

Rehabilitation for Cerebrovascular Disease: Current and new methods in Japan

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Abstract

Rehabilitation is treated as an independent subject in *Japanese Guidelines for the Management of Stroke 2009*, formulated primarily by 5 academic societies, namely The Japan Stroke Society, The Japan Neurosurgical Society, Societas Neurologica Japonica, Japanese Society of Neurological Therapeutics, and The Japanese Association of Rehabilitation Medicine. Rehabilitation is discussed in terms of “procedures for stroke rehabilitation” and “rehabilitation for main disorders and problems.” Rehabilitation should be carried out based on these criteria. As one approach that should be pursued in stroke rehabilitation, we recommend the treatment concept of incorporating intensive rehabilitation intervention simultaneously to the extent possible to encourage functional compensation ability, which we call intensive neurorehabilitation. For example, the patient receives preconditioning to improve the brain's plasticity, followed by intensive and active rehabilitation. Following this approach, positive results have been achieved in pioneering and systematic tests, which focused on using low-frequency rTMS (repetitive transcranial magnetic stimulation) and intensive training with patients who are paralyzed in the upper limbs.

Key words Stroke, Stroke Care Guidelines, Acute phase rehabilitation, Convalescent phase rehabilitation, Intensive neurorehabilitation

Introduction

In Japan, 200,000 to 300,000 people every year suffer cerebrovascular diseases such as cerebral hemorrhage, cerebral infarction and subarachnoid hemorrhage, with approximately 2 million patients nationwide. Even if the patient's life is saved, the aftereffects experienced by stroke victims is a grave problem and is the primary reason that patients become bedridden. In this paper, we will provide an overview of stroke rehabilitation and a description of current conditions in Japan, and also discuss the direction of rehabilitation.

Guidelines for Stroke Rehabilitation

Japan's first guidelines for the treatment of strokes

were devised in 2004 primarily by 5 academic societies, namely, The Japan Stroke Society, The Japan Neurosurgical Society, Societas Neurologica Japonica, Japanese Society of Neurological Therapeutics, and The Japanese Association of Rehabilitation Medicine. The revised guidelines, *Japanese Guidelines for the Management of Stroke 2009* (hereinafter referred to as GL2009), were issued in August 2009.¹ Rehabilitation is treated as an independent subject in GL2009, described under the 2 categories of “procedures for stroke rehabilitation” and “rehabilitation for main disorders and problems.” The general rules of stroke rehabilitation are 1) to provide rehabilitation that is consistent throughout the acute, convalescent, and maintenance phases, 2) set goals based on the prognosis prediction (short-term

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Table 1 The problems of stroke patients to address and the approaches

1. Relapse prevention	Antiplatelet therapy (aspirin, clopidogrel, cilostazol), anticoagulant therapy (warfarin), risk-factor management (antihypertensive, oral hypoglycemic agent, statin)
2. Central or peripheral pain	Amitriptyline, lamotrigine, mexiletine, carbamazepine, transcranial magnetic stimulation
3. Depression	Tricyclic antidepressant, selective serotonin reuptake inhibitors (fluvoxamine, paroxetine), serotonin and noradrenaline reuptake inhibitors (milnacipran hydrochloride), transcranial magnetic stimulation, cognitive behavior therapy
4. Symptomatic epilepsy	Antiepileptic agents (valproic acid, phenytoin, carbamazepine, Phenobarbital)
5. Spasticity	Oral muscle relaxant (dantrolene sodium, tizanidine, diazepam, tolperisone), intraspinal injection of baclofen, nerve block (phenol, ethanol), transcutaneous electrical stimulation, botulinum toxin (BTX) therapy
6. Dysuria	Withdrawing urine, urinary catheterization, cholinergic agents (Besacolin [®] , Ubretid [®])
7. Shoulder-hand syndrome	Corticosteroids (prednisolone), stellate ganglion block
8. Supporting patients' life after returning home	Evaluation of the place of residence, application for the national long-term care insurance (preparing an opinion letter as the physician in charge), application for the physical disability certificate (preparing a medical certificate)

and long-term goals) and design an appropriate program, and 3) provide a comprehensive approach as a rehabilitation team.

