Progression of Memory/Attention Abilities Post-Traumatic Brain Injury

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Introduction

Following a traumatic brain injury (TBI), patients frequently have memory and/or attention deficits. These deficits can significantly influence an individual's ability to adequately perform activities of daily living and function in day-to-day life. The manner in which impaired memory/attention skills progress is vital to success in overall rehabilitation and important for continued success in patients regaining independence. In addition, understanding what happens during this progression and the variables influencing progress will help those who care for and treat patients with TBI provide better therapeutic/ rehabilitation services.

Long and Short-Term Memory

For most head-injured individuals, long-term memory is usually intact. However, some patients who suffer retrograde amnesia, may have trouble recalling long-term memories. As individuals with TBI progress, long-term memories tend to return (Johnson, 1998). Researchers who examined 13 memory-impaired individuals (Thne, Zysset, von Cramon, 1999) found that brain-injured individuals had decreased automatic retrieval from long-term memory. In patients with more severely impaired memory, this automatic retrieval was even further decreased. In head injury, deficits in short-term memory are significant and have been among the most common deficits found in all persons with TBI. Research has shown that long and short-term memory can be impaired in patients with brain injury, but there is a lack of research that has examined at what point in the recovery process that long-term memories return. The overall percentage of patient populations with TBI who have decreased short and long-term memory is not known.

Confabulation

Many patients who suffer deficits in memory and attention may also exhibit confabulatory behaviors. A confabulation occurs when a person recalls or states false or untrue information/events that he/she believes to be true or factual. Most confabulations decrease in frequency and disappear during recovery, while some patterns of confabulation behavior may persist (Weinstein, 1995). One research study examined 101 head-injured individuals and determined that 60 of the patients (59%) continued to demonstrate confabulation at six months post-TBI (Weinstein & Lyerly, 1968). When examining a specific case history, past researchers found that confabulation in an individual with TBI persisted up to nine months post-injury (Demery, Hanlon, & Bauer, 2001). Confabulatory behavior was still present in head-injured individuals even up to three to five years post-injury as reported by other researchers (Weinstein, 1995).

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Severity of Memory/Attention and Time Post-TBI

Because individuals with brain injuries most often have deficits in memory and attention, there have been numerous research studies that have examined improvement/lack of improvement in these areas as time post-TBI progresses. In a study of 113 patients who had suffered head injuries (MacFarland, Jackson, & Geffen, 2001), hospital staff felt that overall functioning, including cognition, was improved to the point that 47 patients (42%) were ready to be discharged at seven to eight weeks post injury, 46 patients (41%) were discharge ready from two to four months post injury, and the 20 remaining patients (18%) continued to have decreased orientation and memory beyond four months post-injury. Other research (Parker & Serrats, 1976) examined 108 individuals with head injuries and found that up to 92% of patients who suffered short periods of 'post-traumatic disorientation (PTD) periods' with decreased memory less than one month post injury, demonstrated improvement in memory to within normal function within the first year after injury. Patients who demonstrated a longer PTD with decreased memory for more than one month, only resulted in 45% of patients who demonstrated normal memory function after one year. During the second year after injury, neither group of patients demonstrated significant change in memory status. Researchers who tested patients with TBI (Kersel, Marsh, Havill, & Sleigh, 2001) found that improvement in all cognitive areas occurred during the first year after injury. At 6 months and 1 year post-injury, the greatest impairment was demonstrated with verbal memory and complex attention measures. One-third of patients continued to demonstrate impairment in all cognitive areas, even at one year post injury. At 6 months and one year post-TBI, impairment was greatest in the area of verbal memory.

Purpose/Objective

The present study had three primary objectives. First, the extent patients' short and long-term memories were intact with respect to time post-TBI was examined. Secondly, the coexistence of confabulations with memory/attention deficits in patients with

TBI was studied and the point, post TBI, where most confabulations ceased was determined. Third, patterns of improvement in memory/attention in patients with TBI in a rehabilitation setting were also examined. Previous researchers have developed protocols for assessing levels of recovery and progression of brain injury such as the Disability Rating Scale (Rappaport, Hall, Hopkins, Belleza, & Cope, 1982) and the Rancho Los Amigos Scale (Hagen, Malkmus, and Durham, 1972). However, collective information about progression of memory/attention according to specified time post-injury is scarce. The information obtained from this research could be used to assist patients, patients' families, therapists, and any persons involved in assisting patients with TBI have a better understanding of memory/attention deficits. In turn, they can use this information to improve care/treatment of the patient.

Method

Participants

Participants for the study included 40 patients enrolled in the comprehensive traumatic brain injury (TBI) treatment program at the University of Missouri Health Care/Missouri Rehabilitation Center in Mount Vernon, Missouri, that were admitted from January 2002 to May 2002. In order to be selected for the study, participants had to meet the following criteria: (a) male or female 16 to 65 years of age; (b) traumatic brain injury; (c) no previous other neurological insults (previous TBI, anoxia, cerebral vascular accident, etc.); (d) memory/attention deficits as determined by their primary speech therapist; (e) adequate communication skills (receptive/expressive language skills and speech) in order to allow for reliable assessment of memory/attention abilities.

Of the 40 patients, 35 were male and 5 were female. Specific ages of patients were not recorded in order to protect confidentiality. However, most patients were between 20 and 30 years of age. The overall average time post-TBI of all patients when they were admitted into the study was 2.98 months (range of two-weeks post onset to one-year three-months post-TBI). The patients in the study suffered TBI as a result of motor vehicle accidents, assaults, falls, and self-inflicted head injuries. Specific areas of brain injury were variable among the patients. Because most rehabilitation facilities serve TBI patients with varied areas of brain lesion/damage and treatment for memory/attention is similar for most patients, the study was designed to examine TBI patients as a whole.

