RESEARCH ARTICLE

Influence of aging on nerve conduction properties in healthy individuals: A cross-sectional study

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ABSTRACT

Background: Nerve conduction study (NCS) is the most sensitive test to measure electrical activity in peripheral nerve. The conduction velocity of the nerve depends on physiological factors such as age, gender, temperature, and height. Aging is accompanied by reduction in nerve conduction velocity, rate decrease in muscle contractility, and alteration in muscle metabolism and neuromuscular junction. Aim and Objective: The main objective of the present study was to access the effect of aging on nerve conduction velocity. Materials and Methods: The study was carried out at the assure electrodiagnostic center, Ahmedabad, among healthy individuals of age group 21–80 years. The motor NCS was performed for median, peroneal, tibial, and ulnar nerves. Analyzation of the data of distal motor latency, motor nerve conduction velocity, and compound muscle action potentials from the distal stimulation was done for all subjects. Results: Males had significantly taller height (162.3 ± 3.6 cm) and more weight (69.2 ± 5.8 kg) than females (height: 154.5 ± 10.2 cm, P < 0.05; weight: 53.5 ± 5.8 kg, P < 0.05). Amplitude of lower limb nerves was also significantly decreased with increasing age (P < 0.05). With increasing age, significant slowing of conduction velocity was observed in median and ulnar nerve, common peroneal and tibial nerve. Conclusions: Age can affect amplitude and conduction velocity of motor nerve. With increasing an age, there is declining trend of conduction velocity and amplitude of motor nerve. Further researches are needed to clarify the trend of latency with increasing age.

KEY WORDS: Age; Amplitude; Velocity; Latency

INTRODUCTION

Nerve conduction study (NCS) is the most sensitive test to measure electrical activity in peripheral nerve.[1] It involves recording of the evoked compound muscle action potential (CMAP) and the sensory nerve action potential.[2] The median, radial, ulnar, common peroneal, sural, and tibial nerves are the commonly examined nerves.[3] The results of this test are expressed as conduction velocities, amplitudes, and distal latencies.[2]

The degree of myelination, fiber diameter, and the intermodal distance affect the nerve conduction velocity. Age, gender, temperature, and height like physiological factors also affect it.[4] In the newborn, the sensory and motor conduction velocities were 40–50% of adult range, and at the age of 3 years, it is similar to adult values shown by the studies.[5] Alteration in muscle metabolism and neuromuscular junction, slowing of muscle contractility, and reduction in nerve conduction velocity are accompanied...
with aging.\[^{[6]}\] Due to wasting in proximal limb muscles as well as the small muscles of the hand, there is a decline in muscular performance with advancing age. Factors such as malnutrition, circulatory impairment, and disuse\[^{[3]}\] reported insignificance of decline in conduction velocity with age. It is agreed on that aging alters nerve conduction studies, but still it does not clearly define at which age group, these changes may occur.\[^{[7]}\] The main objective of the present study was to access the effect of aging on nerve conduction velocity in healthy individuals.

**MATERIALS AND METHODS**

The study was carried out during January 2020–March 2020 at the assure electrodiagnostic center, Ahmedabad. The healthy individuals of age group 21–80 years were included in the study.

**Exclusion criteria**

1. Any individual suffering from hypertension, diabetes, thyroid disorder, and renal disorder.
2. Any individual with a history of neuromuscular transmission disorder, smoker, alcoholics, obesity, and leprosy were excluded from this study.
3. Any individuals taking medicine affecting nervous system.
4. Subjects who denied consent.

Every participant was informed and consent taken. Then, after 30 min rest, the examination was performed in a calm environment. Study participants were divided into three age groups: Group I (21–40 years) \(n = 33\), Group II (41–60 years) \(n = 36\), and Group III (>60 years) \(n = 31\). Subjects were made comfortable and the procedure was explained properly. Personal and family history was taken properly. General and systemic examinations were done properly in detail.

**NCS**

The motor NCSs were performed for median, ulnar, common peroneal, and tibial nerves using the “RMS-EP-MARK II” machine. Filters were set at 2–5 Hz. Sweep speed was 5 ms/division for motor study. Temperature at 27–30°C was maintained constantly in the study room.

