Basic Study on Measurement and Analysis of Spinal Cord Evoked Potentials with invasive and non-invasive methods

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ABSTRACT

Because the spinal cord is a central nervous system like the brain, it was thought that once damaged, it could never be regenerated. However, research is now underway to transplant iPS cell-derived cells into patients with spinal cord injury, and there are high hopes for nerve regeneration. Quantitative evaluation of the degree of damage and recovery is important for spinal cord regeneration therapy. Currently, imaging and neurological diagnostic methods are used to diagnose the extent of damage. However, these methods are not able to quantitatively evaluate the degree of damage because they are largely based on the examiner's subjectivity. Therefore, we evaluated the degree of damage by measuring spinal cord evoked potentials (SCEP), which are evoked potentials that pass through the conduction pathways of spinal cord nerves. First, in order to confirm the waveform of accurately measured SCEP, we performed invasive measurements and were able to confirm the waveform measurement of invasive SCEP. For clinical application, minimally invasive measurement of SCEP from outside the body is necessary, but a method for measuring SCEP from outside the body has not been established. Therefore, we investigated the method of transcutaneous measurement of SCEP by measuring the electrode position and measured waveforms in the transcutaneous measurement of SCEP. The latency and amplitude of SCEP waveforms varied depending on the distance from the stimulation position. The SCEP waveforms did not differ between the left and right spinal cord. The posterior neck position was found to be the most suitable for measuring the scapular region. Next, we performed simultaneous invasive and non-invasive measurements, and found that the latency of the non-invasive measurement appeared at the same time as that of the invasive measurement, indicating that the waveform measured percutaneously in this experiment was also a SCEP. However, the spinal cord was exposed for the measurement, but the spinal cord was injured during the exposure, and accurate waveform measurement could not be performed.

In the measurement experiment of simultaneous invasive and non-invasive measurement, the spinal cord itself was injured when the spinal cord was exposed, so it was not possible to measure all measurement points in a single rat. Therefore, we will examine a method to measure the spinal cord without damaging it and establish a method to make model rats under the same stable conditions. In addition, we will conduct measurements using rats with spinal cord injury, compare waveforms between normal and injured rats, and establish a measurement method for spinal cord evoked potential measurement. We also aim to develop a method to quantitatively understand the status of spinal cord injury from outside the body.