Clinical Case Report

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Delayed recovery of the affected finger extensors at chronic stage in a stroke patient

A case report

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Abstract

Rationale: A 33-year-old male presented with complete weakness of the right extremities due to corona radiata infarct.

Patient concerns: The main concerns of the patient is recovery of hand function especially related to finger extension.

Diagnoses: Right corona radiata infarct.

Interventions: He underwent physical therapy and occupational therapy at the outpatient clinic of the rehabilitation department of the same university hospital until 2 years after onset. In addition, he underwent neuromuscular electrical stimulation for the right finger extensors continuously until 4 years after onset.

Outcomes: At 6 months after onset, the weakness of his right side recovered to subnormal state except for the right finger extensors which were completely weak. At 1.5 years after onset, the right finger extensors began to show slow and continuous recovery. At 4 years after onset, the patient showed motor recovery in the right finger extensors to the extent that he was able to move against gravity. Discontinuation of the left corticospinal tract was observed on 2-month diffusion tensor tractography (DTT); however, the integrity of this discontinuation had recovered to the primary motor cortex on 4-year DTT. On 2-month transcranial magnetic stimulation (TMS), no motor-evoked potential was evoked; in contrast, motor-evoked potentials were obtained at the right-hand muscle on 4-year TMS study.

Lessons: We demonstrated unusual delayed and long-term recovery of the affected finger extensors in a patient with corona radiata infarct using DTT and TMS.

Abbreviations: CST = corticospinal tract, DTI = diffusion tensor imaging, DTT = diffusion tensor tractography, ET = excitatory threshold, MEP = motor-evoked potential, MMT = manual muscle test, ROI = regions of interest, TMS = transcranial magnetic stimulation.

Keywords: diffusion tensor tractography, motor recovery, stroke, transcranial magnetic stimulation

1. Introduction

Stroke is a leading cause of major disability in adults, and motor weakness is one of the most serious disabling sequelae of stroke. Most of the motor recovery in stroke patients is known to occur within 3 to 6 months after onset and the motor recovery after 6 months has been rarely reported.[1–3] A few studies have reported on the stroke patients who showed long-term recovery over 16 to 24 months after onset.[4,5] However, in these patients, the motor recovery was started at the early stage of stroke.[4,5]

The corticospinal tract (CST), a major neural tract for motor function in the human brain, is mainly concerned with execution of movement of distal extremities.[6–10] The CST is essential for achievement of good recovery of impaired motor function in stroke patients.[6–10] Although the CST is involved in the motor control of muscles in all extremity joints, previous studies have reported that the affected finger extensors are the most representative indicator of the affected CST recovery.[11–13]

In the present study, we report on a patient with a corona radiata infarct who showed unusual delayed and long-term recovery of the affected finger extensors, using diffusion tensor tractography (DTT) and transcranial magnetic stimulation (TMS).

2. Case report

A 33-year-old, right-handed male patient presented with complete weakness of the right upper and lower extremities due to a corona radiata infarct (Fig. 1A). He was admitted and underwent comprehensive rehabilitative therapy at a local rehabilitation hospital (3 months) and a university hospital (1 month) until 4 months after onset. After discharge, he underwent physical therapy and occupational therapy at the outpatient clinic of the rehabilitation department of the same university hospital until 2 years after onset. In addition, he underwent neuromuscular electrical stimulation for the right finger extensors continuously until 4 years after onset. He was prescribed the neurotrophic drugs

