The Effects of Cervical Traction on the Soleus H Reflex in Stroke Patients

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Abstract. The purpose of this study was to investigate the effects of cervical traction on the soleus H reflex amplitude in stroke patients. Cervical traction with intensity of 3 kgw was performed on six stroke patients. The soleus H reflex was evoked before, during, and after the cervical traction. All subjects showed smaller H reflex amplitudes in the second and third minutes after traction than before the traction. The results suggested that cervical traction with intensity of 3 kgw inhibited the soleus H reflex amplitude several minutes after traction in stroke patients.

Key words: H reflex, stroke, cervical traction

Spasticity is a major phenomena in stroke patients. Although many approaches have been attempted, inhibiting the spasticity is difficult as yet.

Mechanical stimulation of the cervical region changes H reflex amplitudes. An inhibitory effect was observed on the soleus H reflex with head rotation to the contralateral side, as well as a contrary effect with head rotation to the ipsilateral side. This fact is compatible with a phenomenon called tonic neck reflex in which the receptors are neck muscle spindles, the joint receptors are at the upper cervical region, and the pathway is propriospinal interneuron.

Accordingly, longitudinal cervical traction, which induces mechanical stimulation of the cervical region, is also expected to have an effect on the soleus H reflex. In healthy subjects, cervical traction with intensity of 3 kgw depressed the soleus H reflex amplitude after traction and the degrees of the depression were 6% in the first minute, 7% in the second minute, and 10% in the third minute.

The H reflex amplitude is a parameter of the excitability of the monosynaptic reflex, and the change of the excitability of that reflex is a component of causes of spasticity. Through clinical observations, it has been reported that triceps surae is a muscle in which spasticity is predominantly present in patients with central nervous system dysfunctions such as stroke or cerebral palsy.

In the present study, therefore, the effects of cervical traction with an intensity of 3 kgw on the soleus H reflex amplitude were investigated in stroke patients.

Materials and Methods

The subjects were six stroke patients who had little or no intellectual problems (Table 1). The purpose of the study was explained to them, and their agreement was obtained before beginning the study.

Neuropak Σ Electromyography was used for evoking, amplifying, and recording the H reflexes. The action potentials were recorded by surface Ag-AgCl electrodes applied on the right soleus muscle with a 3 cm separation between the electrodes. The stimulus duration was 1.0 msec at a rate of 0.2 Hz. The intensity of the stimulation was at a level at which evident H waves with small M waves were present. Care was taken to ensure that impedance at the recording site was below 20 kΩ. The signal was amplified with a bandpass filter of 20 Hz to 3 kHz.

The subjects were kept in supine position. An attachment was put on their jaws, and used for pulling their neck in the longitudinal axis. Their right lower limbs were in a half-flexed position (hip angle 20 degrees, knee angle 30 degrees), and their thighs and calves were supported by sandbags so that their legs were at rest without movement artifact. Before starting the trials, the subjects were kept in bed at rest for 10
Table 1  Selected characteristics of the subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Age/Sex</th>
<th>Diagnosis</th>
<th>Months after onset</th>
<th>Paretic side</th>
<th>Br-stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76/F</td>
<td>CI</td>
<td>14</td>
<td>L</td>
<td>II</td>
</tr>
<tr>
<td>2</td>
<td>71/F</td>
<td>CB</td>
<td>21</td>
<td>L</td>
<td>III</td>
</tr>
<tr>
<td>3</td>
<td>59/M</td>
<td>CI</td>
<td>192</td>
<td>L</td>
<td>III</td>
</tr>
<tr>
<td>4</td>
<td>80/F</td>
<td>CB</td>
<td>16</td>
<td>L</td>
<td>IV</td>
</tr>
<tr>
<td>5</td>
<td>90/F</td>
<td>CI</td>
<td>84</td>
<td>R</td>
<td>IV</td>
</tr>
<tr>
<td>6</td>
<td>74/M</td>
<td>CI</td>
<td>36</td>
<td>L</td>
<td>V</td>
</tr>
</tbody>
</table>

CI, cerebral infarction; CB, cerebral bleeding; L, left; R, right.

