The importance of cognitive intervention in acquired traumatic brain injury during 6 months of multidisciplinary rehabilitation: a case description

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ABSTRACT

Planning an immediate and multidisciplinary rehabilitation is crucial to reduce the significant physical, cognitive, and psychosocial impact resulting from head trauma. This study highlights the importance of ongoing cognitive rehabilitation in conjunction with other rehabilitation therapies, such as motor, occupational, and speech therapy, for a 19-year-old woman who suffered an acquired traumatic brain injury in a high-energy vehicle accident. When the patient was admitted to the hospital, their cognitive functioning (LCF) was 4 (confused-agitated state), their Barthel index was 0, their Glasgow coma scale (GCS) was 7, and their disability rating scale (DRS) was 7. The patient's cognitive functioning improved to LCF 8 (purposeful-appropriate), numerical rating scale: 0/10, Barthel index: 53, GCS:15, and DRS: 5 at the time of discharge from the neurorehabilitation unit. In conclusion, early cognitive intervention in a multidisciplinary rehabilitation program is essential to maximizing the patient's potential and improving the rehabilitation's outcome.

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Introduction

Acquired traumatic brain injury (TBI) is a leading cause of acquired disability in young adults, and the resulting impairment can be widespread, affecting a person's physical, cognitive, and psychosocial functioning.[1] Mental performance has a direct effect on functioning, reducing a person's level of independence and contributing to an overall disability, affecting specifically linguistic skills, ability to prepare, coordinate and implement a plan to achieve a pre-set goal, ability to learn new information, self-awareness, ability to criticize and judge, impulsivity, disinhibition, socially inappropriate behavior, frustration, difficulty maintaining focus and working at a fast pace, motor and verbal inertia, anxiety, lack of autonomy in daily life.[2] Therefore, knowing the evolution of these deficits during the initial stages is of utmost importance for clinicians as it can plan more effective intervention programs. In this case, we established a cognitive baseline through practical and efficient assessment tools such as the level of cognitive functioning (LCF) to evaluate responsiveness to stimuli, ability to follow commands, presence of unintentional behavior, cooperation, confusion, awareness, verbal ability, memory, orientation, and higher cognitive ability, to follow improvement and recovery of the patient over time.[3]

Case Report

In March 2022, a 19-year-old undergraduate student of Foreign Languages with sequelae of a serious polytrauma that occurred in February 2022 was admitted to our Neurorehabilitation Unit of Mater Olbia Hospital, for intensive rehabil-

itation treatment. In her past medical history, no chronic diseases or past psychiatric diagnoses were reported.

The following assessment scales were administered: i) numerical rating scale, intensity of pain not assessable; ii) Barthel index, 0 (totally dependent); iii) disability rating scale (DRS), 7 (extremely severe disability).[4-6]

As a result of clinical evaluation, the following was observed: i) spontaneous opening of eyes; ii) left deviation of the face and fixed gaze without any type of visual tracking; iii) left hemiplegia with reduced muscle tone; iv) on right a slight increase in muscle tone; v) lack of motor coordination; vi) left rib and left collar bone fractures; vii) pelvic fracture and sacrum bone fracture; viii) left intradermally stitched suborbital lesion; ix) percutaneous endoscopic gastronomy (PEG) and tracheostomy tube in spontaneous respiration.

Magnetic resonance imaging of the brain was requested, which documented signs of diffuse axonal injury (grade 3) at the left cerebellar level. In addition, signs of bilateral frontal-parietal-temporal subarachnoid hemorrhage along the interpeduncular cistern and longitudinally along the cerebral falx were found.

Neuropsychological examination showed: i) responses that are directly related to the type of stimulus presented; ii) state of hyperactivity; iii) aggressive behavior, with attempts to remove PEG and bladder catheter; iv) lack awareness; v) poor collaboration in rehabilitation treatment; vi) execution of automatic motor activities but not intentionally or on request.

