

Neuropsychological rehabilitation of acquired, non-progressive cognitive-behavioral disorders in evidence-based clinical recommendations

Rehabilitacja neuropsychologiczna nabytych, niepostępujących zaburzeń poznawczo-behawioralnych w zaleceniach klinicznych opartych na dowodach

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Key words

neuropsychological rehabilitation, neurorehabilitation, guidelines, recommendations

Abstract

Introduction: Neuropsychological rehabilitation is an important area of neurological rehabilitation. Its techniques are studied in terms of effectiveness and subjected to collective analyses in order to identify the best interventions.

Objective: The purpose of the article is to present current clinical recommendations for neuropsychological rehabilitation among adult patients with acquired, non-progressive brain damage usually caused by a stroke or head injury.

Data sources: The recommendations are based on the latest scientific papers containing systematic reviews and meta-analysis of studies on the rehabilitation of patients with cognitive dysfunctions and/or behavioral abnormalities.

Conclusions: To date, the highest recommendation and the status of practice standards in neuropsychological rehabilitation have been achieved by therapeutic techniques of 5 post-stroke disorders (attention deficits, mild memory deficits, left-sided visual neglect, aphasia, global decline in cognitive-behavioral functioning) and 5 post-traumatic disorders (attention deficits, mild memory deficits, mild and moderate executive dysfunctions, abnormalities in social functioning and interpersonal communication, global decline in cognitive-behavioral functioning). These techniques may be used independently or introduced in combination with interventions of a lower recommendation level, classified as practice guidelines or practice options. The use of lower grade recommendations should also be considered in situations where there are no standard techniques for specific forms of disorders. In the case of deficits for which no recommendations have yet been made, further research is necessary. This applies to agnosia, profound memory disorders and amnesia, as well as profound executive dysfunctions.

Słowa kluczowe

rehabilitacja neuropsychologiczna, neurorehabilitacja, wytyczne, zalecenia

Streszczenie

Wprowadzenie: Rehabilitacja neuropsychologiczna jest ważnym działem rehabilitacji neurologicznej. Jej techniki są badane naukowo pod względem efektywności i poddawane analizom zbiorczym, żeby wyodrębnić najskuteczniejsze z nich.

Cel: Celem artykułu jest przedstawienie aktualnych zaleceń klinicznych w obszarze rehabilitacji neuropsychologicznej prowadzonej u dorosłych chorych z nabytym i niepostępującym uszkodzeniem mózgu, spowodowanym najczęściej udarem lub urazem głowy.

Źródła danych: Zalecenia pochodzą z najnowszych opracowań naukowych, zawierających systematyczne przeglądy i metaanalizy badań nad rehabilitacją chorych z dysfunkcjami poznawczymi i/lub nieprawidłowościami zachowania.

Wnioski: Jak dotychczas najwyższą rekomendację i status praktycznych standardów w rehabilitacji neuropsychologicznej zyskały techniki terapii 5 zaburzeń poudarowych (deficyty uwagi, lekkie zaburzenia pamięci, lewostronne zaniedbywanie wzrokowe, afazja, ogólne obniżenie funkcjonowania poznawczo-behawioralnego) i 5 zaburzeń pourazowych (deficyty uwagi, lekkie zaburzenia pamięci, lekkie i umiarkowane dysfunkcje wykonawcze, nieprawidłowości funkcjonowania społecznego i komunikacji interpersonalnej, ogólne obniżenie funkcjonowania poznawczo-behawioralnego). Techniki te mogą być stosowane samo-

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dzialnie lub wprowadzane w połączeniu z interwencjami o niższym poziomie rekomendacji, klasyfikowanymi jako praktyczne zalecenia lub praktyczne opcje. Skorzystanie z niżej rekomendowanych interwencji powinno być rozważane także w sytuacjach, gdy dla specyficznych form zaburzeń brak technik standardowych. W odniesieniu do deficytów, dla których nie zostały dotąd sformułowane żadne zalecenia, niezbędne są dalsze badania. Dotyczy to agnozji, głębokich zaburzeń pamięci i amnezji, a także głębokich dysfunkcji wykonawczych.

