Cognitive Deficits in Traumatic Brain Injured Adults

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Abstract

Traumatic brain injury (TBI) results in several communication deficits including cognitive deficits. This study was taken up to investigate cognitive–linguistic deficits in Kannada speaking individuals with TBI. A total of 20 subjects participated in the study (10 in experimental and 10 in control group) in the age range of 16 to 45 years. All the subjects had closed head injury; 4 with LHD, 4 with RHD, and 2 with bilateral damage. These subjects were tested in post injury period ranging from 8 months to 16 months. WAB and CLAP was administered and responses were recorded and scored. Results of the study revealed poorer performance of TBI subjects on different test domains of CLAP with more deficits on problem solving and organization domains. Bilateral damage group performed better than LHD group followed by RHD group. This reduced performance by TBI group was explained as a result of frontal lobe injury.

Introduction

Cognitive abilities include attention, discrimination, memory, learning language, and visuo-spatial perception. Ellis & Christensen (as cited in Gillis, 1996), defined "Traumatic Brain Injury (TBI) as a blow to the head that results in diminished abilities subsequent to ..... and is primarily caused by motor vehicle accidents and violent crimes". TBI can either be open or closed head injury. Closed head injury (CHI) is where the trauma does not cause an opening in the skull. It is also called as acceleration–deceleration injuries and diffuse axonal injuries. Open head injury (OHI) is also called penetrating injuries, the common cause being gunshot wound or fracturing of the skull. Such injuries may produce focal lesions (Gillis, 1996).

An estimated 500,000 individuals sustain TBI each year (200 per 100,000 populations). Of this number, 20,000 will die, 50,000 to 100,000 survive with significant impairment preventing independent living and more than 20,000 suffer continuing sequel that interfere with daily living skills. Of the individuals who sustain TBI nearly twice as many males as females are injured. The risk of TBI is higher for children 4 to 5 years of age, males 15 to 24 years of age and the elderly (over 75 years). In the United States trauma is the third leading cause of death among individuals under the age of 35, as per the National Head Injury Foundation (as cited in Beukelman & Yorkston 1991). Shapiro (as cited in Beukelman & Yorkston 1991) found the incidence of children sustaining TBI similar to that of adults with a morbidity of 10 per 100,000 per year. In India, 100, 000 people die every year due to road traffic injuries.❖

Causes of TBI include penetrating and non penetrating causes. Pathophysiology of TBI consists of primary mechanisms of injury where trauma directly cause damage to the

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brain and secondary mechanisms of injury where the pressure is exerted by something as blood clot caused by trauma.

Communication challenges following TBI are most often non-aphasic in nature; that is, they co-exist with intelligible speech, reasonably fluent and grammatical expressive language and comprehension adequate to support everyday interaction. Depending on the severity of the injury, stage of recovery and particular focus of research, the characteristic communication profiles following TBI have been variously referred to as 'the language of confusion', 'sub clinical aphasia', 'Cognitive-language disturbances' and 'non-aphasic language disturbances' (Chapey, 2001).

Several authors have documented reduced alertness levels in individuals having sustained TBI. It is reported that sustained attention decreases significantly as measured by reaction times. After TBI, the rate of making adjustments in response to automatic tasks is significantly slower. Zomeren and Colleagues (as cited in Kennedy & Deruyter, 1991) found that when a distraction was imposed during a visual reaction task, decision making time was significantly slower in TBI group than in the control group. Speed of processing or information processing rate, has been shown to be delayed following TBI (Kennedy & Deruyter 1991).

Visuoperceptual impairments following brain damage may be primary or secondary. Primary deficits include those which are specific such as visual field cuts, visual neglects, agnosias, spatial or body neglects, topographic (environmental) disorientation, and inability to copy and synthesize shapes and images and are associated with specific lesions. Secondary visuosperceptual deficits are the result of generalized cognitive disruption following TBI. A breakdown in sequencing, association or categorization indicates a disturbance in the encoding phase of memory affecting both immediate and recent recall (Kennedy & Deruyter 1991). These internal organizational strategies are frequently impaired following TBI and are the result of impaired attention and monitoring processes.

Amnesia studies have found the presence of both retrograde and anterograde amnesia following TBI. Although controversy exists over the nature of immediate memory (due to its dependency on attention and perceptual processes) recent memory impairment is well documented in TBI individuals. Disordered or delayed recall of recent events and facts is also well documented in the literature (Kennedy & Deruyter 1991). Impaired reasoning (inductive, deductive and analytic), thinking processes (divergent and convergent), insight and problem solving have been documented as occurring in TBI during all stages of cognitive recovery. Difficulties with integration and part whole relationships have been documented by several investigators. Some authors have reported organizational difficulties leading to impaired planning and execution (Kennedy & Deruyter 1991).