Therefore, the patient presented a LCF 4: confused-agitated.[3]

An individualized rehabilitation plan was formulated by a multidisciplinary team with the primary aim to maximize the re-acquisition of autonomy in activities of daily living (ADL) and reduce as much as possible the psycho-social impact following head trauma.[7]

First month

The patient presented an erratic and delayed execution of simple commands, which are signs of cognitive fatigue and persistent psychomotor agitation. These challenges made it difficult for the patient to actively participate in rehabilitative care. In this phase, physical rehabilitation consisted primarily of passive motion exercises to mitigate complications of immobility and prolonged bed rest. Simultaneously, an intense cognitive intervention improved the patient's comprehension of verbal language and enhanced effective communication. For example, non-verbal communication with a simple gesture such as a thumbs up for "yes" and a hand on the abdomen for "no" was implemented to permit the patient to manifest her needs, increase self-awareness, and improve compliance with rehabilitation treatment. Cognitive training was initially characterized by olfactory, auditory, and tactile sensory stimulation, progressing to a reorientation in time, and space and stimulation of self-awareness. Parents' psychoeducational sessions were conducted to instruct them, on how to adequate the constant sensory stimulation during their visits. After two weeks of cognitive stimulation, the patient began executing on demand albeit inconsistently, simple commands (close eyes; raise a hand; take my hand; touch belly/head/thigh, stick out tongue) and began to use some greeting hand gesture. At the same time, an improvement in communication was observed: the patient was able to respond to a question by nodding her head for "yes" and wagging her finger for "no". Some attempts of vocalization also appear. Despite anterograde memory deficit, which the patient tried to compensate with confabulations, improvement in retrograde memory was noted. Even the weaning from the tracheostomy tube, swallowing, and voice rehabilitation were obstacles by the persistence of some challenges like spatiotemporal disorientation, frequent episodes of confusion, poor awareness of the current clinical condition, hyperactivity, and restlessness following physical and cognitive fatigue. Therefore, instrumental examination of swallowing was replaced by clinical evaluation.

Cognitive framework was improving and was compatible with a LCF 5: confused-inappropriate.[3]

Second month

Cognitive rehabilitation increased and the reorientation training was implemented for the persistence of easy fatigability and episodes of confusional state. There was a slight increase in the patient's level of attention. Despite the dysphonia with a breathy voice due to vocal fold paralysis, the patient started giving verbal responses that, although hypoarticulate were contextually appropriate. (hello, mom, thank you, yes, no, her name). There was a progressive increase in the number of words produced and she began to produce some sentences appropriate to the context (hello mom, brother's name, I'm fine). She was able to remember the main point of a conversation but could not recall details. Verbal language comprehension now appeared sufficient. Vocal rehabilitation was initiated. Tracheostomy tube weaning continued, the tube was maintained capped during the day, and the filter was placed for the night hours. Current achieved cognitive functioning was compatible with an appropriate LCF 6: confused-appropriate.[3]

Third month

The patient began inquiring about the reason for hospitalization and events leading to her current condition (why am I in the hospital? What happened to me?) which had a corresponding impact on her mood, which was reactive to her current clinical condition.

Therefore, psychological support was initiated, focusing on understanding and managing emotions. Video calls were also made with family and friends responding to the patient's specific request. She began to use a tablet to watch films in their original language even though she showed difficulty understanding and processing information in a foreign language. Thanks to improvement in cognitive functioning, occupational therapy in the bathroom commenced with activities like brushing teeth, washing the face, and applying make-up. A daily routine was established to promote self-care and autonomy in ADL.[7] Motor rehabilitation continued with an increased number of exercises aimed at correcting torso load distribution in a static upright position and improving balance, as well as training the proper postural transfers from bed to chair and positioning in a multifunctional tilting wheelchair for increasingly longer periods. Tracheostomy tube weaning progressed to capping the tube 24/24 hours to decannulation. Swallowing rehabilitation proceeds and Functional Oral Intake Scale (FOIS) scored 6:[8] total oral intakes with no special preparation, but must avoid specific foods or liquid items. By the end of the third month of hospitalization, cognitive functioning was compatible with a LCF 7: automatic-appropriate.[3]