In the USA, Department of Defense's Department of Veterans Affairs released its clinical practice guidelines, "Management of Adult Stroke Rehabilitation Care," in 2005.² European Stroke Organisation (ESO) issued comprehensive guidance in 2008.³ These are widely used as stroke rehabilitation guidelines.

Stroke Rehabilitation during Acute Phase

Objectives of acute stroke rehabilitation and conditions for initiating rehabilitation

During the acute phase of a stroke, new neurological symptoms can emerge depending on the site of the lesion and its size, such as impaired awareness and motor impairments, typically hemiplegia. In addition, a decline in activity due to bed rest can result in disuse syndromes, such as loss of muscle strength and muscular atrophy, articular contracture, orthostatic hypotension, cardio-pulmonary depression, and bedsores. Accordingly,

the goal of rehabilitation during the acute phase of a stroke is to encourage the compensatory functions of the cerebrum and facilitate the restoration of the impaired functions while preventing disuse syndromes. Previously, some believed that rest was critical during the acute phase out of concern over the risk of stroke reoccurrence and more severe lesions resulting from a collapse of the autoregulation of cerebral circulation. However, as described in GL2009, currently the goal is to get patients out of bed as early as possible.

Content of acute phase rehabilitation

In the event of hemiplegia during the acute phase of the stroke, facilitation training designed to alleviate the paralysis is carried out, along with the prompt implementation of other training including passive range-of-motion exercises to prevent articular contracture and muscle strengthening exercise to address loss of muscle strength and muscular atrophy. The specific rehabilitation content and procedures vary depending on the patient, but as a general principle, the patient moves from passive training to active training as the level of awareness improves and respiratory

and circulatory dynamics stabilizes. In almost all cases, acute stage rehabilitation is begun at the bedside, and the training should proceed with ECG monitoring and frequent blood pressure monitoring since the risk of systemic complications such as aspiration pneumonia, heart failure and blood pressure elevation is high during this phase.

Approximately 70% of stroke patients have either apparent or latent difficulty swallowing during the acute phase. Therefore, oral care and indirect swallowing training (ice massage, cheek and tongue exercises, etc.) to eliminate resident oral flora should be started soon after the onset of symptoms, even if consciousness is poor, since there is little risk with this training.⁴ Caution is essential when beginning oral intake, and indirect swallowing training using actual food should be started only after swallowing function screening using the repetitive saliva swallowing test (RSST) and modified water swallowing test (MWST).

Stroke Rehabilitation during Convalescent Phase

Objective of rehabilitation in convalescent phase

In many cases, stroke rehabilitation for the convalescent phase is carried out in the convalescent ward. Patients who are past the acute phase and can be expected to further improve functions with rehabilitation intervention are given rehabilitation, with the aim of gaining movement needed for activities of daily living (ADL) including autonomous walking, and ultimately to return home and be back to their place in society. **Table 1** presents the problems most frequently experienced by stroke patients in rehabilitation after the acute phase and the possible approaches to them.

Physical therapy in convalescent phase

Physical therapy (PT) during the convalescent phase is primarily intended to help patients gain mobility and, in particular, regain walking function. Continuing with the training in the seated and standing positions and basic mobility training since the acute phase, patients move to walking training in this phase. If necessary, they begin practice walking at an early stage and the appropriate leg braces are selected and prescribed promptly with the aim of promoting the recovery

of motor functions in the lower limbs and trunk.

Typical leg braces are long leg braces (LLBs) and short leg braces (SLBs) made of plastic or have metal bars. LLB is prescribed for patients presenting with knee buckling on the paralyzed side of the lower extremities when they stand upright. SLB is most appropriate for patients presenting with equinovarus foot, but plastic SLB are prescribed for patients with minor paralysis and knee buckling, while SLB with metal bars are prescribed for patients with significant spasticity, heavy weight and high amount of walking, or foot deformation requiring correction.

Occupational therapy in convalescent phase

In occupational therapy (OT) during the convalescent phase, patients continue facilitation training of the paralyzed arm while also receiving ADL training tailored to day-to-day situations. Training is provided in sequence, beginning with self-care behaviors such as eating, dressing and going to the bathroom. Self-help devices are used as necessary. It is desirable to carry out this training in the hospital room and ward in which the patient is residing, not just in the OT training room.

