wrist) in the forearm at standard sites as specified by American Association of Neurological and Electrodiagnostic Medicine (AANEM). Specific software compatible with the NC electrodes was used for recording nerve conduction parameters.[9]

Demographic parameters, blood parameters (CBC, Fasting blood sugar, LFTs, RFTs, ESR) and NCS parameters were entered and analysed using SPSS-22. The nominal variables were looked for frequencies and percentages while numerical variables were analysed for Mean±SD. The data were normally distributed as checked by Shiparo Wilk test. The different groups were compared with each other using One-way ANOVA followed by Tukey Post Hoc analysis for multiple group comparisons.

RESULTS

The mean age of the study participants was 53.83±8.33 years including 32 women and 43 men being 42.66% and 57.33% respectively. Mean height, weight and BMI and their comparative studies of different groups have been described in Table-1.

Table-2 shows comparison of median motor nerve conduction parameters. There is a significant difference between group I and III and group II and III.

Table-3 shows comparison of three groups for ulnar motor nerve conduction parameters. There was no significant difference in right ulnar motor nerve conduction parameters. The only significant difference was between group II and III in amplitude at elbow (p=0.032). Other results were insignificant.

Table-4 shows comparison of study groups for median sensory nerve conduction parameters. There were significant differences between group I and group III.

Table-5 shows comparison of study groups for ulnar sensory NCS parameters. Here a few significant differences were seen between group I and group III.

Table-1: Comparative studies of demographic parameters

	Mean±SD			*p*		
	Group I	**Group II**	**Group III**	**Group I *vs* II**	**Group I *vs* III**	**Group II *vs* III**
Height (Cm)	162.22±9.36	163.0± 7.43	162.76±7.04	0.930	0.96	0.99
Weight (Kg)	73.74±13.55	71.37±10.05	72.64±10.55	0.747	0.93	0.91
BMI (Kg/m^2)	27.74± 3.9	26.82± 4.0	27.38± 3.1	0.659	0.93	0.85

Table-2: Comparison of Group I, II and III for Median Motor Nerve conduction parameters

	Mean±SD			*p*		
	Group I	**Group II**	**Group III**	**Group I *vs* II**	**Group I *vs* III**	**Group II *vs* III**
Right median motor nerve conduction parameters (wrist)						
Latency (ms)	3.29±0.35	3.44±0.36	3.77±0.51	0.38	0.000*	**0.021***
Amplitude (mV)	10.12±2.4	9.76±2.4	8.07±2.09	0.83	0.007*	**0.031***
Right median motor nerve conduction parameters (Elbow)						
Latency (ms)	7.45±0.6	7.75±0.52	8.06±0.745	0.20	0.003*	0.20
Amplitude (mV)	9.58±2.6	9.17±2.19	7.52±2.41	0.81	0.10	0.05
NCV (m/s)	56.08±3.9	54.68±3.55	54.64±4.13	0.41	0.39	1.00
Left median motor nerve conduction parameters (Wrist)						
Latency (ms)	3.16±0.32	3.34±0.32	3.5±0.52	0.25	0.009*	0.32
Amplitude (mV)	10.38±2.54	9.98±2.43	7.66±1.98	0.82	0.000*	**0.002***
Left median motor nerve conduction parameters (Elbow)						
Latency (ms)	7.21±0.61	7.55±0.49	7.71±0.85	0.18	0.027*	0.67
Amplitude (mV)	9.9±2.42	9.52±2.49	7.28±2.56	0.84	0.001*	**0.006***
NCV (m/s)	57.38±4.19	56.1±3.75	55.95±5.49	0.58	0.51	0.99

Table-3: Comparison of Group I, II and III for ulnar motor nerve conduction parameters

	Mean±SD			*p*		
	Group I	Group II	Group III	Group I *vs* II	Group I *vs* III	Group II *vs* III
Right ulnar motor nerve conduction parameters (Wrist)						
Latency (ms)	2.38±0.25	2.46±0.33	2.47±0.37	0.60	0.57	0.99
Amplitude (mV)	9.22±1.4	9.7±2.35	8.76±1.58	0.61	0.65	0.17
Right ulnar motor nerve conduction parameters (Elbow)						
Latency (ms	6.42±0.58	6.6±0.49	6.64±0.72	0.57	0.43	0.97
Amplitude (mV)	8.72±1.62	9.02±2.45	8±1.68	0.85	0.39	0.16
NCV (m/s)	56.52±5.16	55.88±4.68	56.04±5.94	0.90	0.94	0.99
Left ulnar motor nerve conduction parameters (Wrist)						
Latency (ms)	2.42±0.34	2.5±0.26	2.46±0.38	0.67	0.93	0.87
Amplitude (mV)	8.98±1.5	9.32±2.12	8.37±1.55	0.76	0.43	0.13
Left ulnar motor nerve conduction parameters (Elbow)						
Latency (ms)	6.28±0.75	6.46±0.5	6.55±0.82	0.65	0.38	0.89
Amplitude (mV)	8.11±1.64	8.85±2.03	7.57±1.57	0.30	0.52	**0.032***
NCV (m/s)	59.43±6.21	58.71±3.97	57.13±5.9	0.88	0.30	0.56