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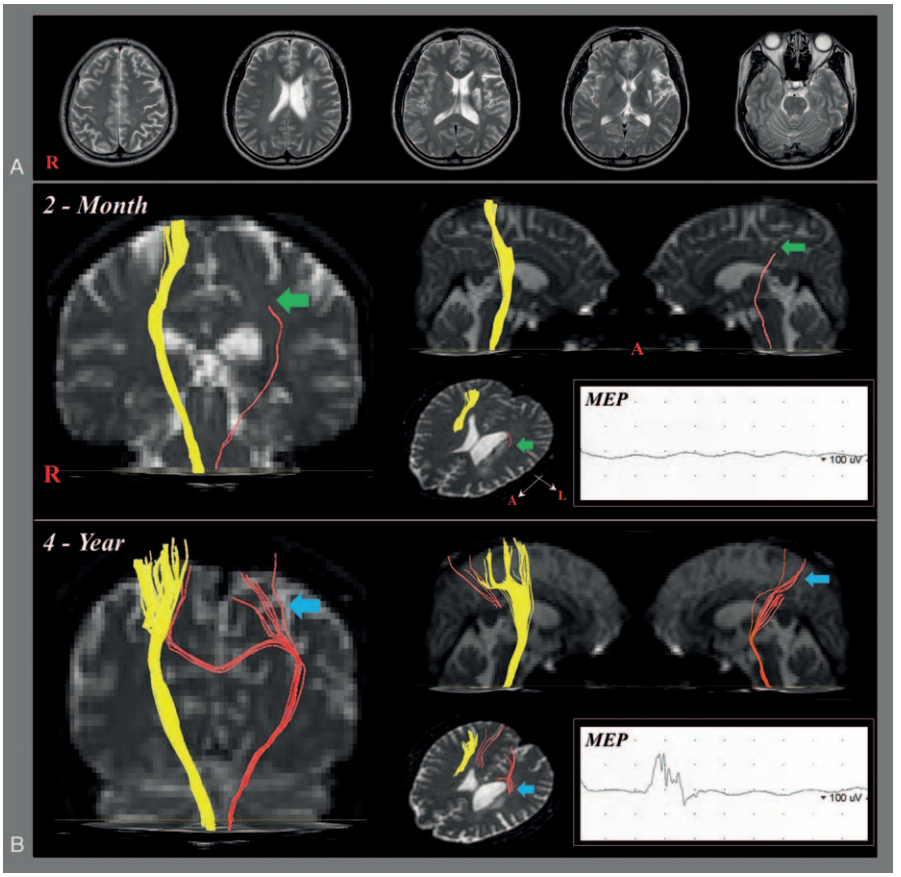

Figure 1. (A) T2-weighted images (2 mo after onset) showing an infarct in the left corona radiata. (B) Results of DTT and TMS. Discontinuation of the left CST at the corona radiata level was observed on 2-mo DTT, however, the integrity of the discontinued left CST had recovered to the primary motor cortex through the posterior area of the corona radiata infarct on 4-y DTT. No MEP was obtained from the right abductor pollicis brevis muscle on 2-wk TMS; however, MEP (latency: 22.3 ms, amplitude: 200 uV) was evoked on 4-y TMS. CST = corticospinal tract, DTT = diffusion tensor tractography, MEP = motor-evoked potential, TMS = transcranial magnetic stimulation.

(pramipexole 2 mg, amantadine 300 mg, and levodopa 375 mg) from 3 months to 12 months after onset, however, he did not take any medicine except for antiplatelet since 12 months after onset.[14] The weakness of his right side had recovered to a nearly subnormal or normal state (manual muscle test [MMT]; 4~4+) except for the right finger extensors (MMT; 0) at 6 months after onset. The right finger flexors showed mild spasticity as 1^+ on the Modified Ashworth Scale. At approximately 1.5 years after onset, the right finger extensors began to show movement with the range of 5 ft and revealed very slow and continuous recovery. At 4 years after onset, the patient showed significant motor recovery in the right finger extensors to the extent that he was able to move against gravity (MMT: 3). The grip strength of the right hand was 16 kg and Purdue pegboard scores were 1. The patient's wife provided signed, informed consent, and the study protocol was approved by Yeungnam University hospital Institutional Review Board.