INTRODUCTION

“...Behavioral dysfunctions impair the patient more frequently than sensory and motor deficit, because they disrupt mental, communicative and emotional interaction with the environment...”^{1A}. They may dominate the clinical picture or be the only disturbances that impair the performance of social roles and/or the independent life of the patient. It is therefore not surprising that therapy in this sphere of functioning referred to as neuropsychological rehabilitation has a rich tradition (dating back to nineteenth-century speech therapy) and is an integral element of neurological rehabilitation.

Neuropsychological rehabilitation comprises a variety of actions aiming to decrease cognitive, emotional and personality deficits following brain damage² and increase the patient’s potential in terms of his/her mental, social, vocational, recreational, and /or daily activity³⁻⁵. Although usually associated with the improvement of cognitive functions (attention, memory, perception, cognitive organization of movement, language, visual-constructive, and executive skills), it also involves interventions aimed at improving emotional functioning and the modeling of behaviour⁵⁻⁷.

Neuropsychological rehabilitation is carried out in the most justified and structured way in patients with acquired and non-progressive brain damage, the effects of which may be reduced as a result of both spontaneous recovery (compensatory neuroplasticity typical for the first few weeks and months after brain damage)⁸⁻¹⁰ and therapeutic intervention (experience-dependent neuroplasticity)^{11,12}. The largest recipient groups for such rehabilitation are patients after stroke, affecting mainly the el-

derly¹³, and patients after traumatic brain injury (TBI), to which young people are most at risk¹⁴⁻¹⁶. There are also patients who have suffered brain damage caused by neuroinfection, hypoxic-ischaemic pathology (e.g. after sudden cardiac arrest^{17,18}), the development and treatment of non-cancerous and benign tumors¹⁹ as well as patients suffering from epilepsy.⁵

Since neuropsychological rehabilitation relies upon the cooperation of patients with the therapist (and/or other participants of the therapeutic process, e.g. with the family), it is not suitable for use with people unable to interact and undertake therapeutic tasks. It is also not justified in people with the impairments of consciousness, which – proceeding with generalized disturbance of mental processes – prevents active and intentional interaction with others. Such rehabilitation is also not offered to patients with progressive cognitive impairments or dementia syndrome.

AIMS AND STAGES OF NEUROPSYCHOLOGICAL REHABILITATION

Neuropsychological rehabilitation should be introduced as soon as the patient’s general condition stabilizes and he/she is able to consciously participate in treatment. Before starting, the goals of therapy should be set based on the current evaluation of the patient’s cognitive performance and analysis of the patient’s functional and adaptation problems occurring in everyday life. These targets should be:

- specific (addressed to particular disorders and/or functional problems);
- realistic (possible to achieve);
- time-defined (described in terms of the approximate time needed for their development);

- measurable (possible to be assessed in a neuropsychological functional examination and/or test);
- staged (modified depending on the clinical condition, phase of the brain injury, patient’s important needs and the effects of previous interventions).^{4,6,13}

The adoption of specific goals is the basis for the decision regarding the form and methods of rehabilitation. In brain injuries where there is an acute phase and recovery process, an important criterion in method selection is the time that has passed since the onset of the damage. It is considered that early (so-called “acute”) rehabilitation in the first weeks – especially in the first quarter since the brain damage – and typically performed in hospital, is primarily intended to strengthen the brain’s spontaneous recovery processes, which are most dynamic shortly after falling ill and are responsible for the majority of functional benefits. Behavioral methods of activating and directing these processes involve undertaking activities that engage the impaired functions as well as preventing undesirable reactions and compensations. At this stage, depending on the patient’s condition, the therapy may take the form of individual, general cognitive stimulation (this applies to people with a syndrome of profound disturbances, generalized deficits and/or those with somatic complaints). Alternatively, it may involve specific training of functions (which applies to patients with less severe disorders and those able to cooperate actively), usually combined with psychoeducation and emotional support for the patient and his family.