Table-4: Comparison of Group I, II and III for right median sensory nerve conduction parameters

	Mean±SD			*p*		
	Group I	Group II	Group III	Group I *vs* II	Group I *vs* III	Group II *vs* III
Right median sensory nerve conduction parameters						
Latency (ms)	2.38±0.27	2.58±0.38	2.89±0.49	0.17	**0.000***	**0.01***
Amplitude (µV)	34.55±14.2	30.46±11.2	22.65±9.57	0.44	**0.002***	0.05
NCV (m/s)	58.99±6.6	55.35±8.2	49.87±8.14	0.22	**0.000***	**0.03***
Left median sensory nerve conduction parameters						
Latency (ms)	2.29±0.25	2.51±0.34	2.64±0.38	0.05	**0.001***	0.33
Amplitude (µV)	40.7±15.85	34.31±12.04	26.81±9.09	0.18	**0.001***	0.09
NCV (m/s)	61.24±6.39	56.82±7.83	54.65±7.92	0.09	**0.007***	0.55

Table-5: Comparison of Group I, II and III for ulnar sensory nerve conduction parameters

	Mean±SD			*p*		
	Group I	Group II	Group III	Group I *vs* II	Group I *vs* III	Group II *vs* III
Right ulnar sensory nerve conduction parameters						
Latency (ms)	1.97±0.32	2.08±0.4	2.12±0.28	0.60	0.40	0.94
Amplitude (µV)	38.95±17.98	33.12±11.36	28.5±14.8	0.35	**0.04***	0.52
NCV (m/s)	60.56±7.83	57.45±8.4	59.59±12.7	0.50	0.93	0.72
Left ulnar sensory nerve conduction parameters						
Latency (ms)	1.96±0.23	2.04±0.23	2.23±0.43	0.67	**0.01***	0.08
Amplitude (µV)	39.8±20.1	37.24±16	29.84±14.3	0.85	0.10	0.28
NCV (m/s)	60.35±5.93	57.06±5.51	56.88±9.77	0.25	0.22	0.99

DISCUSSION

The nerve conduction parameters decline with advancing age which was significant in all the groups but mostly seen between group I and III (40–50 years *vs* 61–70 years). It was found that amplitude of CMAP and SNAP declined with advancing age. Similar findings were observed by Loewenbrück KF *et al*, who found out that there was a decline in median and ulnar peak sensory amplitudes during four years follow-up study.[10] As amplitude is representative of total number of functioning axons in a nerve fibre, the decrease in amplitude may be attributed to decline in number or function of nerve axons with advancing age.[11] Increasing age is also associated with peripheral oedema and increase in skin resistance which might be the reason behind low amplitudes with advancing age.[12] There was also an increase in sensory and motor latency of both the median and ulnar nerve with advancing age which means there is more delay in transmission of nervous signals to the nerve fibre with advancing age. This is in accordance with a study conducted by Singh R *et al* who showed similar results.[8] This may be due to many factors like alterations in myelin sheath (myelin figures/myelin balloons), loss of nerve fibres, decreased neurotransmitters.[13]

In the present study, the median and ulnar nerve conduction velocities also showed decline with advancing age. This finding is similar to a follow-up study in which it was found out that ulnar sensory NCV declined at a rate of 0.14 m/s per year while median sensory NCV declined at a rate of 0.21 m/s per year.[14] Falco *et al*[15] reported a 10% decline in NCV over 60 years of age. In another longitudinal study on median and ulnar sensory nerves Suthar HR *et al*[16] demonstrated that median sensory NCV declined at a rate of 0.29 m/s while ulnar sensory NCV declined at a rate of 0.42 m/s per year. They also reported a decline in both sensory and motor NCV of median and ulnar nerves in aging study groups.[16]

Fong *et al*[17] did NCS on different ethnicities for effect of demographic and physical factors on NCS

parameters, it was seen that advancing age was associated with reduced motor as well as sensory nerve conduction velocities.[17] As NCV is the measure of degree of myelination of peripheral nerve fibres, the decline in NCV with advancing age may be due to loss of myelinated nerve fibres.[18]

CONCLUSION AND RECOMMENDATIONS

The age-related changes are more marked in median nerve than ulnar nerve. More accurate results could have been obtained by following the same study population and having a large sample size. Further longitudinal studies are needed to determine the rate at which NCS parameters decline with advancing age.

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