Bond (as cited in Kennedy & Deruyter, 1991) suggests that cognitive intellectual deficits and emotional behavioral difficulties are both more persistent and contributory to the psychosocial disability following head injury than are physical impairments. Reports in literature indicate that cognitive and emotional difficulties can occur with relatively high frequency even when there are no documented physical or neurological difficulties. Thus, this particular study was taken up to investigate cognitive-linguistic deficits in Kannada speaking individuals with TBI.

The aims of the present study were:

a. To investigate the nature of cognitive linguistic deficits in TBI subjects.
b. To compare the performance of TBI and normal subjects.

c. Comparison of performance of cognitive-linguistic tasks on Cognitive Linguistic Assessment Protocol (CLAP) (Kamath, 2001) across left hemisphere damage (LHD), right hemisphere damage (RHD) and bilateral damage (BD) subjects.

Method

Cognitive linguistic disturbances are most often present as a consequence of TBI. Present study was taken up to investigate the nature of cognitive deficits present in TBI adults. The study also aimed to find out the differences in the performance by subjects with left hemisphere damage (LHD), right hemisphere damage (RHD) and bilateral damage subjects, if any.

The participants selected were Kannada speakers. Kannada is a Dravidian Indian language, a language spoken mainly in the state of Karnataka.

Subjects: A total of 20 subjects participated in the present study (10 in experimental and 10 in control group) in the age range of 16 years to 45 years (mean age= 23 yrs).

Subject selection criteria for TBI individuals

1) 10 subjects with TBI resulting from road traffic accident participated in the study.
2) Individuals with damage to either of the hemisphere were taken; 4 with LHD, 4 with RHD and 2 with bilateral damage.
3) Subjects had Kannada as their native language and had a minimum of primary schooling.
4) The TBI subjects were evaluated by a neurologist and Speech Language pathologist.
5) The subjects were diagnosed as non-aphasics based on the performances on WAB and clinical symptoms.
6) All the subjects included for the study were right handed.
7) Subjects were tested in the post injury period from 8 to 16 months.
8) Both adult males and females were considered for the study (9 males and one female)
9) All the subjects had closed head injury (CHI).
10) All the subjects had post-traumatic amnesia as diagnosed by a neurologist.

Subject selection criteria for controls

Equal number of controls matched for age, gender, handedness and educational level were taken. They had history devoid of any psychological, cognitive, peripheral, sensory deficit and alcohol intake.

Tools used for the present study

Western Aphasic Battery (WAB) (Kertesz, 1979), linguistic portion (excluding reading, writing and apraxic subsections) was used to assess aphasic component in the TBI subjects. Cognitive Linguistic Assessment Protocol (CLAP) for adults developed by Kamath (2001) in Kannada was used for assessing the cognitive-linguistic abilities of TBI patients. CLAP consists of the following domains and test items as shown in table-4.

Procedure: The subjects were taken from BGS Apollo Hospital, Mysore. These subjects were tested in the post injury period ranging from 8 months to 16 months. They were seated comfortably and were tested in a clinical situation with minimum external noise. Testing was carried out in one or two sessions as required. WAB and CLAP were administered and

responses were recorded and scored. The same testing protocol was adopted for control group as well.

Results and Discussion

The data obtained was tabulated and subjected to appropriate statistical analysis in order to investigate the aims of the present study. Table 1 provides details of scores obtained on various domains of CLAP.

Table 1: The various domains of CLAP

	Domain	Test item	Max. Scores
1.	Attention, Discrimination and perception		
	Visual	a. Letter cancellation	10*
		b. Contingent letter cancellation	10*
		c. Word cancellation	10*
	Auditory	a. Sound counts	10
		b. Letter-pair cancellation	5
		c. Word-pair discrimination	5
		d. Months – backward naming	10*
2. Memory			
	Episodic memory	a. Orientation & recent memory questions	10
		b. Digit forward	5
	Working memory	a. Digit forward	5
		b. Digit backward	5
	Semantic memory	a. Co-ordinate naming	5
		b. Super ordinate naming	5
		c. Word naming fluency	5*
		d. Generative naming	5
		e. Sentence repetition	10
		f. Carry out commands	10
3.	Problem solving	a. Sentence disambiguation	10
		b. Sentence formulation	5
		c. Predicting outcome	10
		d. Compare and contrast	10
		e. predicting cause	10
		f. Why questions	10
		g. Sequential analysis	5
4.	Organization	a. Categorization	10
		b. Analogies	10
		c. Sequential events	40