Fourth month

The patient faced difficulty maintaining attention in demanding and stressful situations, exhibiting impaired judgment and inappropriate awareness of danger. Challenges persisted particularly in new and unstructured situations, leading to impulsive action driven by frustration. Neuropsychological rehabilitation aimed at self-awareness, planning, initiating, and completing activities continued and at the end of the fourth month of hospitalization cognitive functioning appeared compatible with LCF 8 purposeful-appropriate.[3]

Fifth month

An extensive neuropsychological battery composed of standardized tests was administered (Table 1).[9-13]

To evaluate mood, the hospital anxiety and depression scale (HADS),[14] used to screen for depression and anxiety, was administered. Neuropsychological examination revealed a reduction in information processing speed and visuospatial scanning ability. Visuospatial long-term memory and sustained attention were not optimal, compared to a normal encoding, storage, and resilience capacity of verbal material. Albeit slightly, a difficulty in cognitive flexibility persisted. There was no evidence of ideational or ideomotor apraxia. Programming ability, inhibitory control, sensitivity to interference, and logical-operational reasoning were within normal ranges. The patient's spontaneous speech was informative, topic fluctuation was not observed, and subjects and content were always congruous. Language comprehension was adequate, but verbal initiative remained reduced. There is no evidence of socially inappropriate behavior, impulsiveness, loss of self-control, and reduced tolerance to frustrations. There was sufficient awareness of the current clinical condition with associated mood lowering, as evidenced by the score obtained on HADS of 11 (moderate depression).[14] In terms of otorhinolaryngology and speech therapy, the patient regained independence in eating, good vocal quality, and almost total vocal cord motility was restored. PEG was removed and complete oral nutrition without restrictions was achieved (FOIS scored 7).[8] From an occupational point of view, she was able to maintain a daily routine aimed at self-care and carrying out ADLs.[7] On a motor level, the patient had regained complete autonomy in postural passages and transfers. An improvement was recorded in the control of static and dynamic torso, which allowed the almost autonomous achievement of upright statics and greater safety in walking, which was possible for short distances without aids but with supervision.

Sixth month

Improvement was evidenced by scores obtained through the evaluation scales administered: i) Barthel index:[5] 63, moderate level of dependence; ii) trunk control test:[15] 100%; iii) LCF 8:[3] purposeful-appropriate; iv) DRS 3:[6] partial disability.

In September 2022, the patient was discharged home with an indication to continue rehabilitation locally and to initiate psychotherapy.

Discussion

In our study, intensive neurological rehabilitation yielded substantial enhancements in cognitive functioning for the patient. Despite some residual deficits, such as reduction in information processing speed, visuospatial scanning difficulties challenges in foreign language comprehension, and visual-spatial long-term memory, rehabilitation helped improve the patient's communication, self-awareness, and understanding of one's current and past situation, facilitating adaptive response to stimuli, verbal production, encoding, storage, and resilience capacity of verbal material.

Conclusions

Our work shows how cognitive rehabilitation - when in synergy with motor, speech, and occupational rehabilitation - plays a crucial role in optimizing functional recovery, mitigating the great social and psychological impact, and enhancing the overall quality of life of individuals with TBI outcomes.

Table 1. Neuropsychological test scores.

Cognitive function	Test used		Raw score	Correct score	Cut-off
Long term memory verbal	Rey's 15-word list	Immediate recall	40	29.1	28.53
		Delayed recall	9	5.5	4.69
	Short story recall	Immediate recall	4.9	4.4	3.10
		Delayed recall	4.9	4.1	2.39
Long term memory visuo-spatial	Rey's Osterrieth complex Figure	Immediate recall	15.5	10.7	6.44
		Delayed recall	9.5	4.3	6.33
Attention	The visual search		30	21.75	31.00
	The trail making test	A	128	145	94.00
Executive functions		B	253	308	283.00
		B-A	125	163	187.00
	FAB		18	18	13.5
	Phonemic fluency		33	26.2	17.35
	Categorical fluency		31	25	25
Constructional praxis	Rey's Osterriethcomplex figure	Copy	27	24.4	23.74
Abstract reasoning	Raven's colored progressive matrices		32	27.2	18.96

FAB, frontal assessment battery.