3. Diffusion tensor imaging and transcranial magnetic stimulation

Diffusion tensor imaging (DTIs) were acquired 2 times (2 months and 4 years after onset) using a sensitivity encoding head coil on a 1.5-T Philips Gyroscan Intera with single-shot echo-planar imaging. Seventy contiguous slices (matrix = 128 × 128 matrix, field of view = 221 × 221 mm^2, echo time = 76 ms, repetition time = 10,726 ms, SENSE factor = 2; EPI factor = 67 and b = 600 mm^2/s; number of expectations = 1; and a slice thickness of 2.3 mm) were acquired for each of the 32 noncollinear diffusion sensitizing gradients. Fiber tracking was performed using the fiber assignment continuous tracking (FACT) algorithm implemented within the DTI task card software (Philips Extended MR Work Space 2.6.3). Each of the DTI replications was intra-registered to the baseline "b0" images to correct for residual eddy-current image distortions and head motion effect, using a diffusion registration package (Philips Medical Systems) (threshold fractional anisotropy = 0.2, angle = 50). For reconstruction of the CST, the first region of interest (ROI) was placed on the upper pons (portion of anterior blue color) on the color map with an axial image. The second ROI was placed on the mid pons (portion of anterior blue color) on the color map with an axial image. Discontinuation of the left CST at the corona radiata level was observed on 2-month DTT; however, the integrity of the discontinued left CST had recovered to the primary motor cortex through the posterior area of the corona radiata infarct on 4-year DTT (Fig. 1B).

TMS was also performed 2 times (2 months and 4 years after onset) using a Magstim Novametrix 200 magnetic stimulator with a 9-cm mean diameter circular coil (Novametrix Inc, Wallingford, United States). Cortical stimulation was performed with the coil held tangentially over the vertex. The left hemisphere was stimulated by a counterclockwise current, and the right hemisphere was stimulated by a clockwise current. Motor-evoked potentials

(MEPs) were obtained from both abductor pollicis brevis muscles in a relaxed state. The excitatory threshold (ET) was defined as the minimum stimulus required to elicit an MEP with a peak-to-peak amplitude of 50 uV or greater in 2 out of 4 attempts. Stimulation intensity was set at the ET plus 20% of the maximum stimulator output. On 2-month TMS, no MEP was evoked from the left hemisphere, even though stimulation intensity was increased to 100% of maximal output (Fig. 1B). By contrast, on 4-year TMS study, MEPs were obtained at the right abductor pollicis brevis muscles during stimulation of the left hemisphere with 100% of maximal output (the MEP of shortest latency; latency: 22.3 ms, amplitude: 200 uV).

4. Discussion

This patient showed the recovery of the affected finger extensor which indicated the CST function started since 1.5 years after onset and recovered to the extent that he was able to move against gravity at 4 years after onset. This finding was compatible with the change of DTT and TMS: the integrity of the discontinued CST at the CR infarct level on 2-month DTT was restored through the posterior peri-infarct area on 4-year DTT. 2-month TMS showed no MEP on affected hand muscle, however, 4-year MEP which has the latency of CST.

In the present study, we demonstrated unusual delayed and long-term recovery of the affected finger extensors in a patient with corona radiata infarct using DTT and TMS. This patient began to how motor recovery of the affected finger extensors at approximately 1.5 years and recovered to the extent to move against gravity until 4 years after onset. It appeared to coincide with the changes on DTT and TMS: the integrity of the left discontinued CST was restored through the posterior peri-infarct area on 4-year DTT and although no MEP was evoked at the affected hand muscle on 2-month TMS, MEP which had the latency of CST was observed at the affected hand muscle on 4-year TMS.[15] It is well known that most of the motor recovery in stroke patients occurs within 6 months after onset.[1,2] Therefore, we believe that the delayed started and long-term recovery of this patient was a unusual recovery pattern of the stroke patients and very little is known about this kind of motor recovery in stroke patients.[5] However, the limitations of this study should be considered. First, this study is a single case report. We suggest that further studies including larger number of chronic stroke patients who showed delayed motor recovery at chronic stage should be encouraged. Second, although DTI is a good anatomic imaging tool, it can produce both false positive and negative results due to the complexity and crossing fiber effect.[16] Third, further studies on rehabilitation strategies to induce or facilitate the delayed motor recovery for chronic hemiparetic stroke patients should be invited.

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