In the later stages of rehabilitation (“post-acute”), the condition of most patients is stable enough to intensify activities and steer them onto the im-

^A Błażejewska-Hyżorek B., Czernuszenko A., Członkowska A., Drodzowski W., Gąsecki D., Kaźmierski R., et al. Management of stroke. Guidelines from the Expert Group of the Section of Cerebrovascular Diseases of the Polish Neurological Society (Polish: Postępowanie w udarze mózgu. Wytyczne Grupy Ekspertów Sekcji Chorób Naczyniowych Polskiego Towarzystwa Neurologicznego). *Neurol Neurochir Pol* 2012; 46 (Supl. 1): S1-S114 (quotation: S97).

portant aspects of functioning. Therapy then takes the form of individual and/or group interventions, combined with educating the patients on their acquired disorders and the possibilities for overcoming them. Depending upon the severity of the neurological syndrome, this may be carried out in hospital, an outpatient or home environment. It is believed that training performed in the first six months and even up to a year following brain injury can still stimulate the already weakening self-repair mechanisms, and contribute towards improvement through learning. According to some scientists, the formation of necessary skills should proceed from an improvement of more basic functions (e.g. maintaining alertness, sustained attention) to higher-order skills (e.g. divided attention, working memory), for which the former are a fundamental component^{14,20,21}. One year after becoming sick, when the brain's self-repair processes have likely ceased, rehabilitation can serve to further develop skills (if specific training is still effective), or to compensate for persistent deficits and support the patient in adaptation to life with a disability.^{6,7,22,23}

It is recommended that patients progress smoothly to subsequent stages of rehabilitation, so the therapy – as long as it is needed – is continuous¹. Currently in Poland, neuropsychological rehabilitation is guaranteed only to patients treated in inpatient departments of neurological rehabilitation (5 days of therapy per week, minimum 30 minutes daily for 6, 9, 12 or 16 weeks, depending on the severity of neurological disorders, the time since being discharged from the treatment center for the acute phase of brain damage and the presence of underlying conditions). Unfortunately, such treatment does not fall within the scope of the services provided in departments of systemic rehabilitation or those provided at home, outpatient or day clinics,

to which people with brain damage may also be assigned^{24,25}.

RECOMMENDATIONS FOR NEUROPSYCHOLOGICAL REHABILITATION

The relationship between the cause of brain damage and its clinical consequences has an influence upon the specific character of rehabilitation needs in different groups of patients. In patients after stroke, the most common and most disabling cognitive dysfunctions are aphasia-type language and verbal communication deficits (strokes within vascularization of the left middle cerebral artery) and attention-perceptual disorders referred to as left visual or visual-spatial neglect (strokes in the basin of the right middle cerebral artery). Meanwhile, in patients after TBI, especially from a road traffic accident^{15,16}, there is often a frontotemporal pathology, manifested by executive, attention-memory dysfunctions and/or personality changes^{14,26,27}. Consequently, the rehabilitation of these afore-mentioned disorders is the main focus of the scientific research.

In an effort to optimize therapeutic activities, neuropsychological techniques are more and more often evaluated in terms of their efficiency, hoping to identify the most effective forms of intervention. Systematic reviews of studies and their collective meta-analyses are the basis to formulate recommendations in the field of *evidence-based cognitive rehabilitation* and related activities.