Table 2. Semi-structured interview about the patient's current condition nine months post-home discharge.

Questions	Patient responses
"Nine months after discharge, are you continuing with rehabilitation?"	"Yes, I am undergoing rehabilitation in Cagliari. I am engaging in occupational therapy, physiotherapy, speech therapy, and sessions with a psychologist."
"From the beginning of your admission to our Neurorehabilitation Unit to now, you have traversed a long and complex path. To what extent and in what areas do you think you have progressed?"	"In all areas. I started from a tragic situation, but yes, I think I have improved in all areas: in the initial situation I was in a wheelchair, and now I can walk! Of course, I always need a person next to me for safety, but compared to before is much better! My voice is not back the way it was before but it has improved so much: when I was in the hospital it was difficult for me to shout, but now I can. For autonomy, I am now able to dress/undress, put on makeup, and wash myself: I had started doing it in the hospital thanks to the occupational therapist and I continued at the rehabilitation center where I go now. The accident caused severe damage to my left eye, which caused me diplopia and now I am treating it with prismatic lenses. My arm at the moment I consider to be the most serious problem: it has improved since I was in the hospital but it still has a long way to go. I still have some difficulty concentrating; however, I am preparing for the entrance test in Primary Education Science at the University"
"I remember at the time of your hospitalization you were a first-year undergraduate student of Foreign Languages".	"It was not feasible to continue... too many hours of lessons, it was becoming too difficult to keep up with the exams... however, I want to continue at the University, so my friends told me about Primary Education Science, which is easier than Foreign Languages... lessons are not obligatory and are in Italian."
"What daily activities are you doing now?"	"Every morning I go to the Rehabilitation center to do physical and speech therapy, then I go to the pool twice a week to do rehabilitation. I come home, have lunch, take a nap, and then get up to study for the University. Twice a week I go out with some friends."
"Have you changed hobbies or keep the same ones?"	"Certainly, I have changed them, there are some things that now, unfortunately, I don't do anymore like going to the gym or the disco. Every time I go out, I think 'Is that place suitable for disabled people?' 'Is there a lot of walking involved?' 'Are there architectural barriers?' So, I give up going to many places."
"Do you do your medical check-up at Mater Olbia Hospital or some other hospital?"	"The Mater, for me living in Cagliari, is too far away... so I have made a few visits to Brotzu Hospital in Cagliari but I make most of the visits in private professionals."
"Are you receiving support from family, community, and friends?"	"From family absolutely yes! I ended so many friendships because of my disability but I made other friendships, certainly more authentic than the previous ones."
"Have you started the psychotherapeutic support?"	"Yes, I started it four months after my discharge. I'm going twice a week"
"Have you had problems with social isolation, post-traumatic stress disorder (hyperarousal, irritability, insomnia, avoidance situations that may remind you of the traumatic event), depression, which may have hindered the healing process or are you feeling well and optimistic about your future?"	"I didn't go into depression but I came close... the awareness of disease, giving up some friendships at such a delicate time, the change of routine was a source of great suffering. Thanks to psychological support and my mom, I am doing much better."

We emphasize the key role of early cognitive intervention in the rehabilitation process of patients with TBI, unfortunately, given the reported and increasing need, especially among young adults.

Nine months post-home discharge a follow-up by a phone call from the psychologist was conducted, and some information about her current condition was collected (Table 2).

Based on the rehabilitative treatment described so far, we hope for further recovery of ambulation and autonomy. We note the persistence of a reduction in information processing speed, sustained attention, visual-spatial scanning, and foreign language comprehension, which have led to a change in the university course. However, thanks to rehabilitation treatment, and psychological and social-affective support, the patient acquired more awareness of the disease which allowed her to identify necessary strategies to modify her previous routine according to her current needs and difficulties.

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