Austrian Guideline of Neurorehabilitation after stroke

Reference: Österreichische Schlaganfall-Gesellschaft, Positionspapier – Update, neurologisch, 2018, Supplement 3/2018
Link: https://www.xn--gsf-rna.at/wp-content/uploads/2016/11/Positionspapier-2018_OEGSF_neurologisch.pdf

Evidence-based neurorehabilitation

Introduction

Post-stroke rehabilitation is a set of measures aimed at continuing acute or emergency treatment and initiate measures to compensate any damage that may have occurred in the brain. The aim is to start these general and special measures without delay after the emergency therapy in order to allow patients the best possible return to their former or newly adapted personal and social surroundings. This set of measures allows for continued participation in the personal, family, professional, and social life and characterises the rehabilitation.[60] The earliest possible involvement of the patient and relatives is required. One distinguishes early rehabilitation and a late or long-term rehabilitation. These terms are used in different ways and have no defined biological basis. Nevertheless, they are important for defining institutional, financial, and social claims. For science-based treatment guidelines, it makes more sense to use the terms neural repair, neuroplasticity and neuro-recovery. This means that, in rehabilitation, the phase of neuroprotection, important in the acute phase of stroke, is largely completed and the phase of repair begins.[61] That is, the aim of preventing the death of neurons is gradually being replaced by the goal of reorganisation of neural systems.[62] This establishes a reference to the continuity of the biological process and the clinical progression.

Many stroke experts believe that rehabilitation is differentiated from emergency therapy not only in terms of time, but also in terms of occupation, and is the responsibility of other medical professions and/or institutions. This is not optimal from the point of view of the continuity of the treatment, but in the organisational daily routine, this is mostly due to the limitation of the resources at the emergency hospital. Many emergency doctors and neurologists still feel they are "on the front line" and think rehabilitation takes place somewhere behind the front line. That therefore justified the traditional idea of "follow-up rehabilitation" stroke, i. e., a consecutive model of care. However, a look at the biological process after a stroke allows us to make a case for very early rehabilitation (often initiated within 24 hours). This creates an overlap between neuroprotection and neuro-recovery. This is important, among other things, for early drug use (see below).

Over the past two decades, there have been two major changes:

1. In particular, the ability to more accurately visualise reparative processes in the brain through improved imaging showed that protection of the neurovascular unit from ischemic injury is paramount. The penumbra can often be saved hours, sometimes even up to 24 hours, after the stroke by recanalisation of vascular occlusions, especially with good collateralisation. Passive measures (positioning, improved capillary flow due to transient blood flow increase) or active measures (neuroprotective measures in recanalised arterial vessels) must be re-evaluated in this context, and clinical studies are in progress. Furthermore, there is the option to apply repair-active drugs, and even here, some (few) options are emerging. These include stem cell therapy, gene-based therapies, monoclonal antibodies, extracts from biological animal tissue, and other recovery enhancers.[61] All in all, with unprecedented precision in molecular, dynamic imaging, we have the possibility today of imaging the pathophysiological processes in detail and in the course of time and correlate them with the clinical progression. In contrast, the observation that more than 1,000 neuroprotective trials were unsuccessful has to be viewed in new light and re-evaluated.[61]

2. In 2017, new global and European documents were prepared, defining the essentials of rehabilitation, especially from the point of view of those affected and their relatives. The document "Rehabilitation 2030"[63] by the WHO and the "Report on Stroke in Europe"[64] by the Stroke Alliance for Europe (SAFE), as well as the ESO SAFE Stroke Action Program for Europe 2018-2030 (ongoing consensus conferences)[65] identify the need and importance of post-stroke neurorehabilitation. The "Global Stroke Bill of Rights" document by the WSO also calls for assessment, rehabilitation, and participation as a basic right of patients after a stroke.[66]

