Effectiveness of rehabilitation for young patients with extensive right hemisphere cerebral infarction: A report of two cases

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Case report

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Key Clinical Message

In younger patients, including those with extensive infarction involving the anterior and middle cerebral artery regions of the right hemisphere, appropriate treatment for rare causes and goal-oriented long-term rehabilitation, such as higher brain function training, could improve severe disabilities and allow for further education and employment.

Abstract

Although the number of young stroke patients is small, many have serious sequelae and rare causes. In addition to independence in activities of daily living, education and employment are desired. We present two cases of extensive infarction in the right cerebrum in patients who underwent rehabilitation with good outcomes.

Keywords: cerebral infarction, employment, higher brain function, rehabilitation, schooling, young patients

Introduction

The occurrence of stroke differs between young and older patients. According to the Strategies Against Stroke Study for Young Adults in Japan, young patients aged <40 years with stroke account for only 2.2% of all patients; however, 26.0% of them had a modified Rankin Scale (mRS) score of 3–5 at the time of hospital
The post-hoc descriptive exploration from A Very Early Rehabilitation Trial after stroke showed that 30% of working-age stroke survivors (65 years) had a poor outcome with mRS ≥3, and 28% of them rated their quality of life as poor. Young patients with stroke commonly remain severely disabled; however, only few reports are available on their long-term rehabilitation courses.

The occurrence of cerebral infarction due to causes other than atherothrombotic cerebral infarction, cardiogenic cerebral embolism, and lacunar infarction ranges from 2.8% in older patients to 25.1% in younger patients. In younger patients, cerebral infarction due to arterial dissection, moyamoya disease, cerebral arteriovenous malformations, and antiphospholipid syndrome are more common. Therefore, younger patients sometimes experience from strokes with causes that have been poorly reported previously.

We report the cases of two young patients with extensive infarction involving the anterior and middle cerebral artery regions of the right hemisphere due to unusual causes, who underwent long-term rehabilitation from convalescent rehabilitation to school and employment with favorable results mRS 2.

Case report

Case 1

Case history

The patient was a right-handed 15-year-old boy in the ninth grade who lived with his parents and older brother and had no relevant medical history. The patient presented with a headache and left hemiplegia and was transported to the Japanese Red Cross Ashikaga Hospital. He was diagnosed with cerebral infarction of the right basal ganglia based on brain magnetic resonance imaging (MRI) and was admitted. He showed no evidence of cardiac disease, arrhythmias, vascular malformations, coagulation system abnormalities, or autoantibodies. On day 6 after onset, the right internal carotid artery was occluded, and the infarction lesion extended into the anterior cerebral artery territory. Subsequently, the patient was transferred to a university hospital and treated with immunosuppressive drugs for suspected idiopathic central nervous system vasculitis. However, the infarcted foci further expanded into the anterior and middle cerebral artery regions, and the patient underwent internal and external decompression on day 9. He underwent cranioplasty 41 days after symptom onset. Owing to a lack of evidence of vasculitis on pathological examination, arterial dissection was also suspected; however, a definitive diagnosis was difficult to make. As a rehabilitation treatment, botulinum toxin therapy was initiated in the lower extremities, and a knee-ankle-foot orthosis was fabricated.

The patient was transferred to the convalescent rehabilitation ward of the Japanese Red Cross Ashikaga Hospital 99 days after onset. He had left hemiplegia with 9 and 12 upper and lower extremity points on the Fugl-Meyer assessment (FMA), respectively; spasticity of the left ankle dorsiflexion on the modified Ashworth scale (mAS) 2; and moderate left sensory dullness. The patient had left spatial neglect on the behavioral inattention test (BIT), impaired attentional function on the trail-making tests A (TMT-A) and TMT-B, and executive function disorders on the Behavioral Assessment of the Dysexecutive Syndrome (BADS; Table 1). Furthermore, his full-scale intelligence quotient (FIQ) of the Wechsler Adult Intelligence Scale Third Edition (WAIS-III) decreased. He had no abnormal cranial nerve findings, visual field deficits, dressing apraxia, or constructional apraxia. He required minor assistance with activities of daily living (ADL) using his wheelchair and scored 85 on the Functional Independence Measure (FIM) scale. Brain computed tomography (CT) (Figure 1) revealed extensive low-density areas in the anterior, middle, and posterior cerebral artery regions of the right hemisphere.