**Measurement of nerve conduction velocity**

Data of latency, NCV, and CMAPs with the distal stimulation were analyzed accurately for all the subjects. The time from the stimulus to the initial CMAP deflection of the baseline is latency. The amplitude of CMAPs was measured from the baseline to the highest negative point. In the study, surface electrodes were used. Aseptic precautions were taken to prepare skin, the recording electrodes were fixed to the subjects skin with adhesive tapes.

Supramaximal stimulus was given to the targeted nerve with current duration of 0.2 ms with the stimulator, and the action potential was recorded by the electrode. Each nerve’s length was measured by a flexible measuring tape. For safety reasons, in between the stimulating and recording electrodes, ground electrode was placed. The sites for stimulation of different nerves are shown in Table 1.

**Statistical analysis**

The data were entered into Microsoft Excel 2010 spreadsheet and analyzed using EPI INFO Ver.7 software. Quantitative data were shown in mean ± standard deviation and qualitative data in frequency and percentage (%). One-way ANOVA and Z test were applied to find out the outcome. Apparently, “\(P\) < 0.05” was considered as statistically significant.

**RESULTS**

In the present study, 100 subjects were included of different age groups (<20–80 years). Out of 100 subjects, 67 were male and 33 were female. All subjects were categorized in three groups: (a) 21–40 years, (b) 41–60 years, and (c) more than 60 years. Table 2 shows gender-wise distribution of height and weight. Males had significantly higher height \( (162.3 ± 3.6\) cm) and weight \((69.2 ± 5.8\) kg) than females \( (height: 154.5 ± 10.2\) cm, \( P > 0.05; \) weight: 53.5 ± 5.8 kg, \( P > 0.05)\).

Table 3 shows nerve conduction properties for median, ulnar, common peroneal, and tibial nerve for different age groups. With increasing age, latency was increased in median nerve,
ulnar nerve, common peroneal nerve, and tibial nerve but it was not statistically significant ($P < 0.05$).

Amplitude of lower limb nerves (common peroneal nerve and tibial nerve) was also significantly decreased with increasing age ($P > 0.05$). Decline trend of amplitude in upper limb nerve was also observed but statistically not significant ($P < 0.05$). From 21–40 years to >60 years age group subjects, amplitude was decreased by 4.4% (wrist), 4.7% (elbow) in median nerve, 12.3% (wrist), 9.5% (elbow) in ulnar nerve, 25.5% (ankle), 18.5% (fibular head) in common peroneal nerve, and 13.3% (medial malleolus) and 15.8% (popliteal fossa) in tibial nerve.

Mean velocities for median, ulnar, tibial, and common peroneal nerve were as follows: 57.38 ± 1.72 m/s, 57.45 ± 1.30 m/s, 47.49 ± 2.52 m/s, and 48.07 ± 3.67 m/s, respectively. With increasing in age, significant slowing of conduction velocity was observed in median and ulnar nerves. Similar trend was observed in common peroneal and tibial nerves. From 21–40 years to >60 years age group subjects, latency was increased by 4.8% for median nerve, 6.4% for ulnar nerve, 15.3% common peroneal nerve, and 5.8% for tibial nerve.

**DISCUSSION**

A NCS is commonly used and thoroughly validated test to assess the motor and sensory nerves function.[6] NCSs are influenced by many factors such as age, height, gender, and body mass index.[8-12] Aging is associated with impaired body functions, loss of adaptation to stress, and senile diseases. Patients with old age have distal latency lengthier, smaller CMAP, decreased NCV due to decreased number of nerve fibers, reduction in nerve’s diameter, and change in membrane of fibers due to aging.[9,13]

In the present study, decline trend of conduction velocity with increasing age was observed in median, ulnar, peroneal, and tibial nerve. Conduction velocity for median nerve was significantly decreased from 58.9 ± 3.2 m/s to 56.1 ± 1.0 m/s in 20–40 years age group to more than 60 years age group. In the study of Senthilkumari et al., conduction velocity was significantly decreased from 59.47±3.3 to 52.8±4.3 in 15–30 years age group to 45–60 years age group.[6] Awang et al. also observed that significant reduction in motor conduction velocity as age increases (Motor conduction velocity from age group 20–29 to 50–59 years: Median nerve