The present treatment guideline is largely consensus-oriented since the vast majority of the recommendations have little or no solid scientific evidence. This is related to the fact that the timing of the initiation of the intervention, the frequency and intensity of the intervention, as well as the duration and combination with other measures must each be identified separately if one demands that controlled studies must support these recommendations. For example, the controversy over the possible negative effects of very early mobilisation (<24 h) does not call into question early mobilisation (after about 24 hours). Many more detailed studies are in progress or in process of planning, many have already been carried out, but with small case numbers and no clinically relevant endpoints. This now necessitates a gradual departure from GRADE concepts and other guiding principles, assuming that most of the recommendations are Class III and Level C. Wherever there is higher evidence, this is shown in the text. Otherwise, we follow the Best Practice Recommendations of the Canadian Stroke Society.[67]

Stroke Units and Early Rehabilitation

Stroke units (SU) reduce mortality and disability. In a well-equipped SU, not emergency diagnosis and therapy is performed, but also targeted care and rehabilitation.

1. This is ensured by a suitably defined staffing, which includes physiotherapy, occupational therapy, speech therapy, but also psychologists and social workers. Some clinics have also introduced music therapy. All patients should receive the earliest possible assessment by neurological examination and the use of proven and tested scales and scores.

2. Regular (at least weekly) team meetings with the senior neurologist and other physicians should be held in order to define and document the therapy objective and the progress of therapy. It is important to consider concomitant diseases or pre-existing disabilities. Screening for depression is obligatory, and other psychiatric illnesses need to be considered as well.

3. Cognitive screening is also an important assessment and treatment field.

4. Finally, a discharge management should be planned, defining and arranging the further measures.

5. All measures should be discussed with relatives as soon as possible, and, as far as possible, they should also play an active role in rehabilitation.

6. Patients with mild to moderate failure also benefit from early rehabilitation.

7. Patients and relatives require information about stroke, its causes, treatment, and prevention. This can take place individually as well as in a group.

Outpatient, Semi-stationary and Long-term Rehabilitation

1. Follow-up examinations should be planned and arranged as well, with documentation done at discharge, and no later than after 3 months. The Post Stroke Checklist is a proven tool for capturing long-term needs.

2. The long-term care and documentation should be done after 12 months, and annually thereafter over 3 years.

3. Supported early discharge from the hospital is concept developed predominantly in the UK and Scandinavia of early treatment of the mild to moderate handicapped by a mobile rehabilitation team at home and in the community. It replaces prolonged hospital treatment. It could be shown that early, better participation and cost-effectiveness can be achieved by this community-based approach to rehabilitation. It is important to actually offer the necessary treatment resources in the community and to apply them seamlessly. In Austria, this has so far been little tested due to the different responsibilities of financing. Foreign experience shows that hospitalisation can be reduced by an average of 6 days, and the likelihood of death or disability can be reduced by 20% (Level A). Patients after severe strokes should continue to be eligible for inpatient rehabilitation.

There is evidence that continuing ADL training at home after discharge is effective up to one year after a stroke (Level B). Different types of rehabilitation, including outpatient or day-clinic training, have a positive effect on ADL independence in the first year after discharge.

Stroke survivors often suffer from muscle weakness in the affected, but also unaffected, limbs and from reduced cardiorespiratory fitness. Physical post-stroke fitness training reduces disability and improves ambulatory ability and other stroke related issues (Level B). Even cognition, mood, and fatigue can be improved. Physical fitness programs should be designed and offered to all stroke patients who are physically able to participate, similar to cardiac rehabilitation programs.

While in many countries access to rehabilitation facilities is different, and sometimes very difficult, for many stroke patients, such facilities are currently sufficiently available in Austria. However, in the view of neurological experts, the therapy units offered there, which are specific therapies, are often too few and can therefore not be adequately performed. This applies to speech problems and communication, problems of cognition, mood, and motivation. Therefore, options for speech therapy, cognition training, and activation should be increasingly offered in the rehabilitation facilities or community-oriented therapy facilities. It should be noted that individual therapies must be devised for many patients due to pre-existing disabilities. Overall, each patient should receive a written plan for further treatment upon discharge from the hospital.