Table 2  The changes in H reflex amplitude induced by the cervical traction

<table>
<thead>
<tr>
<th>Subjects</th>
<th>H1 (mV)</th>
<th>H2 (mV)</th>
<th>AR</th>
<th>H3 (mV)</th>
<th>AR</th>
<th>H4 (mV)</th>
<th>AR</th>
<th>H5 (mV)</th>
<th>AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.96</td>
<td>1.13</td>
<td>0.18</td>
<td>1.22</td>
<td>0.27</td>
<td>0.91</td>
<td>0.05</td>
<td>0.94</td>
<td>0.02</td>
</tr>
<tr>
<td>2</td>
<td>4.35</td>
<td>3.94</td>
<td>–0.09</td>
<td>3.02</td>
<td>0.31</td>
<td>2.97</td>
<td>0.32</td>
<td>2.72</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>0.83</td>
<td>0.65</td>
<td>–0.22</td>
<td>0.53</td>
<td>0.36</td>
<td>0.39</td>
<td>0.53</td>
<td>0.47</td>
<td>0.43</td>
</tr>
<tr>
<td>4</td>
<td>1.04</td>
<td>1.09</td>
<td>0.05</td>
<td>0.90</td>
<td>0.13</td>
<td>0.84</td>
<td>0.19</td>
<td>0.72</td>
<td>0.31</td>
</tr>
<tr>
<td>5</td>
<td>0.55</td>
<td>0.64</td>
<td>0.16</td>
<td>0.56</td>
<td>0.02</td>
<td>0.54</td>
<td>0.02</td>
<td>0.46</td>
<td>0.16</td>
</tr>
<tr>
<td>6</td>
<td>0.08</td>
<td>0.07</td>
<td>–0.13</td>
<td>0.16</td>
<td>1.00</td>
<td>0.05</td>
<td>0.38</td>
<td>0.07</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Amp., mean amplitude of H reflex; AR, amplitude ratio.

Cervical traction with an intensity of 3 kgw was examined. In the second minute of each trial under experimental conditions, cervical traction was applied for a minute. The orders of the trials were randomly assigned to each subject, and each trial lasted 5 minutes evoking 60 waves of the soleus H reflex. Each trial contained five blocks. The first minute was designated as H1 block, the second minute during which the cervical traction was applied as H2 block, the first minute after the traction as H3 block, the second minute after the traction as H4 block, and the third minute after the traction as H5 block (Fig. 1).

Data analysis

The 12 consecutive waves of each block were averaged. The M waves and the averaged soleus H reflex amplitudes were estimated peak to peak. Amplitude Ratios (ARs), defined as each block’s amplitude divided by an amplitude of H1 block and subtracted by one, were calculated. In order to monitor the stabilities of the electrical stimulation, the percentage of each block’s mean M wave amplitude (Mp) compared with mean M wave amplitude in H1 block was calculated.
Results

The mean and the standard deviation of the stimulus intensity were 11.1 and 4.5 mA, respectively. Overall mean Mₚ was 11.0%. Individual Mₚs varied from 73% to 203% among subjects. During traction, 3 subjects showed positive ARs, and others showed negative ARs (Table 2). The mean of ARs during the traction was –0.01. All of subjects showed negative ARs in H4 and H5 blocks. The mean of ARs in H4 block was –0.25, and that in H5 block was –0.24.

Discussion

Although there weren’t major changes of H reflex amplitude during cervical traction, there were large depressions after the traction. The result suggests that cervical traction with intensity of 3 kgw inhibits H reflex in the extensor muscle of the ankle joint of stroke patients after cervical traction.

An interpretation of this result is that due to stretching of the muscles around the neck reducing viscosity of polar regions of muscle spindles, afferent firing rates from the neck muscles were reduced, and this reduced the firing rate from the neck receptors, which inhibited the H reflex amplitudes. However, this explanation may not be suitable, because the response lasts for several seconds after stretching. An interpretation of this result is that due to stretching of the muscles around the neck reducing viscosity of polar regions of muscle spindles, afferent firing rates from the neck muscles were reduced, and this reduced the firing rate from the neck receptors, which inhibited the H reflex amplitudes. However, this explanation may not be suitable, because the response lasts for several seconds after stretching.

Another interpretation is that the fatigued neck muscles caused the soleus H reflex amplitudes to be small. However, the phenomenon of muscle fatigue inhibiting reflex responses has been shown to be true only for H reflexes arising directly from the fatigued muscle. The supraspinal effect is also a possible cause of the result.

The result was compatible with results for healthy subjects which are mentioned in the introduction, although the degrees of the depression were inconsistent. The degrees of depression are larger for hemiplegic patients than that for healthy subjects, but the results may not be comparable because of different experimental methodology.

A limitation of this study was the reduced stability of the M amplitude as shown in the results. Because the M amplitude was a parameter of the degree of intensity of stimulation, it could affect the soleus H reflex amplitudes. Also the short lasting trial in the present study was not enough to confirm a long lasting inhibitory effect.

Conclusion

There was inhibition of the soleus H reflex amplitude several minutes after cervical traction. The result implied the possible usefulness of cervical traction for inhibiting excitability of the monosynaptic reflex in stroke patients.

Acknowledgments. The participation of patients in this study is gratefully acknowledged.

References