

NEUROREHABILITATION IN NEUROTRAUMA

YOKO KATO¹, ANIL SANGLI, SACHIKO YAMAGUCHI, ISAO MORITA, TETSUO KANNO,
HIROTOSHI SANO

¹Department of Neurosurgery, Fujita Health University, Japan

Since time immemorial, neurotrauma has been recorded in various continents. The advancement in neurotraumatology ever since Denny Brown and Trussell's landmark experimental study of concussion, has come a long way with major contributions from neuropathology, neurophysiology, neurochemistry, biomedical sciences, public policies, intensive care medicine and last but not the least, genetics. A simple introduction of lap and shoulder belt have reduced majority of serious accidents. Continuous recording of intracranial pressures, recognition of acute brain swelling with characteristics of cerebral blood flow in brain damage and development of Glasgow coma and outcome scales by a well-designed multi-centered multi-national outcome study in head injuries brought in major changes in sequelae and outcome by preventing and reducing the secondary insults. Computed tomography (CT) and improvement in morbidity and mortality of acute extra axial hematomas by immediate surgery, has influenced and guided several organizations in developing research and formulating guidelines for treatment of acute neurotrauma. The recognition of the spectrum in head injury, aids in prevention of injury and measures to improve outcome by ever developing neuro-rehabilitative measures, apart from advancements in the genetic aspects of understanding the brain's response to injury along with attention to modern principles of neuro-intensive and critical care, has manipulated neurotrauma towards achieving innovative newer frontiers. Assessment of the extent of injury and the deficits in neurotrauma is as challenging as the management itself. Several criteria including the Japanese Coma Scale and the proposition for the international coma scale have been attempted. Once the baseline characters and the psychology¹ of the patient is understood along with the extent and nature of the severity of the injury, a defined patterned timescale with a schedule can be created & tailor made to every patient and all out efforts instituted to rehabilitate not only the individual but also the whole family and the society at large.

Keywords: traumatic brain injury, neurorehabilitation, coma scales, minimally conscious state, vegetative state, outcome scales, neurorehabilitatory interventions

INTRODUCTION AND HISTORICAL REVIEW

Multiple casualties in the World War I brought innumerable casualties along with challenges to treat them. Most of the Neurorehabilitation developed by the end of the first World War slowly dwindled after the war. Onset of World War II brought in renewed interest to Neurorehabilitation with specialized hospital based programs. It was with the advances of Harvey Cushing, in Neurosurgery techniques and Dr. Howard A. Rusk in active rehabilitatory measures which revolutionized the concept of Neurorehabilitation. Newer challenges crept up with the advent of motor vehicle and sport injuries. Rancho Los Amigo Hospital is one of the first Institutes established solely for the purposes of

Neurorehabilitation and still has one of the best methods of established cognitive² and physical rehabilitation schedules.

One of the most frightening aspects in Neurotrauma is that permanent disability or death often is the rule in many including Asian and Oceanic countries³. The concept of Neurorehabilitation is still at its infancy and requires a cohered effort of all involved to prevent Neurotrauma and improve rehabilitatory measures (4).

EVALUATION CRITERIA IN REHABILITATION FOR NEUROTRAUMA

Among the several definitions of disability, impairments etc., WHO definition is more acceptable which terms 'impairment' as any loss or abnormality of the physical, functional and psychological aspects. If the activity or the range of activity considered to be normal for a human is unable to be performed, then, it may be termed as disability⁴⁰. The result of the disability or impairment causing prevention of fulfillment of the role, normal for the individual is termed handicap.

Several assessment modalities to find out the extent of impairment, resulting disability or handicap are recognized (5, 6, 7, 8). They have their own advantages and dis-advantages and not one in isolation shall fulfill all criteria. The most popular among these are in table 1.

Response to close monitoring and documentation of the response is difficult in GOS; (table 2). Functional improvement can be evaluated with Barthel Index but the neurocognitive recovery is not evaluated by it. The functional independence measure (FIM) evaluates functional states and can be applied easily on admission at timely intervals and during discharge. The Disability Rating Scale (DRS) is further, a simpler version of the FIM developed for head trauma. Individuals with a scale between 0-30 are ideal in patients who have entered the chronic phase of

recovery. The RLAS (Rancho's Los Amigo Scale) though has restrictions of being able to be applied individually in evaluation of the functional criteria, can never-the-less be applied to redirect individuals to assign specific protocols in rehabilitation. The orientation and post-traumatic amnesic disorder accompanying trauma can be assessed to the GOAT (Galveston Orientation and Amnesia Test) (37-39).

SEQUELAE IN NEUROTRAUMA

Neurotrauma taxes the individual, family and the society in almost all the areas by bestowing the ugly and most affronting sequelae. To mention a few among the many, the anatomical integrity, functional measures and the psychological factors take a toll on the individual impeding his return to the society as it requires after Neurotrauma (11, 12, 13).

Multiple medical problems associated with neurotrauma includes ulceration, skin breakdown, infections, seizures, contractures, hypertension, GI complication, hepato-biliary complication, DVT, endocrine abnormalities in the acute or chronic phase, spasticity, heterotopic ossification, contractures all are long term problems causing serious deterioration in rehabilitation (14, 15, 16).