Late Rehabilitation and Reintegration

More persistent problems are common and primarily affect cognition, mood, and mental state. As a rule, however, secondary preventive drugs are predominantly monitored. Recurrent rehabilitation stays are rare, mostly granted as a result of self-initiative, and vary regionally.

Whether further rehabilitation after one year improves the recovery is poorly documented. Permanent disabilities, however, tend to lead to further deterioration and accompanying disorders. Therefore, chronic defects must be treated further and regularly evaluated by the neurologist. Spasticity, pain, paresthesia, and disorders of temperature sensation often develop only with chronic defects. Especially here, the Post Stroke Checklist has a place as a screening tool and can be quickly applied by the physician to discover the underserved areas.

Although there are few studies, targeted specific training - such as balance training, gait training with different methods, and upper extremity training - have shown positive effects even after periods of more than one year after the stroke. Although Cochrane analyses were inconclusive, they have shown an overall positive trend.[68] For many younger patients, returning to work is a matter of identity and quality of life, as well as an indispensable source of income. Therefore, vocational rehabilitation is crucial for many patients.

All patients and their relatives are entitled to a neurological evaluation after 6-12 months, and then regularly for at least 3 years post stroke.

Therapeutic Measures

Post-stroke rehabilitation is a goal-oriented process, with the background to enable the patient to achieve their best physical, cognitive, emotional, social, and functional level of activity (Level A).

This process begins as early as possible after the event (aiming for 24-48 hours, Level B) and is achieved by an interdisciplinary, specially trained team at a specialised facility (Level A).

Assessment: At the beginning of the treatment, a therapeutic assessment is performed (recommended within 48 hours), assessing the specific functional limitations of each patient at the various levels of the International Classification of Functioning, Disability and Health (ICF)[69]. This system classifies the functional state of a patient in body structures and their functions, the level of activity of the patient, the participation of the person in their social environment, as well as personal and environmental context factors. The selection of the appropriate standardised tools depends on the main impairments of the patient, practicability, relevance as well as the objective of the rehabilitation (Level B). **Table 4** shows examples of standardised assessment tools in the functional levels of the ICF.

Table 4: Standardised assessment instruments in stroke rehabilitation (examples)

Body structure/function	**Activity**	**Participation**
Swallowing: Gugging	Activities of Daily Life (ADL):	
Swallowing Screen (GUSS)	Barthel Index (BI) Independence Index for the neurological and geriatric rehabilitation (SINGER)	
Strength: Motricity Index (MI), Medical Research Council (MRC), Dynamometer	Ingestion: Bogenhausen Dysphagia Score (BODS)	Action ability: Canadian Occupational Performance Measure (COPM)
Tone: Modified Ashworth Scale (MAS), Tardieu Scale	Torso: Trunk Control Test (TCT) Balance: Berg Balance Scale (BBS)	Quality of living: Short Form 36 Health Survey Questionnaire (SF-36)
Mobility: Goniometry	Ambulation: Functional Ambulation Categories (FAC), 10-metre walk test, timed up and go (TUG)	Reintegration into the home environment: Reintegration to Normal Living (RNL)
Mental functions: Montreal Cognitive Assessment (MoCa)	Arm/hand function: Box and Block Test, Nine Hole Peg Test, Action Research Arm Test (ARAT)	

Target definition: From the results of the assessment procedures performed, the interdisciplinary team, together with the patient and the patient's environment, can define and agree on treatment objectives, which can be regularly re-evaluated. Although first treatment approaches – depending on the capacities of the patient – are carried out at the structure and function level (e. g. strength, tone, respiration,...), objectives of activity/participation level should be clearly measurable and scheduled to be motivating and relevant for the patients (Level A).

An early therapeutic assessment may also provide initial prognostic indications of the tendency to remission of abilities (finger/arm function or ambulatory ability - within 48 hours) or activities of daily living (Barthel index within 5 days)[70], which, in addition to realistic target agreements, allows choosing the most appropriate treatment methods best supported for each course.

