CASE STUDY

EFFECTIVENESS OF COGNITIVE RETRAINING AFTER BRAIN TRAUMA— CASE STUDIES

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Abstract

India has a rather unenviable distinction of having the highest rate of head injury in the world. In India, more than 100,000 lives are lost every year with over 1 million suffering from serious head injuries. Traumatic brain injury is a complex injury with a broad spectrum of symptoms and disabilities. The impact on a person and his or her family can be devastating. Cognitive difficulties are very common in people with traumatic brain injury. Studies have shown that cognitive retraining plays a crucial role in improving the cognitive and basic functioning in these patients. We report three confirmed cases of effective cognitive retraining in moderate and severe traumatic brain injury.

Key words: *Brain injury; Cognitive deficit; Cognitive retraining*

1. INTRODUCTION

Head injury survivors may experience a range of neuropsychological problems following a traumatic brain injury. Depending on the part of the brain affected and the severity of the injury, the result on any one individual can vary greatly. Personality changes, memory deficits, lack of impulse control, and poor concentration are all common. Behavioral changes can be stressful for families and caregivers who must learn to adapt their communication techniques, established relationships, and expectations of what the impaired person can or cannot do (Eames, 1988).

In some cases extended cognitive retraining in a outpatient setting will be necessary to regain certain skills. A neuropsychologist also may be helpful in assessing cognitive deficits. However, over the long term both the survivor and any involved family members will need to explore what combination of strategies work best to improve the functional and behavioral skills of the impaired individual.

Given below are case studies of three head trauma patients (of moderate to severe head injury). All the cases were evaluated repeatedly on the following:

2. CASE I

A 30 year old right handed male suffered a severe head injury during train accident following a brain hemorrhage and was rendered unconscious for 3 days. The accident occurred one year prior to seeking psychiatric treatment. Post injury, his family noticed

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personality and behavioral changes in him. He was diagnosed to be having severe cognitive problems along with physiological problems including, loss of sleep, extreme aggression, and loss of appetite for which he was given psychiatric medication for approximately 2 weeks. But there was no sign of improvement in his behavioral and cognitive functioning. As a result of which he was referred to neuropsychologist for cognitive retraining.

Table 1. Clinical Neuro Psychology Procedures Used

Clinical Neuro Psychology Procedures Used		
Neurocognitive Evaluation		References
Mini Mental Status Examination		Folstein, Folstein & McHugh (1975)
Gesell’s Drawing Test		Gesell & Amatruda (1947)
Verbal Scales	Range of Knowledge/ current awareness	Pershad & Verma (1990)
	Attention and Concentration	
	Working Memory	
	Judgment/Comprehension Ability	
	VIQ	
Non Verbal Scales	Non Verbal Reasoning/ Abstract Intelligence	Bhatia (1955) Alexander (1937)
	Concrete Intelligence	
	PQ	
	Mean IQ	Pershad & Verma(1990) & Bhatia (1955)
Memory Evaluation	Remote Memory	Pershad & Wig (1977)
	Recent Memory	
	Mental Balance	
	Delayed Recall	
	Immediate Memory	
	Simple Memory	
	Ability for New Learning	
	Visual Retention	
	Recognition	
Misrecognition	Present/Absent	
Interperseveration	Present/Absent	Pershad & Verma (1990) Pershad & Wig (1977)
Intraperseveration	Present/Absent	
Neuropsychological Evaluation		Mukundan (1996)
	NIMHANS Neuropsychological battery	
Cognitive Retraining/Restructuring		
	Planned as per the results on the Neurocognitive/neuropsychological evaluation results (Holistic Approach Used for all the patients)	

Before starting cognitive retraining session, a complete neuropsychological evaluation was done which included MMSE (Folstein, Folstein & McHugh(1975) - 22/30 indicating mild impairment in orientation; Memory Evaluation(Pershad & Wig, 1977) 16th percentile indicative of very poor memory functioning (including recent memory, mental balance,

attention & concentration, delay recall, new learning, visual retention and recognition were found to be impaired); BSS (Bhatia 1955): IQ- below 70 and PQ- below 69; Verbal scale (Pershad & Verma, 1990): where general knowledge=79, attention & concentration=83, working memory=58, comprehension=64, PQ=62 & VIQ=71, all of which were indicative of low average intellectual functioning; and Mukundan's Neuropsychological Battery (Mukundan, 1996) where his frontal lobe functions were found to be impaired (working memory, abstract intelligence, serial learning and set shifting). While temporal and parietal lobe functions were intact.