Although there are studies available in Poland regarding therapy for cognitive functions in adult patients (e.g. *Wytuczne postępowania w udarze mózgu* [English: Guidelines for the management of stroke]¹³; *Terapia neuropsychologiczna dorosłych chorych z uszkodzeniem mózgu* [English: Neuropsychological therapy in adult patients with brain damage]⁶; *Reha-*

bilitacja neuropsychologiczna - ujęcie holistyczne [English: Neuropsychological rehabilitation – holistic approach]²⁸), there have not yet been recommendations created for such treatment. However, one may follow the example of foreign institutions, where we can find clinical practice recommendations in respect of the type and severity of disorders, type of brain damage and stage of neurorehabilitation. They may also be grouped according to the form of interaction (behavioral: based on the patient's interaction with the therapist; non-behavioral, e.g. utilizing neurophysiological processes and reactions), type of therapeutic approach (restitutive: concerning the maximum recovery of the disturbed functions; substitutive: compensating for deficits) and specificity of the procedure (modular: concentrated on a single, typically dominating deficit; holistic: aimed at general improvement in cognitive-behavioral functioning).^{6,29}

The greatest relative contribution to creating guidelines for neuropsychological therapy has come from the experts of the Cognitive Rehabilitation Task Force of the American Congress of Rehabilitation Medicine, ACRM, working under the guidance of Keith Cicerone. In 2019 they published the fourth edition of recommendations, based on an evaluation of the quantity and methodological quality of research into the treatment of post-stroke and post-TBI disorders²⁹.

In their classification, a high level of recommendation for a specific intervention indicates that its effectiveness is supported by substantive scientific evidence (high-reliability studies identified in a comprehensive review of the literature – see footnote^B). Hence, it should be considered as a *practice standard* of therapeutic procedure. An average level of recommendation means that the research indicates probable effectiveness of the given intervention (footnote^C), leading to the status of a *prac-*

^B High level of recommendation: at least one experimental study of Class I (well designed, prospective study with randomisation [randomised assignment of individuals to the compared groups] and a control group – Randomized Controlled Trial [RCT], with sufficiently large groups of individuals), supported by studies of Class II and III (observational studies, case studies), directly pointing to the effectiveness of the intervention and providing substantive evidence for its effectiveness.

^C Average level of recommendation: at least one RCT study, but with some methodological limitations, or well designed Class II studies with adequate samples (prospective, non-randomised cohort studies; retrospective, non-randomised case-control studies), directly pointing to the effectiveness of the intervention and providing evidence of its probable effectiveness.

tice guideline, whilst a low level indicates possible effectiveness (footnote^D) and the status of a *practice option*^{29,32}.

The guidelines developed by Cicrone's team can be supplemented with conclusions drawn from the work of other expert groups (including the Cognitive Rehabilitation Task Group of the European Federation of Neurological Societies, EFNS)³³, and also results of meta-analyses relating to particular cognitive disorders^{14,34} or specific forms of intervention³⁵⁻³⁷.

Practice standards in neuropsychological rehabilitation

The status of practice standard in neuropsychological rehabilitation means that each patient suffering from disorders specified in the recommendations who is able to actively cooperate in the therapy should be given the chance to benefit from these recommended forms of intervention. Presently, nine purely behavioral techniques of individual restitutive and/or compensatory therapy, typically applied in combination with meta-cognitive strategies aimed at developing the patient's self-awareness as regards the acquired dysfunction, have attained this level of recommendation^{14,29,33}. These techniques are listed in Table 1.

As Table 1 illustrates, in patients who have developed an attention deficit as a result of stroke or TBI, therapy should directly improve the disturbed functions in order to restore them as much as possible. In the case of fundamental attention deficits, which are expressed in intensity (reduced readiness to react, disturbances in alertness and vigilance)³⁸, it is recommended to combine sustained attention training with acoustic warning stimulation (significant stimuli preceded by a sound signal) and a strategy of the patient's self-instruction to be alert³⁹. This combination should not only encourage better performance of the exercises, but also

increase the probability of the therapy's effects being generalized to daily activity.^{29,33,39,40}

In the field of specific syndromes of attention disorders, such as left visual neglect after stroke (asymmetry of visual attention distribution towards stimuli located in the surrounding space to the disadvantage of the left side), visual scanning training is most commonly recommended²⁹. This requires the patient to deliberately explore more and more complex visual material, during which various techniques of drawing attention to and/or deliberately directing the eyesight towards the neglected (left) side of the space are offered to him^{33,41}.