Investigation and treatment

Brain MRIs were repeated without re-exacerbation, and immunosuppressive drugs were tapered off with no recurrence. The patient was not treated with antiplatelets or anticoagulants to prevent recurrence. Botulinum toxin therapy was continued in the lower extremities, and an Adjustable Posterior Strut-ankle foot orthosis (APS-AFO) was fabricated. He underwent conventional rehabilitation, including upper extremity
function training, gait training, ADL training, and higher brain function training, 3 h daily. His left hemiplegia improved to 27 and 22 upper and lower extremity points on the FMA, respectively. Table 1 shows the progress of the higher brain functions (HBF) evaluation. The BIT scores were above the cutoff; TMT, verbal comprehension, and perceptual organization (PO) of WAIS-III improved, although not to above the cutoff. The patient could perform ADL independently with an AFO and scored 121 on the FIM scale. He was discharged 246 days after symptoms onset.

Outcome and follow-up

He attended a junior high school graduation ceremony during hospitalization. As he celebrated graduation with his classmates, his desire to attend regular high school grew stronger. He continued rehabilitation in the outpatient department 2 h daily, 2 days/week, and goal-oriented training in the form of examinations resulted in fewer careless mistakes and improved sustained attention. The FIQ of the WAIS-III improved to 90 points (Table 1). One year later, he attended a regular high school. He joined a broadcasting club, created a documentary about himself, and won a prefectural competition. He is currently ranked two on the mRS and is studying social work in college. The patient did not develop epilepsy.

Case 2

Case history

The patient was a right-handed 33-year-old female office worker who lived alone and had no relevant medical history. The patient presented with left hemiplegia and was transported to another hospital. She was diagnosed with cerebral infarction in the anterior and middle cerebral artery regions due to vasospasm and hyperthyroidism. She had no evidence of cardiac disease, arrhythmias, vascular malformations, coagulation system abnormalities, or autoantibodies other than the thyroid-stimulating hormone (TSH) receptor antibody (TRAb). On days 2 and 5 of onset, the patient underwent internal and external decompression. She underwent cranioplasty 41 days after symptom onset. Hyperthyroidism was treated using thiamazole. The patient was transferred to the convalescent rehabilitation ward of the Japanese Red Cross Ashikaga Hospital 50 days after onset. She had left hemiplegia with 9 and 10 upper and lower extremity points on the FMA, respectively, and moderate left sensory dullness. The patient had left spatial neglect on the BIT and impaired attentional function on the TMT-A and TMT-B (Table 2). The PO and processing speed (PS) scores of the WAIS-III were low. She had no abnormal cranial nerve findings, visual field deficits, dressing apraxia, constructional apraxia, or executive function disorders according to the BADS. She performed ADL with guidance in a wheelchair and scored 95 on the FIM scale. Brain MRI revealed an occluded right internal carotid artery, and the infarcted lesion extended into the right anterior and middle cerebral artery territories (Figure 2). Laboratory tests results for thyroid function were as follows: free triiodothyronine (FT3), 4.13 pg/mL; TSH, <0.01 μIU/mL; and TRAb, 4.9 IU/L.

Investigation and treatment

An endocrinologist regularly assessed the FT3 and TSH levels and adjusted the thiamazole dosage. Normalization of thyroid function prevented recurrent stroke, and the patient was not treated with antiplatelet or anticoagulant agents to prevent recurrence. She was provided with conventional daily rehabilitation that included upper extremity function training, walking training, ADL training, and higher brain function training for 3 h daily. Her left hemiplegia improved to 20 and 23 upper and lower extremity points on the FMA, respectively. Table 2 shows the progress of the HBF evaluation; the BIT scores were above the cutoff. The TMT, PO, and PS improved, although not to above the cutoff levels. The patient performed ADL independently with APS-AFO and scored 121 on the FIM. She was discharged 246 days after the onset and continued rehabilitation in the outpatient department. Flexion spasticity of the left elbow and fingers worsened to a score of three on the mAS; therefore, botulinum toxin therapy was initiated on the upper extremities, and the mAS improved from 1+–2. She continued rehabilitation in the outpatient department 2 h daily, 1 day/week. Goal-oriented training for clerical work resulted in fewer errors and a faster processing speed. The FIQ of the WAIS-III improved by over 100 points (Table 2).
Outcome and follow-up

She began using employment support services with disability certificates. Two years after the disease onset, she was hired from the disabled employment bracket and was responsible for transcribing minutes and data entry. She travels nationally and internationally as a leisure activity. She is currently ranked two in mRS. She has no evidence of epilepsy nor the appearance of recurrence or vascular abnormalities on brain MRI.

Discussion

We present two cases of young patients with extensive infarction in the right anterior and middle cerebral artery regions, which differed from those of older patients regarding causes and outcomes. None of the patients were treated with antiplatelet agents or anticoagulants to prevent the recurrence of rare causes of stroke. Case 1 was suspected to have vasculitis or dissection; therefore, other than a temporary immunosuppressant, no medication was prescribed to prevent recurrence. Although aspirin treatment can be considered for an embolic stroke of an undermined source,4 this case was carefully monitored without treatment. Case 2 was complicated by hyperthyroidism. Hyperthyroidism can cause atrial fibrillation, prothrombotic change,5 and moyamoya disease, which were not observed in this case; therefore, the patients were treated with thiamazole alone. Both cases required appropriate collaboration between hospitals and departments, as well as careful follow-up.