After detailed evaluation, cognitive restructuring was started with main focus of improving his attention and concentration level and making the patient functionally independent. It included cognitive training modules with progressive difficulty (i.e. letter cancellation and grain sorting) as well as making a significant daily activity schedule giving utmost importance to the patient convenience. The extensive retraining session spread across 6 weeks with 1 week time interval between two follow-ups. Plus, to improve his focal signs, coloring activity was given. Initially there were no changes seen. But after 2 weeks slight changes in functional skill was evident but again there was a period of relapse as well as the aggression level had also increased. After 4 weeks, again same neuropsychological evaluation was done where slight improvement was evident. MMSE (Folstein, Folstein & McHugh, 1975)- 23/30 indicating mild impairment in orientation; Memory Evaluation (Pershad & Wig, 1977)- 16th percentile indicative of very poor memory functioning (recent memory, mental balance, attention & concentration, delay recall, new learning, visual retention and recognition were found to be impaired as before); BSS(Bhatia, 1955): IQ- 84 and PQ- 88. Verbal scale (Pershad & Verma, 1990): where general knowledge=82, attention & concentration=93, working memory=89, comprehension=78) overall PQ- 88 & VIQ- 77 indicative of slight improvement in intellectual functioning. In Mukundan's neuropsychological battery (Mukundan, 1996) his frontal lobe functions were found to be slightly improved (working memory, serial learning and set shifting) in comparison to earlier evaluation. Thus, cognitive retraining was found to be effective in improving his attention and concentration level to an extent. However the patient is still under follow up after 1 month period.

3. CASE II

A 22 year old right handed male suffered a moderate penetrating head injury which resulted in damage of most of the frontal/prefrontal lobular functions. There was an immediate significant loss of consciousness but there was no significant history of vomiting and seizure. He lost most of the immediate family members. His complaints included headache, inability to concentrate, problematic memory, bed wetting, difficulty in processing information, anxiety, sleep disturbance, excessive worries, and fatigue. Considering his problems, he was referred for cognitive retraining.

Before cognitive retraining session, a detailed neuropsychological evaluation was done for lateralization and localization of brain functions which included MMSE(Folstein, Folstein & McHugh, 1975)- 24/30 indicating mild impairment in orientation; Verbal Scale (Pershad & Verma, 1990) where (general knowledge=106, attention & concentration=109, working memory=66, comprehension=51) overall PQ- 82 & VIQ- 83 indicative of low average intellectual functioning; APA (Alexander, 1937) -IQ=58 indicative of mild mental retardation and Mukundan's neuropsychological battery (Mukundan, 1996) where his frontal/prefrontal lobe functions were found to be impaired (working memory, abstract intelligence, ideational fluency, set shifting and orbito- frontal functions), while in parietal lobe he had dyscalculia and visuo-constructive impairment. In temporal lobe he suffered from mild impairment in visual comprehension and auditory perseveration. However, all apraxias and agnosias were intact.

Based on the evaluation outcomes, cognitive restructuring was started with an initial focus of improving his attention and concentration level and making the patient functionally independent. It included cognitive training modules with progressive difficulty (i.e. mathematical problems, coloring letter cancellation and grain sorting) as well as making a significant daily activity schedule giving utmost importance to the patient convenience. For following two weeks the patient didn't follow the schedule and activities religiously. Along with retraining sessions, individual, family counseling and bereavement therapy (Worden, 1991) was followed. Henceforth, he started following the retaining schedules actively for 3 months. As a result of which patient showed improvement. Thereafter he maintained well, talked about his problems on his own but was still depressed about the death of his immediate family members.