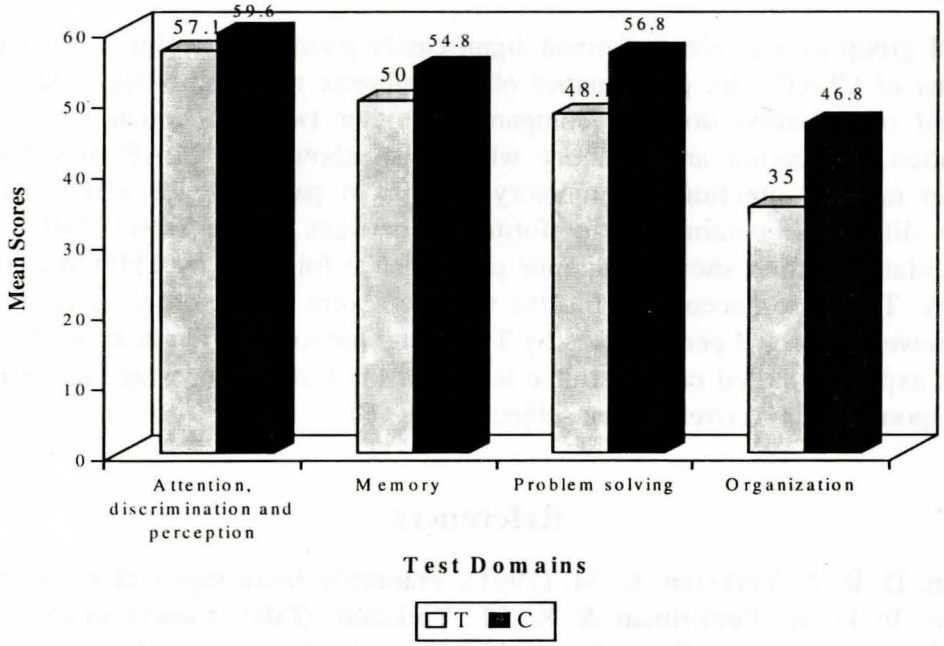
* Items are timed tasks.

Table 2: Comparison of performance of TBI and normal subjects on subsections of CLAP

Test Domain	Subjects	Mean	SD	t-value	Significance
Attention, discrimination and perception	T	57.10	3.03	2.54	0.021*
	C	59.60	0.70		
Memory	T	50.00	5.48	2.53	0.021*
	C	54.80	2.44		
Problem solving	T	48.10	7.67	3.56	0.002**
	C	56.80	0.92		
Organization	T	35.00	14.94	2.23	0.039*
	C	46.80	7.55		

df = 18 T-TBI group C-Control group
n=10 ** P<0.01 *p<0.05

Graph 1: Performance of TBI and control group on sub-sections of CLAP



As seen from table 2 and graph 1 the control group had a higher mean score than that of TBI group for all the test domains of CLAP. Results of t-test showed statistically significant difference in scores of the two groups.

Overall, the TBI subjects needed more repetition of instructions than normals. Also, the time taken to initiate and complete a task was more for subjects with TBI. Self-corrections were seen in most of the subjects in the form of rephrasing the answer or repetition of the answer. Also they needed cues to initiate the response. Two of the subjects (T_5 and T_7) had disfluencies present in their speech. Two of the subjects with RHD (T_5 and T_7) had evident attention problems. They could not do one or two subsections of the test even with the help of cues. Lots of emotional fluctuations were also noticed in these patients. They exhibited irrelevant responses and their responses were off-target. They also gave extra information, more than what was asked to them. The results indicate that there was also difficulty in topic maintenance.

The findings of present study are in accordance with earlier studies reported in literature in terms of impaired attention (Browner & Wolffelar 1985), perceptual deficits

(Goldstein & Oakley 1986), memory deficits (Brooks 1974), impaired reasoning and problem solving (Golding 1981) and impaired categorization (Kennedy & Deruyter 1991). This reduced performance by TBI group was explained as a result of frontal lobe injury which controls the cognitive functions (Hartely 1995).

Comparison of the mean scores of TBI subgroups revealed reduction in performance of TBI subjects from attention, discrimination perception domain to the organization domain for all the subgroups of TBI i.e., bilateral damage, LHD and RHD. The better performances were seen by bilateral followed by LHD, and the RHD group performed poorest in all the test domains. While discussing these findings one important point to be noted here is that in the LHD group, all the 4 subjects were moderately injured and in RHD group all the 4 subjects were severely injured. However, in the bilateral group, one of the subjects was moderately and the others were severely injured. This factor would also have contributed in the discrepancy of scores obtained for these three sub-groups of TBI.

Conclusions

TBI group as a whole performed significantly poorer than controls for the different sub-sections of CLAP. The performance of the subjects were more impaired on problem solving and organization domains compared to other two test domains, i.e., attention, discrimination, perception and memory which also show that CLAP may not be very sensitive in tapping attention and memory deficits in patients with TBI. There was no significant difference obtained in performance between the different TBI sub-groups, although, bilateral group showed superior performance followed by LHD and RHD group respectively. The reason accounted for this was the severe degree of injury in subjects with RHD. However, the equal performance by TBI group for some of the tasks with those of the controls is explained based on the simple nature of the task, younger age range of subjects taken and spontaneous recovery in the subjects with TBI.

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