<table>
<thead>
<tr>
<th>Nerve</th>
<th>20–40 (n=33)</th>
<th>41–60 (n=36)</th>
<th>&gt;60 (n=31)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median nerve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latency at wrist</td>
<td>3.40 ± 0.52</td>
<td>3.51 ± 0.50</td>
<td>3.82 ± 0.60</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Latency at elbow</td>
<td>7.12 ± 1.63</td>
<td>7.34 ± 1.53</td>
<td>7.63 ± 1.62</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at wrist</td>
<td>7.80 ± 1.23</td>
<td>7.62 ± 1.45</td>
<td>7.46 ± 2.01</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at elbow</td>
<td>7.83 ± 1.04</td>
<td>7.62 ± 1.45</td>
<td>7.46 ± 2.01</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Conduction velocity</td>
<td>58.90 ± 3.20</td>
<td>57.10 ± 1.00</td>
<td>56.10 ± 1.00</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Ulnar nerve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latency at wrist</td>
<td>2.65 ± 0.41</td>
<td>2.90 ± 0.34</td>
<td>3.10 ± 1.12</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Latency at elbow</td>
<td>5.91 ± 0.43</td>
<td>6.20 ± 0.42</td>
<td>6.42 ± 0.81</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at wrist</td>
<td>5.87 ± 1.80</td>
<td>5.54 ± 1.62</td>
<td>5.15 ± 1.12</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at elbow</td>
<td>5.66 ± 1.52</td>
<td>5.42 ± 2.11</td>
<td>5.12 ± 1.89</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Conduction velocity</td>
<td>59.10 ± 1.23</td>
<td>57.80 ± 1.26</td>
<td>55.30 ± 1.40</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Peroneal nerve</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Latency at ankle</td>
<td>3.52 ± 0.71</td>
<td>3.74 ± 0.84</td>
<td>4.12 ± 0.15</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Latency at fibular head</td>
<td>7.23 ± 1.12</td>
<td>7.76 ± 0.98</td>
<td>8.12 ± 1.49</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at ankle</td>
<td>5.30 ± 1.90</td>
<td>4.53 ± 1.82</td>
<td>3.95 ± 0.94</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Amplitude at fibular head</td>
<td>4.87 ± 0.92</td>
<td>4.25 ± 1.95</td>
<td>3.98 ± 1.67</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Conduction velocity</td>
<td>52.20 ± 1.90</td>
<td>46.00 ± 3.20</td>
<td>44.20 ± 2.50</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Tibial nerve</td>
<td></td>
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<tr>
<td>Latency at medial malleolus</td>
<td>3.98 ± 1.67</td>
<td>4.23 ± 1.87</td>
<td>4.98 ± 1.59</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Latency at popliteal fossa</td>
<td>8.65 ± 1.21</td>
<td>8.76 ± 1.98</td>
<td>8.98 ± 0.98</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Amplitude at medial malleolus</td>
<td>11.56 ± 2.38</td>
<td>10.98 ± 2.98</td>
<td>10.02 ± 1.90</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Amplitude at popliteal fossa</td>
<td>9.62 ± 2.45</td>
<td>8.99 ± 1.98</td>
<td>8.10 ± 2.01</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Conduction velocity</td>
<td>49.90 ± 3.60</td>
<td>47.30 ± 4.90</td>
<td>47.00 ± 2.50</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
In the present study, decline trend of amplitude for lower limb nerves (common peroneal nerve and tibial nerve) was demonstrated. Verdu et al. also revealed that age was correlated negatively with the amplitude in motor NCSs and velocity in motor NCS.

In the present study, latency was also increased with increasing age but statistically not significant. Due to loss of myelinated and unmyelinated nerve fibers in peripheral nerves, there is increasing latency and reduction in nerve conduction.

Factors such as malnutrition, circulatory impairment, and disuse may also be the reason for the nerve conduction delay. In the present study, association of other factors such as height, BMI, and gender was not confirmed. These factors may act as confounding factors.

CONCLUSIONS

Age can affect amplitude and conduction velocity of motor nerve. With increasing an age, there is declining trend of conduction velocity and amplitude of motor nerve. Further researches are needed to clarify the trend of latency with increasing age.

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REFERENCES


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