In the present cases, the patients had good outcomes with regards to ADL and social reintegration despite extensive cerebral infarction. Patients with stroke aged 18–44 have significantly higher FIM scores than older patients.6 Furthermore, return to work 12 months after stroke is associated with young age, acute stroke severity, and 3-month disability.7 Case 2 required more than 12 months to return to work owing to the severe disability but was able to find new employment. Notably, younger patients with stroke need a higher prediction of ADL and return to societal goals regardless of stroke severity.

Age >35 years, the presence of cardiovascular risk factors, and large-artery atherosclerosis in the carotid territory are predictors of negative long-term outcomes, including higher mortality, recurrent stroke, and poorer functional recovery.8 Aging and arteriosclerosis may contribute to a decline in residual brain function. The two patients in this report were aged <35 years and had no cardiovascular risk factors or atherosclerosis, which resulted in a favorable functional prognosis.

These two patients were successfully enrolled in school and were employed as their HBF improved. In Japan, of those in school, 94.7% were able to return to school, and of those in employment, 68.5% were able to return to their original job, and 3.9% were able to change jobs.1 In Australia, the United Kingdom, and Southeast Asia, 57% of the respondents returned to work.2 In young patients with stroke, independence in ADL and discharge from home, schooling, and employment may be desirable. Greater independence in ADL, fewer neurological deficits, and better cognitive ability are the most common predictors of return to work,9 whereas absence of aphasia, attention dysfunction, or walking ability are identified as significant predictors of returning to work.10 Improvement in HBF and independence in walking and ADL are important for social reintegration.

Damage to the right cerebral hemisphere or frontal lobe often causes anosognosia and impaired self-awareness, which inhibits rehabilitation.11 However, these two cases did not show such symptoms despite extensive infarction of the right cerebral hemisphere, including the frontal lobe. Impaired self-awareness is associated with bilateral cerebral dysfunction in the frontal lobe.12 Lack of lesions in the left hemisphere and preserved brain function at a young age may have contributed to the retention of self-awareness. Furthermore, psychological and sociocultural factors can cause unawareness.13 A stable personality, family support, and the provision of appropriate information about the disease may have prevented impaired self-awareness.

In the cases reported here, long-term and continuous rehabilitation, including botulinum toxin therapy and orthotic treatment in the acute, convalescent, and outpatient phases, led to favorable outcomes. For patients with moderate-to-severe acquired brain injury, continued outpatient therapy could help sustain the gains made in early post-acute rehabilitation.14 An intensive, patient-centered, interdisciplinary rehabili-
A rehabilitation approach can considerably improve different domains, maximizing spontaneous recovery. Focusing on the individual and developing age-appropriate person-centered stroke care is important. Goal-oriented rehabilitation may be effective in returning to school and work.

The two cases in this report had the desired outcomes with the cooperation of parents, schools, and employment services. Family and school contexts often play a much larger role in pediatric stroke. Similarly, socioeconomic factors are the most critical factors influencing the return to work, along with individual abilities, healthcare factors, and disabilities resulting from stroke. Participants who received vocational rehabilitation reported being more satisfied with their work than those who received conventional care. An active cooperation between medical institutions and work support agencies is critical. Therefore, family, school, and employment services are important for positive patient outcomes.

In conclusion, for two young patients with extensive cerebral infarction of the right cerebrum, management was provided in the convalescent ward and outpatient clinics, including disease management in collaboration with various departments, rehabilitation including orthotics, botulinum toxin therapy, and HBF training, and support for further education and employment. The patients were able to attend higher education and work. Goal-oriented and long-term rehabilitation can help young patients with stroke achieve their goals, even those with severe disabilities.

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Patient consent statement
Written informed consent was obtained from the patients to publish this article.

References


Figure legends

Figure 1. Brain computed tomography image for case 1 upon admission to the convalescent rehabilitation ward.

Computed tomography images show extensive areas of low density in the right anterior, middle, and posterior cerebral artery regions (arrowheads).

Figure 2. Brain magnetic resonance imaging for case 2 upon admission to the convalescent rehabilitation ward.

Diffusion-weighted images show extensive areas of high signal intensity in the right anterior and middle cerebral artery regions (arrowheads). Magnetic resonance angiography showing an occluded right internal carotid artery (circle).
Figure 1. Brain computed tomography image for case 1 upon admission to the convalescent rehabilitation ward.
Figure 2. Brain magnetic resonance imaging for case 2 upon admission to the convalescent rehabilitation ward.

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