In the case of mild post-stroke or post-TBI memory impairments, compensatory techniques are considered to be most effective, aimed at decreasing the distorting effect of the deficit on the patient's everyday activity¹⁴. In compensation, which involves registering and checking important information, analog aids can be used (e.g. writing down a list of things to do in a calendar) and electronic appliances (e.g. audio-visual notifications on a mobile phone). For people with relatively isolated memory impairment, their use should minimize the effects of problems with remembering what needs to be done in the future (prospective memory) and with recollecting information about past events (retrospective memory). In addition, as part of influencing the memory processes themselves, it is recommended to learn mnemonics such as visualization and associations related to memorized material^{14,29,33,34,42}. However, it is noted that benefits from additional processing of memory information are most likely in people with a slight memory deficit and a large cognitive reserve²⁹. Hence, their introduction should be considered on an individual basis.

In people with left-hemisphere stroke, the standard should be therapy for aphasia and limb apraxia. In the field of aphasic syndromes (language impairments manifested in ac-

tivities of listening, speaking, writing and reading), various cognitive-linguistic interventions are advised which are aimed primarily at improving the reception and formation of verbal messages, although – in milder aphasias – it is also important to improve written language. In the case of aphasic types not related with speech fluency disorders (referred to as fluent aphasias: Wernicke's, transcortical sensory, anomic), it is sufficient to give language training alone, such as: exercises in understanding speech, naming objects/activities/phenomena, production of speech with an appropriate grammatical, logical and content structure. However, therapy programs for patients with aphasias with speech dysfluency (known as non-fluent aphasias: Broca's, transcortical motor, mixed, mixed transcortical) should include language exercises as well as articulation and/or prosodic exercises, as for instance in melodic intonation therapy (using melodic-rhythmic patterns for speech initiation and execution and increasing the extent of expression)^{43,44}. Together with the appropriate choice of language tasks, their intensity is an important factor, as demonstrated by studies of constraint-induced aphasia therapy (focusing on improving spoken language whilst limiting all forms of non-verbal communication)⁴⁵. This is reflected in the thesis that even short-term but intense therapy of aphasia is a better choice than regular therapeutic sessions stretched over a period of time.⁴⁶⁻⁴⁸

In turn, in apraxia (abnormalities in planning and cognitive organization of movement activities) specific gesture training is advised, to recognize and make adequate use of gestures⁴⁹, together with exercises aimed at rebuilding habits and motor skills^{33,50}. These exercises, due to their nature, should be performed as part of occupational therapy, ideally using real objects and tools whilst maintaining a natural situational context. When planning the therapy, one should remember potential limitations arising from the frequent coexistence of limb

^D Low level of recommendation: studies of Class II (clinical observations) or III (clinical series without concurrent controls, single-subject designs), directly pointing to the effectiveness of the intervention and providing evidence for its possible effectiveness.²⁹⁻³²

Table 1

Neuropsychological therapy techniques with the status of practice standards in patients with acquired, non-progressive brain damage. ^{14,29,33}			
	Cognitive Impairments	Brain Damage	Therapeutic Practice Standards (Rehabilitation Stage)
Attention and perception	Attention deficits	TBI Stroke	Direct-attention and metacognitive strategy training (later stages of rehabilitation)
	Left visual neglect	Right-Hemisphere Stroke	Visual and spatial capabilities therapy with visual scanning training
Memory	Mild impairments of prospective memory	TBI Stroke	Training using external compensatory tools and internalized memory strategies
	Mild impairments of retrospective memory	TBI	Training using external compensatory tools and internalized memory strategies
Praxis	Impairments of cognitive organization of movement	Left-Hemisphere Stroke	Specific training for gesture recognition, motor skills strategy training (early stage of rehabilitation)
Social communication	Language impairments	Left-Hemisphere Stroke	Cognitive-linguistic therapies (acute and post-acute stages of rehabilitation)
	Social communication deficits	TBI	Conversational skills training, facial emotion expression recognition training
Executive function	Mild and moderate executive dysfunction	TBI	Metacognitive strategy training, possible problem solving or goal management training (later stages of rehabilitation)
Cognitive functioning	Cognitive deficits of varying severity	TBI Stroke	Comprehensive-holistic rehabilitation programs (later stages of rehabilitation)

apraxia with language disorders (possible consequences: difficulty in understanding verbal commands, verbal description of functional problems, self-instruction for movement activities) and/or basic motor deficits (e.g. difficulty in engaging limbs suffering paresis in ambidextrous activities).^{33,50-52}