Table 1

Sl. No.	Assessment Scale
1	GOS – Glasgow Outcome Scale
2	BI – Barthel Index
3	FIM – Functional Independence Measure
4	DRS – Disability Rating Scale
5	RLAS – Rancho Los Angio Scale for Cognitive function

Table 2

Glasgow Outcome Scale

(From Jennett B, Bond MR: Assessment of outcome in severe brain damage: A practical scale, *Lance* 1:480-484, 1975)

OUTCOME	DESCRIPTION
Good recovery	Resumption of normal daily activities independently
Moderate disability	Impairments or disabilities persist, but with adaptive or assistive equipment, worksite modifications, or other compensatory strategies ; the

	individual remains functionally independent
OUTCOME	DESCRIPTION
Severe disability	Impairments of disabilities persist and assistance of others is required to perform daily activities
Persistent vegetative state	Patient does not survive
Death	

Table 3

Injuries can cause sensory, motor, cognitive, emotional or psychosocial impairments

Sensory impairment	Blindness Deafness Anosmia Sound, light, head intolerance
Motor impairment	Hemiparesis, Quadriparesis Gait disturbances Inco-ordination Seizures
Cognitive impairment	Deficits in alteration Deficits in memory Language and communication disorder Visuo-spatial disorder Problem solving disorder
Emotional impairment	Irritability Restlessness Frustration Anger Depression Mood Alteration Elation Denial Loss of Energy Fatigability
Psychological impairment	Dependency Change of States Lack of respect Loss of family, economic resources Sexual maladjustment Drug and alcohol abuse

LANGUAGE, NON-VERBAL AND NEUROPSYCHOLOGICAL SEQUELAE

Most elusive and difficult to understand and treat is perhaps the language function; whether it be motor or

sensory aphasia. Recovery depends on several factors like the extent of injury and the neurological dysfunction. Controlled oral word association test (COWAT) is the most frequently used verbal fluency

test (17, 18). Constructional apraxia, word finding difficulty, disordered geometric organization, facial recognition, attention and concentrate deficits, speed of processing information, selective attention, hyper or hypo-arousal disorders, memory disturbances, modulation of cognition to achieve goal directed behaviors are the most challenging among Neurotrauma rehabilitation.

PITFALLS IN NEUROPSYCHOLOGICAL ASSESSMENT

Intelligent Quotient (IQ) has been a predictor for the evaluation of cerebral function. IQ measures and summarizes all the quotients as a single score. This depends on the emotional and motivating factors and not necessarily on sole cerebral function. Nevertheless, WAIS-III [Wechester Adult Intelligent Scale-III] measures the verbal IQ and performance IQ. Language disturbance, tasks requiring adaptable abilities are all affected in neurotrauma and may alter the scores (27-31). If the IQ after Neurotrauma drops, it does not necessarily mean that the individual is has an infant brain. In fact, it is still not fully surmised regarding the confusional and functional cognitive balance that is due to an uneven compromise in neural function. Low or high IQ does not mean anything since it may not cover the full scale of the cerebral function or cater to that aspect of the deficit in the cognitive behavior which is at stake.

OTHER FACTORS AFFECTING NEUROREHABILITATION

The mentality of the individual, psychological background, the social and emotional conditioning at childhood, the strengths and weakness, pre-injury-psychological problems, medical problems, alcohol, tobacco or drug abuse, economic background, depression, antisocial traits, marital harmony, family background and support, psychological conditioning at the time of trauma may all compound idealistic assessment methods and confuse management (32, 33, 34). Running a battery of Neuropsychological test helps to assess multiple domains to analyze the strengths/weakness apart from going through the

academic records and records at pre-injury work area. Even, poor scholastic records may not directly relate to cognitive skills, since they may defer due to multiple factors and practicality issues. Adjustment to the post-injury lifestyle may take a longer time and hence the emotional and other abilities come into play causing altered results thus giving a wrong picture (19, 20).

Capacity to think in a normal way, going back to preinjury passions like music, hobbies, language, somatization of emotions, self-care, law abiding nature etc., cannot be individually or in total be evaluated by any single test and requires usually a battery of tests. Motivating an individual to get better, to relearn all that he has lost requires a great deal of immense dedication and commitment on the part of the family or caretakers. Cognitive awareness of the deficiency with the acquired will and motivation gives a great boost to achieve. By and large premorbid perfectionists, attention seeking, grandiose, histrionic, somatoform disordered patients require proper expert guidance (21, 22). Remembrance of the near death experience is more problematic especially in rape or assault etc.

Several medical, social, psychological, sensory and motor modalities of rehabilitation are in vogue (9, 10). Sensory modality by dorsal column stimulation, deep brain stimulation, medial nerve stimulation, touch, speech, music, visual stimuli etc., has given varying benefits²⁶. Thus, an overall intensive management in acute trauma for medical complications and in the later stages for psychosocial and functional complications helps in a better assessment and functioning (35, 36).

CONCLUSION

The neuropsychological testing and testing for various cognitive functions must include proper reliability, validity and standardization wherein presently the main domains such as sensory, motor, intellectual and attention deficits along with language and memory disorders become the major part. The same test must be examined by different clinicians using various parameters in the same way and note down the observations stereotypically, thus making any result, examiner-independent (25).

The degree to which a positive co-relation exists by applying the same examination in the same individual at different points of time, indicates the reliability which for which the co-relation co-efficient should be at least ≥ 0.8 . It is important to know what a particular test measures, its aim is and how well the aim is achieved. It is mandatory to transcend our own disciplines and make a conscious, reliable, affordable and practical decision to make a traumatic brain injury patient live inside and outside and face day-to-day problems. A holistic approach is thus required, since patients may have anatomical, physiological and psycho-emotional or cognitive problems (23, 24). It is a multi-disciplinary attitude with the neurosurgeon, neuropsychologist and other health care professionals who can perpetuate to this extremely difficult, noble task of bringing a patient back to reality.

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