After 3 months, more challenging cognitive tasks were included, i.e, reading newspaper, making word list and remembering by using visual analog, medium difficulty mathematical problems, computer configuration task and increasing social interaction. All these activities continued for 7 months. And again a detailed neuropsychological evaluation was done to see improvement where MMSE(Folstein, Folstein & McHugh, 1975)-27/30 indicative of no impairment in orientation; Verbal Scale (Pershad & Verma, 1990) where (general knowledge=116, attention & concentration=86, working memory=101, comprehension=77); overall PQ- 130 & VIQ- 95 indicative of average intellectual functioning; APA (Alexander, 1937) IQ=84 indicative of below average intelligence and Mukundan's neuropsychological battery (Mukundan, 1996) where his frontal/ prefrontal lobe functions were found to improved except mild impairment in abstract thinking, while parietal lobe and temporal lobe functioning had no impairment.

After 10 months long extensive retraining sessions, he started living independently, doing well in his job and maintaining well socially. However, after 1 year, he had a relapse where he started feeling anxious, not able to concentrate, problematic memory, episodes of sadness, and not keeping well with his job.

Again a neuropsychological evaluation was done where his performance ability was found to be decreased; VIQ (Pershad & Verma, 1990)= 98; PQ= 72; APA (Alexander, 1937)= 97 in comparison to earlier evaluation. His working memory & abstract intelligence too were found to be mildly impaired. He was severely depressed [BDI: 29] (Beck, Ward, Mendelson, Mock & Erbaugh 1961) However, 3 sessions of counseling was done and the patient again retracted back to his normal independent life.

4. CASE III

A male aged 28 years old with right handedness had some personal problems and attempted suicide as result of which he suffered severe head injury resulting in paralysis and hemineglect (left). There is significant history of suicidal ideation, delusions, and frequent mood swings. Family reported that patient is aggressive, sentimental, talkative, negative approach to life and gets irritated easily. He complaints of problems with visual tracking, sadness and sleep disturbances. He had a history of psychiatric problems (as reported by family) for which he had taken treatment. The treatment document was unavailable. The patient was referred from Trauma Center for cognitive restructuring.

Accounting the above problems, a neuropsychological assessment was done where MMSE (Folstein, Folstein & McHugh, 1975)-20/30 indicating mild impairment in orientation; GDT (Gesell & Amatruda, 1947): PQ=40 indicative of below average intellectual performance; APA (Alexander, 1937) IQ= below 7 years of age indicative of mild mental retardation, while other test including Mukundan's neuropsychological battery (Mukundan, 1996) could not be administered because of paralytic condition and inability to sit. Therefore an immediate cognitive retraining session was started which included activity schedule (basic skill training); progressive letter cancellation task, grain sorting and computer reading home tasks

were given for 1& half month with regular 1 week review in between. The patient followed the tasks well though with some initial fluctuations. His motivation and cooperation along with family psychotherapy made him improve in his negative behavior and attitude towards life. Though paralytic condition remained the same hence he was referred for physiotherapy.

After extensive cognitive retraining for about 4 months, again a neuropsychological evaluation was done where MMSE (Folstein, Folstein & McHugh, 1975)- 27/30 indicative of no impairment; Verbal Scale (Pershand & Verma, 1990) where general knowledge=116, attention & concentration=123, working memory=121, comprehension=106; overall VIQ=117, PQ= 40; & mean IQ= 79 which is indicative of low average intellectual functioning but cognitive retraining had played a crucial role in bringing improvement in his overall functioning as he is currently pursuing higher studies and living life independently, though still he is not able to walk independently.

5. DISCUSSION

Traumatic brain injury (TBI) is defined as damage to the brain resulting from external mechanical force, such as rapid acceleration or deceleration, impact, blast waves, or penetration by a projectile (Chestnut, Carney, Maynard, Patterson, Mann & Helfand, 1999). Brain function is temporarily or permanently impaired and structural damage may or may not be detectable (Parikh, Koch, & Narayan, 2007). TBI is usually classified based on severity into mild, moderate, and severe categories (Saatman & Duhaime, 2008).

Traumatic brain injury is a principal cause of death and disability in young adults with consequences ranging from physical disabilities to long-term cognitive, social and behavioral deficits. Individuals who sustain brain injuries frequently have difficulties in arousal, attention, concentration, memory, problem solving, decision making, insight and other areas of cognition that impede their ability to perform their occupation in everyday life. Alterations in perception, motor control, balancing, emotional functioning, social interaction and control of behavior are also common after brain injury and are closely linked with cognitive issues (Bell & Sandell 1998). Thus, Cognitive retraining is central to traumatic brain injury rehabilitation. Cognitive retraining involves two essential processes: restoration of functions that can be restored and learning how to do things differently when functions cannot be restored to pre-injury level.