In people with post-TBI abnormalities in social communication, conversation training and/or facial expression recognition training are recommended. They aim to improve the patient's interpersonal skills and therefore counteract the social isolation caused by inadequate speech and emotional response. However, considering that injuries to the brain's prefrontal areas often lead, in addition to personality changes, to general disorganization of the patient's performance, it is also important to improve thinking skills. With mild and moderate executive dysfunctions (problems with planning and organizing cognitive and practical activity), it is recommended to apply interventions aimed at improving self-awareness of acquired dysfunctions and learning strategies for self-control and self-regulation of one's own behavior. It is worth practicing these strategies in formal training, such as

problem-solving training or goal-directed behavior management²⁹. They teach patients to handle issues in stages, adapting actions to changing circumstances, detecting and correcting errors, and predicting the effects of one's own performance⁵³.

In a situation where the result of TBI or stroke is a generalized decline in cognitive functioning, patients should be offered complex, holistic rehabilitation programs including individual training for disturbed functions, group therapies on self-awareness of the condition and emotional-social functioning together with education on how to deal with the consequences of the disorder²⁹.

Detailed descriptions of the above-mentioned techniques can be found in the monograph titled *Terapia neuropsychologiczna dorosłych chorych z uszkodzeniem mózgu* (English: Neuropsychological therapy in adult patients with brain damage), edited by J. Seniów⁶ or in the English-language book called *Neuropsychological rehabilitation: The international handbook*, edited by B. Wilson et al.⁵ From these works it may further be concluded that, whilst in formal recommendations some training is assigned to specific stages of rehabilitation, there is no evidence that their

earlier use could have any negative or undesirable consequences. Behavioral interventions are not invasive methods and the decision to introduce them should be based primarily on the specificity of the disorder and secondly the patient's ability to undertake the particular therapy.

Practice guidelines in neuropsychological therapy

Techniques with the status of practice guidelines (Table 2) should be used in addition to or as an extension to a standard procedure or offered when there are no methods with a higher level of recommendation.

As is apparent in Table 2, the presented guidelines consist of therapies for more profound cognitive impairments than indicated in practice standards (often aimed at important aspects of everyday functioning) as well as behavioral and non-behavioral interventions which look to enhance the effects of routine therapies and training with the use of computer programs. However, in terms of the latter, it is noted that patients do not perform computer exercises completely independently, despite their automation. In addition to the gen-

Table 2

Techniques of neuropsychological therapy with the status of practice guidelines in patients with acquired, non-progressive brain injury. ^{29,35}			
	Cognitive Impairments	Brain Damage	Therapeutic Practice Guidelines (Rehabilitation Stage)
Attention and perception	Deficits in attention and working memory	TBI	Direct-attention training using computer based tasks
	Left visual neglect	Right-Hemisphere Stroke	Combination of visual scanning training with left hand stimulation or left limb activation technique
Memory	Severe memory impairments	TBI Stroke	External compensatory tools applied to important life activities
Social communication	Language impairments	Left-Hemisphere Stroke TBI	Training of specific deficits of language, e.g. impairments of reading comprehension
	Aphasia	Left-Hemisphere Stroke	Combination of standard therapy with rTMS (later stages of rehabilitation)
Executive functions	Mild and moderate executive dysfunction	TBI	Metacognitive strategy training applied to practical activities, performed as part of occupational therapy
	Deficits of self-awareness of disease symptoms	TBI	Delivering clear – verbal and/or visual – feedback on performance as an element of metacognitive strategy training (later stages of rehabilitation)
Cognitive functioning	Deficits of attention, memory and executive skills	TBI Stroke	Computer-assisted cognitive tasks performed under the supervision of a therapist as an element of a more complex program of therapy