Acute treatment phase/mobilisation phase: The beginning of mobilisation is dependent on various factors, such as vital signs, aetiology, and comorbidities, and is individually determined by the treatment team. Very Early Mobilisation (VEM) refers to mobilisation outside the bed within 24 hours.[71] It is impossible to make a general recommendation for each patient; however, with early mobilisation, shorter, less intensive treatment units seem to have a better effect than a long, demanding therapy duration[72] (Level B).

Training phase/rehabilitation phase: Due to increased plastic processes, the greatest functional changes can be expected within the first few weeks or months, which is why intensive rehabilitation can have the largest impact, but is not always completed, during this period. In practice, however, patients spend most of the day alone and inactive in their room in a sitting or lying position - even in specialised institutions. A higher intensity of training in terms of duration in a stimulating environment has clear positive effects on the functional recovery of the patients.[73] Several hours daily of training measures in the various therapy sections are recommended.[67] In addition, opportunities of self-initiated training in a challenging and motivating environment should be offered (Level A).

However, the success of therapy is not only dependent on the intensity in terms of duration, but also on the contents of the treatment. Many so-called "traditional treatment concepts", which have developed empirically over the past decades, were unable to show individual benefits. The recommendation is an eclectic approach[68] that uses an individual best studied, workable, and defined method for the functional problem. Increasingly, (motor) learning theories are being implemented. These are reflected in an increasing number of newly developed therapeutic measures:

- Tasks must include active problem solving by the patients and just solvable, in terms of the level of difficulty, and regularly increased in their intensity (Level A).
- A sufficient number of repetitions in a variable setting is a prerequisite for learning. The corresponding amount of repetition is currently barely being achieved in common therapeutic practice[74] (Level A).
- Tasks must be relevant, understandable, and motivating for the patient and applied with appropriate instruction and feedback so that planning of the execution and outcome control can be handled by the patients themselves (Level A).
- Learning is task- and context-dependent and specific. This means that the tasks that are predominantly learned are those that are trained in a specific environment – transfer to other tasks or generalisation cannot be assumed. The implementation in the everyday environment must be trained in that environment (Level A).

General: Neurorehabilitation is effective, but there is no evidence of the superiority of a particular method - the recommendation is for an eclectic treatment approach.[68]

Recommendations

There is a wealth of therapeutic measures that have been evaluated for a wide range of symptom complexes and that can be used individually in each patient, depending on their physical, emotional, motor, and cognitive abilities, in a wide variety of combinations (**Tab. 5**).

Drugs

In certain cases, drug treatment may be helpful and may benefit neurorepair: For example, there is some positive evidence for L-DOPA[76] and antidepressants (SSRI)[77] (Class 2-3, Level B-C).

With regards to a specific peptide preparation, there is evidence of positive effects in rehabilitation: Cerebrolysin® (30 ml over 3 weeks or longer)[78] (Class 2, Level B) can improve rehabilitation of the upper extremity after a stroke.[79, 80]

There is no convincing evidence for food supplements or vitamins. Stem cell therapies are still being studied, and trials will be completed in the years to come.