Patients whose dominant hand have been paralyzed to a significant extent and are expected to have difficulty performing ADL with their paralyzed hand are given training to change their hand dominance. Patients with minor upper limb paralysis and patients that must return to work relatively quickly after leaving the hospital receive training known as instrumental ADL (IADL), which specifically deals with daily life activities such as using the telephone, shopping, cooking, washing clothes and using public transportation.

In some cases, OT includes assessment of higher brain function impairment such as memory impairment, impaired attention, and executive impairment, as well as cognitive rehabilitation to address these impairments. If shoulder-hand syndrome and shoulder subluxation develop in the paralyzed arm as a complication after the acute phase, intervention is also provided (use of a triangle bandage or sling, thermotherapy, etc.).

Speech and language therapy, cognitive rehabilitation, and swallowing therapy in convalescent phase

Speech and language therapy (SLT) is commonly offered for language disorder. SLT primarily

Table 2 New methods of rehabilitation intervention for stroke

1. CIMT (constraint induced movement therapy)
2. rTMS (repetitive transcranial magnetic stimulation)
3. tDCS (transcranial direct current stimulation)
4. FES (functional electrical stimulation)
5. BWSTT (body weight supported treadmill training)
6. CIAT (constraint induced aphasia therapy)
7. FIT (full-time integrated treatment) program
8. noradrenaline and dopamine agonists
9. Botulinum toxin (BTX) therapy

addresses aphasia, but first the Standard Language Test of Aphasia (SLTA) and Western Aphasia Battery (WAB) should be used to identify the type of speech loss the patient is experiencing and the severity. The therapy attempts to improve language functions themselves with the repetition of appropriate and robust verbal stimulation, but if this is unsuccessful, therapists attempt to improve communication skills with the use of non-verbal means such as gestures.

Cerebrovascular dementia is assessed using the mini-mental state examination (MMSE) and the Wechsler Adult Intelligence Scale-Revised (WAIS-R). If these tests indicate a reduction in cognitive function, as described in GL2009, the patient is given training designed to restore the lost function as well as training to generalize compensatory methods (use of memos and notes to address memory defects) so that the patient can apply such methods in real life.

In swallowing rehabilitation during the convalescent phase, direct swallowing training is preferable. The patient should first be given pasty food products suitable for dysphagia while verifying the amount ingested and breathing conditions (such as the amount of expectoration), before advancing in stages to rice porridge and then regular food. Percutaneous endoscopic gastrostomy should be considered for patients with poor vigilance even after the acute phase and patients with no apparent improvement in their swallowing function.

New Stroke Rehabilitation

Table 2 shows new rehabilitation intervention methods, which evidence are still insufficient but

have been attracting attention for their clinical effectiveness in recent years. Constraint Induced Movement Therapy (CIMT) is rehabilitation for upper limb paralysis, in which intensive therapy is given for 6 hours every day to patients who are conscious for more than 90% of the waking hours. The unaffected arm is restrained with a sling or other means to force the patient to use the affected arm. Extremity Constraint Induced Therapy Evaluation (EXCITE) trial has confirmed its effectiveness, and it was given a recommendation grade of B in GL2009.⁵

Repetitive transcranial magnetic stimulation (rTMS) is an intervention method designed to activate the site of compensatory functions around the lesion by giving high-frequency stimulation (5 Hz or higher) that has local neural stimulatory effect on the affected side of the brain or giving low-frequency stimulation (1 Hz or lower) with local neural inhibitory effect on the unaffected side of the brain (thereby reducing the interhemispheric inhibition from the unaffected side of the cerebrum to the affected side of the cerebrum). The rTMS is being tested in clinical applications for upper limb paralysis and aphasia after strokes.⁶ Transcranial direct current stimulation (tDCS) is also attracting attention as a more affordable means of stimulating the cerebrum. Depending on where the 2 electrodes are placed, tDCS can either stimulate or suppress the local neural activity. Functional electrical stimulation (FES) attempts to restore impaired movements through direct electric stimulation of the nerves or muscles in the paralyzed limb. In particular, experiments are underway to improve the walking function of patients presenting with drooping feet by contracting the tibialis anterior muscle.