erally accepted advantage of training conducted under the supervision of a professional over independently performed exercises, in the case of disorders that seriously disrupt human functioning (such as neglect syndrome or severe attention and memory deficits), performing cognitive tasks without the supervision of a therapist, or at least a trained volunteer, is disadvised^{29,32}.

The quality of the scientific evidence (data indicating probable efficacy) supports the supplementation of the above guidelines with the non-behavioral, non-invasive technique of repetitive transcranial magnetic stimulation (rTMS) in patients with post-stroke chronic, non-fluent aphasia. Research shows its addition to standard speech and language training can increase the efficacy of rehabilitation³⁵, thanks to concomitant interactions at the cognitive and neurophysiological level. The pro-therapeutic importance of rTMS is attributed to the reduction of differences in the levels of activation of the cerebral hemispheres caused by damage to one of them. In the case of aphasia, these differences are expressed by too low excitability of the hemisphere affected by the stroke, i.e. left (activation depression of the persistent cortical areas, including the components of the

language system) and overactivation of the structurally intact right hemisphere (right-hemispheric hyperactivation, with the greatest excitability of structures opposite to the stroke location)⁵⁴. According to previous studies, this activation “balancing” should be administered by way of inhibiting right hemisphere activity with low-frequency (≤ 1 Hz) rTMS, applying the stimulation coil to the head over the inferior frontal gyrus (the region opposite to Broca’s area, usually damaged in non-fluent aphasia)³⁵. However, it should be noted that although the method is non-invasive, it cannot be used in people with contraindications to magneto-stimulation; it is sometimes poorly tolerated by patients; and should only be used by appropriately qualified personnel (licensed doctors or trained medical workers, working under a doctor’s supervision)⁵⁴⁻⁵⁶.

Practice options in neuropsychological rehabilitation

Optional techniques (Table 3), similarly to practice guidelines, may be added to a standard program of therapy or be introduced conditionally in the absence of methods of higher-level recommendation.

Table 3 shows that, in addition to the even wider use of modern electronic technologies (computer programs, virtual reality) in therapy planning, it is also worth considering: the principle of errorless learning (the selection of tasks and aids which eradicate the possibility of incorrect answers and corrections associated with trial and error learning), the functionality of proposed exercises (aimed at every-day and/or important life activities), group improvement of cognitive functions and/or the modulation of social behavior. However, it is noted that with severe cognitive-behavioral disorders the expected benefits from such interventions may not be realized when the activities are not practiced directly²⁹. Therefore, patients with serious cognitive syndromes should be offered therapies of the highest ecological value, understood as the incorporation of therapeutic activities to the reality of the patient’s life and that of their family⁷.

Additional meta-analyses, where relatively few and small studies were identified, support the inclusion among rehabilitation options of therapy for acalculia³³ and a combination of standard therapy of neglect syndrome with techniques of transcranial brain stimulation^{36,37}.