Table 5: Special techniques

Upper extremities	
Task-oriented arm/hand training	I, A
Active and passive positioning of the extremity (in part. early phase)	III, C
Constraint-induced Movement Therapy (CIMT)	I, A
Mental training, movement observation	II, B
Mirror therapy	II, B
Functional electrostimulation, EMG-triggered	I, A
Repetitive transcranial magnetic stimulation or transcranial DC stimulation	II, B
Strength training if residual motor skills present	II, B
Bilateral arm training in severely affected patients	III, C
Rhythmic acoustic cueing	III, C
Robot Assisted Therapy: to increase the intensity	II, A
Virtual reality as an add-on	I, B
Circuit and group training	III, C
Shoulder pain	
Preventive: Joint protection strategies, positioning, electric stimulation	II, B
Pain treatment: gentle mobilisation and stretching	II, B
Balance	
Task-oriented balance training, reactive and proactive	I, A
Multisensory balance training	II, A
Balance training with pressure measuring platform and visual control	II, A
Circuit training, group	II, B
Treadmill training with weight relief	II, B
Fall prevention management	II, B
Tai Chi, hydrotherapy, home training	III, C
Gait	
Task-oriented gait training	I, A
Treadmill training (with and without weight relief)	I, A
Robot assisted gait therapy: possibly with functional electric stimulation in non-ambulatory patients	II, B
Rhythmic acoustic stimulation	II, C
Strength training in mildly to moderately affected patients	II, B
Functional electric stimulation, optionally with biofeedback	II, B
Virtual reality as add-on therapy	II, B
Mental training (Level A), movement observation, groups, circuit training	II, B
Aid supply: Ankle joint orthoses, ambulatory aids…	II, B
Activities of Daily Life (ADL training)	
Task-oriented training	I, A
Adaptation of the personal environment, Aid supply	III, GCP
Strategy and coping training, cueing	III, GCP
Family counselling and education, Self-management programs	II, B
Cardiovascular endurance	
Patient sufficiently stable or disqualified from Contraindications: cardiovascular endurance training (3 times/week), possibly under monitoring	II, B
Spasticity	
Positioning, active and passive mobility training, stretching	III, C
Braces and casts in individual cases	III, C
Botulinum toxin in focal and symptomatic adverse spasticity, according to international guidelines[75]	
Dysphagia	
Early initial swallowing screening; in case of abnormalities, professional swallowing evaluation	II, B
Food adaptation, nutrition management	II, B
Restorative or compensatory swallowing therapy	II, B
Patient and family counselling	II, B
Neglect	
Exploration training and prism training	II, B
Vibration and electric stimulation training	II, B
Aphasia	
Communicative training	II, B
Disorder-specific training	II, B
Non-verbal compensation	GCP
Apraxia	
Gesture training	GCP
ADL training	GCP

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Appendix: Evidence Classification Scheme for a therapeutic intervention*

	Evidence Classification Scheme for a therapeutic Intervention
Class I	An adequately powered, prospective, randomized, controlled clinical trial with masked outcome assessment in a representative population or an adequately powered systematic review of prospective randomized controlled clinical trials with masked outcome assessment in representative populations. The following are required: a) randomization concealment, b) primary outcome(s) is/are clearly defined c) exclusion/inclusion criteria are clearly defined d) adequate accounting for dropouts and crossovers with numbers sufficiently low to have a minimal potential for bias; and e) relevant baseline characteristics are presented and substantially equivalent among treatment groups or there is appropriate statistical adjustment for differences.
Class II	Prospective matched-group cohort study in a representative population with masked outcome assessment that meets a–e above or a randomized, controlled trial in a representative population that lacks one criteria a–e.
Class III	All other controlled trials (including well-defined natural history controls or patients serving as own controls) in a representative population, where outcome assessment is independent of patient treatment.
Class IV	Evidence from uncontrolled studies, case series, case reports, or expert opinion.
	Rating of recommendations
Level A	Established as effective, ineffective, or harmful for a therapeutic intervention, and requires at least one convincing Class I study or at least two consistent, convincing Class II studies.
Level B	Established as probably effective, ineffective or harmful for a therapeutic intervention, and requires at least one convincing Class II study or overwhelming Class III evidence.
Level C	Established as possibly effective, ineffective or harmful for a therapeutic intervention, and requires at least two Class III studies.
Good Clinical Practice (GCP)	Recommended best practice based on the experience of the guideline Practice development group. Usually based on Class IV evidence indicating large clinical uncertainty, such GCP points can be useful for health workers.

* Brainin M et al., Guidance for the preparation of neurological management guidelines by EFNS scientific task forces – revised recommendations 2004. Eur J Neurol 2004; 11(9):577–81