Body Weight Support Treadmill Training (BWSTT) helps patients practice walking using a suspended weight-bearing mechanism and a treadmill, and is said to have the potential to improve walking function more effectively than general PT programs. Constraint Induced Aphasia Therapy (CIAT) is an intensive speech training, in which the patient spends 2 to 3 hours for consecutive days focusing to speak the common words in everyday conversation without using any gestures or any other means.⁷ Researchers in the US have reported that short-term intervention with CIAT improves speech function even during the chronic phase. The Full-time

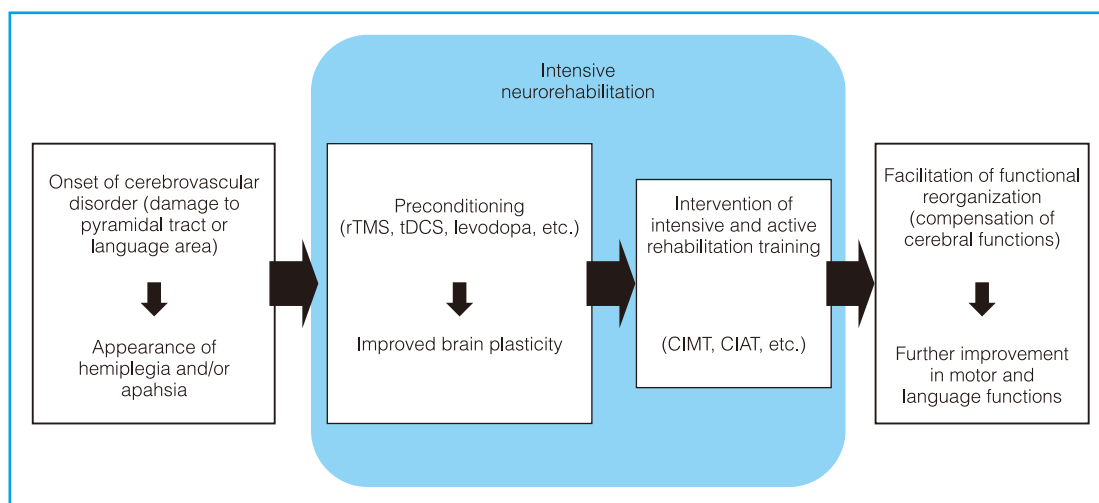


Fig. 1 The concept of intensive neurorehabilitation

Integrated Treatment (FIT) program is a treatment system in which the patient resides in a hospital ward integrated with the training room and receives rehabilitation 7 days a week, and leads an active life even in his/her hospital room. Its effectiveness has been reported by researchers in Japan, and their results suggest that an increase in the frequency and intensity of rehabilitation could lead to further improvements in function.⁸

Noradrenalin-type and dopamine-type agonists were thought to promote the rebuilding of the neural network, and of these drugs, randomized controlled trials (RCTs) have confirmed that levodopa is effective in improving motor function.⁹ Botulinum toxin (BTX) therapy is a new treatment method for spasticity after the stroke, and its application in Japan was authorized in October 2010. BTX, which has a muscle-relaxant effect, is injected directly in the muscles in which tonus is increased, and many RCTs overseas have already confirmed its effectiveness. GL2009 gives this treatment method a recommendation grade of A.¹⁰

Intensive Neurorehabilitation for Strokes

We advocate the treatment concept that *treatment should incorporate intensive rehabilitation intervention simultaneously to the extent possible to encourage functional compensation ability of the*

brain, which we call “intensive neurorehabilitation,” as one approach in stroke rehabilitation in the future. For example, the patient may receive preconditioning intervention to improve the brain’s plasticity, followed by intensive and active rehabilitation (Fig. 1). This would not be feasible for many facilities due to manpower issues, but it could become an intervention practice that could maximize the brain’s latent recovery capacity. In our facility, we have achieved good results with this approach by using low-frequency rTMS and intensive one-on-one rehabilitation training with stroke patients in the chronic phase with upper limb paralysis.¹¹

Conclusion

Recently, more stroke centers are being established, and a community liaison path for stroke has become increasingly popular in Japan. The flow of rehabilitation process has become more efficient from the acute phase to the convalescent phase and then to maintenance phase, improving the effectiveness of stroke rehabilitation. We expect that stroke rehabilitation tailored to patients’ conditions and in line with GL2009 will be delivered even more effectively than it has been thus far, and hope that new methods of rehabilitation intervention for stroke sequelae will be accepted as the established methods and become widely applied to patients.

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