Within the scope of post-stroke/post-TBI acalculia (problems with un-

Table 3

Techniques of neuropsychological therapy with the status of practice options in patients with acquired, non-progressive brain injury. ^{29,33,36,37}			
	Cognitive Impairments	Brain Damage	Therapeutic Practice Options (Rehabilitation Stage)
Attention and perception	Left visual neglect	Right-Hemisphere Stroke	Using electronic technologies in visual scanning training Combining standard therapy with rTMS or tDCS treatments
	Deficits of visual perception without neglect	Right-Hemisphere Stroke	Training of visuospatial abilities and visual organization skills (early stage of rehabilitation)
Memory	Mild memory deficits	TBI Stroke	Group therapy
	Severe memory deficits	TBI	Errorless learning strategy to acquire specific skills and knowledge
Language and spatial relations	Acalculia	Stroke TBI	Re-education in terms of knowledge of numbers, arithmetic exercises
Social communication	Language impairments and social communication deficits	TBI	Group therapy
	Cognitive and language deficits	Left-Hemisphere Stroke TBI	Computer-based tasks in addition to a standard program of therapy
Executive functions	Mild and moderate executive dysfunction	TBI	Group interventions serving to improve self-awareness of disease symptoms, problem-solving abilities, behavioral self-control and emotional self-regulation (later stages of rehabilitation)
	Severe executive deficits with limited awareness of disease and inability to compensate for deficits	TBI Stroke	Functional training for everyday skills, applying the principle of errorless learning
	Cognitive-executive deficits	Stroke	Metacognitive strategy training as an element of occupational therapy (early stage of rehabilitation)
Cognitive functioning	Functional cognitive disorder	TBI Stroke	Integrated program of individually selected and targeted trainings to increase independence in home and work life
			Group-based interventions targeted at increasing functional self-awareness, independence and/or general improvement of mental well-being as a component of comprehensive-holistic therapeutic programs

derstanding the number system and counting), it is recommended to gradually rebuild in patients the knowledge of numbers and their relations and also to improve their counting skills by performing more and more difficult arithmetical tasks³³.

Meanwhile, in people with post-stroke left visual neglect one may consider combining cognitive training with rTMS^{36,37} or with transcranial direct current stimulation (tDCS)³⁷. The methods differ in terms of impact on brain processes; while both may be used in order to inhibit the undamaged (potentially overactive) left hemisphere (low-frequency rTMS; cathodal tDCS: ≤ 2 mA), only tDCS is used to enhance activation of the damaged hemisphere, i.e. right one (anodal tDCS: ≤ 2 mA)⁵⁴. However, the decision to use these meth-

ods should be taken in the context of their existing low level of recommendation and the possible workload and discomfort caused by the treatments^{54,55}.

Limitations and shortcomings in existing recommendations

Despite the growing number of studies on techniques of neuropsychological rehabilitation, the body of evidence remains small and the research too heterogeneous (different forms and parameters of trainings, various clinical characteristics of the subjects) to try to estimate the minimum “doses” of therapies needed to obtain functional benefits (among others, duration of exercises, frequency and number of therapeutic sessions)

or to specify interventions in terms of their detailed rules and stages of the procedure.

Another insufficiently explored area is the effectiveness of standard therapies of various cognitive impairments in patients with coexisting health problems. Clinical observations indicate that psychological characteristics with a particularly unfavorable impact on therapies include: executive dysfunctions associated with disorganization and lack of insight into one's illness, aggression, irritability, anxiety or depression. Their presence, for instance, in people with memory impairments can impede the implementation and independent use of even simple compensatory techniques. In turn, negative somatic factors include: pathological fatigue, pain, visual disturbances, epileptic seizures⁵⁷.

Beyond the need for further research in those areas with established recommendations, for many other neuropsychological deficits guidelines have not yet been created at all due to either a shortage of studies or their low methodological value. This problem concerns such rare disorders as agnosias (difficulties in recognition/interpretation of perceived stimuli), as severely disabling conditions as amnesias, profound memory disorders and executive dysfunctions, and those as little clinically studied as body schema disorders (an inability to orient parts of the body and/or differentiate its left and right side) or alexithymia (an inability to identify/understand emotions, to describe and express feelings).

SUMMARY

Neuropsychological rehabilitation is an important part of the neurorehabilitation process in adult patients with acquired and non-progressive brain injury. Training of cognitive functions and interventions that model emotional reactions and social behavior should serve to restore important skills and/or compensate for remaining impairments, and to adapt patients to the consequences of their condition. Rehabilitation programs should be created following current recommendations in terms of standards, guidelines and options of therapeutic procedure. The primary objective of the therapeutic programs should be to maximize the patient's independence and improve their quality of life.

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