Cognitive retraining or Brain injury rehabilitation (Sohlberg & Mateer, 2001) is based on the nature and scope of neuropsychological symptoms identified on special batteries of test designed to measure brain functioning following brain injury. While practice in various cognitive tasks--doing arithmetic problems, solving logic puzzles, concentration skills, or reading--may help brain rehabilitation, this is usually not enough. The retraining modules are designed taking into account a broad range of neuro-functional strengths and weaknesses. Basic skills are strengthened before more complex skills are added. Only through comprehensive neuropsychological analysis can the many possible effects of brain injury be sorted out. This pattern of functional strengths and weaknesses becomes the foundation for designing a program of brain rehabilitation.

Brain recovery follows patterns of brain development. Gross or large-scale systems are developed (or be retrained) before fine systems. Attention, focus, and perceptual skills develops (or are retrained) before complex intellectual activity can be successful.

Restorative rehabilitation helps the patient recover brain functions that have been impaired. This approach is usually emphasized initially until it is evident that the patient has reached a plateau or has reached the level of functioning that the patient had before the injury. (Burke 2009)

Compensatory rehabilitation helps the patient cope with and compensate for impairments that are likely to be permanent. (Burke, 2009)

Although restorative rehabilitation tends to be employed in the earlier stages of rehabilitation, the needs of the particular patient will dictate exactly which type will be utilized. In fact, at any given time during a program, a patient may receive one type for one particular function and the other type for yet another function.

From the beginning of a program, the neuropsychologists help the patient and often the family to cope with the emotional and behavioral turmoil of the injury. Depending on the severity of the injury, life may never be the same. (Burke, 2009). This can be frightening and depressing. Brain injury may also cause irritability, anger, temper outbursts, emotional liability, and impulsivity. In addition to private therapy and family counseling, the neuropsychologist will often refer to other professionals and support groups. It is very important that patients realize that they are not alone in this ordeal.

On the other hand, it often happens that patients may be unaware of their deficits, a condition known as anosagnosia. In that case, the neuropsychologist will help patients to become aware of and to comprehend the consequences of impairments. This critical process helps patients to understand their limitations and increases their motivation to work harder in the program.

Regardless of the specific treatments used, the patient will likely need to have a comprehensive neuropsychological assessment performed. This will help to determine the extent of injury and to understand as completely as possible the strengths and weaknesses of the patient (Burke, 2009)

Attention process exercises are utilized to exercise very specific circuits in patients' brains. This stimulates reorganization and recovery. In most cases, the initial emphasis is on optimizing patients' arousal levels and normalizing as much as possible various aspects of systems involved in attention and concentration. This type of treatment usually helps other cognitive functions as well including aspects of memory, speed of information processing, and executive functions. Such programs usually contain hierarchically-arranged modules focusing on different cognitive domains. (Burke, 2009). Patients move through these at their own paces as they master each one. Such exercises are practiced regularly, and consideration is given to helping patients generalize newly-learned or re-learned skills beyond the clinical setting to their home or vocational setting. (Burke, 2009). Studies have shown improved long-term recovery with neuropsychological retraining. Such rehabilitation is highly quantifiable so that daily, immediate, precise feedback can be provided to both doctors and patients. This is thought to promote faster and more complete neuronal recovery to facilitate brain reorganization, possibly in moderate and severe head injury patients, to help patients compensate for certain permanent deficits, and to increase patients' motivations and beliefs that they can progress toward normality as they see themselves actually making incremental progress.

In a meta analysis done by Cicerone, Azulay, & Trott in 2009 suggested that several high quality observational studies support the effectiveness of interventions for attention, communication skills, and executive functioning after TBI through comprehensive-holistic rehabilitation.

In conclusion: A holistic Cognitive retraining is an effective method for rehabilitating moderate to severe head injury patients. Such extensive procedures may be beneficial only with the patient's compliance; family support and long term follow up. However, larger sample may be needed to support such conclusions.

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