Procedure and Measures

Ethical approval for this study was obtained from the University of Missouri-Columbia's Health Sciences Institutional Review Board. Upon review of the research protocol, the board determined that the protocol imposed 'minimal risk to the research subject.' The board also determined that since the gathering of research information did not interfere with or add to the patients' routine rehabilitation course or therapies, that the 'requirement for the investigator to obtain a signed consent form' was waived.

After patients were admitted to the rehabilitation program and determined to be appropriate for the study, their speech therapists gathered information regarding three research areas from evaluation and treatment sessions in reference to time post-onset of TBI. First, speech therapists tracked whether short and long-term memory was intact at the time of evaluation. Second, the patients' time post-TBI and corresponding severity of deficits in attention and memory were tracked once every two weeks. Severity of memory/attention deficits was tracked per use of the Functional Independence Measure (FIM Instrument) (Guide for the Uniform Data Set for Medical Rehabilitation - Version 5.1, 1996). Patients with FIM scores of '4' or '5' were mildly impaired, those with a FIM score of '3' were moderately impaired, and a FIM score of '1' or '2' were designated as severely to profoundly impaired. Presence of confabulation in association with presence of memory/attention deficits was also tracked once every two weeks.

Results

Long and Short-Term Memory

In the research population up to three months post-onset, the percentage of patients demonstrating long-term memory that was intact and not intact was 61% and 39%, respectively. At three and a half months post-TBI, all of the patients' long-term memories were intact. All of the patients except one 1 had impaired short-term memory regardless of the time that had passed since onset of injury.

Confabulation

Up to six months post-TBI, 33% of all patients in the study exhibited confabulation to some extent, and 67% of the population did not. The highest prevalence of confabulation occurred at two months post-injury. One patient demonstrated confabulation

until his discharge from the facility at six months post-TBI.

Severity of Memory/Attention and Time Post-TBI

The relationship between severity of memory/attention deficits and time post-TBI was examined, and results of examination are presented in Table 1. The table only shows month per month increments. Research was conducted in half-month increments up to 6 months and then month per month. In patients up to two and a half months post-TBI for memory and up to three months for attention, there was a mix of severity levels from mild to profound. At two and a half and three months post-injury, respectively, profound impairment disappeared and mild, moderate, and severe memory/attention impairments remained. From three and a half to six-months post-TBI, the largest number of patients per time post-TBI were mildly impaired in memory and attention. At six months post-injury, severe impairment in both areas disappeared with only mild and moderate impairment remaining. At seven to nine months post-TBI, most patients were mildly impaired in memory/attention, with some moderate impairment still present. At ten months post-injury, there was only mild impairment in memory/attention, and impairment continued up to one year four months post injury.

Of the 14 patients who initially had severe/profound memory and attention impairment, six of the patients (43%) improved to only minimal impairment within the 6 months that the research was conducted. Four of the patients (29%) improved to moderate impairment, and four of the patients did not make improvement in their memory/attention skills during the length of the study. The average length of time that it took patients to progress from

Table 1.
Progression of severity of memory/attention deficits per time post-TBI.

Time Post-TBI	Severity of Memory/Attention				
	Mild	Moderate	Severe	Profound	None
1 month					
Memory	9%	55%		36%	
Attention	9%	55%		36%	
2 months					
Memory	21%	36%	21%	21%	
Attention	14%	29%	29%	21%	7%
3 months					
Memory	33%	33%	33%		
Attention	38%	29%	33%		
4 months					
Memory	65%	12%	24%		
Attention	65%	6%	29%		
5 months					
Memory	50%	42%	8%		
Attention	67%	25%	8%		
6 months					
Memory	60%	40%			
Attention	70%	30%			
7 months					
Memory	78%	22%			
Attention	78%	22%			
8 months					
Memory	71%	29%			
Attention	71%	29%			
9 months					
Memory	75%	25%			
Attention	75%	25%			
10 months					
Memory	100%				
Attention	100%				
11 months					
Memory/Attention					
12 months					
Memory/Attention					
1-2 years					
Memory	100%				
Attention	100%				

profoundly/severely impaired to minimally impaired was 1.75 months. All of these patients demonstrated this progress between five weeks and four months post-TBI.

Discussion

The present study examined the progression of memory/attention deficits in individuals with traumatic brain injury. With respect to time post-injury, short-term memory, long-term memory, confabulation, and severity of memory/attention deficits were examined. The purpose of such research was to provide documented information about the progress of memory/attention in patient populations within a rehabilitation setting with traumatic brain injuries. Results of the research can aid therapists in treatment planning, determining long-term goals, and providing education to patients, families/caregivers, and staff in a medical facility treating the patients.

Long and Short-Term Memory

Regarding memory, the present study supports previous findings (Then, Zysset, & von Cramon, 1999) that patients with TBI have decreased short and long-term memory abilities. In the present study, all patients except one had short-term memory deficits, regardless of time post-TBI. Up to three months post-TBI, 39% of patients exhibited long-term memory deficits, and long-term memory was intact for all patients at or beyond three-and-a-half months post-injury.

Regarding long term-memory, previous research has demonstrated that patients with TBI had decreased automatic retrieval from long-term memory (Then, Zysset, & von Cramon, 1999). In the present study, only 39% of patients demonstrated impaired long-term memory up to three months post-TBI. Sixty-one percent of patients demonstrated no long-term memory deficits up to three months post-injury, and at three and-a-half months post-injury, the patients no longer exhibited long-term memory deficits. Perhaps this regaining of long-term memories is a result of improvement in overall cognitive function and thought organization abilities. Perhaps lack of basic, underlying cognitive functions may explain the reason why long-term memory may be more impaired during the initial, acute stages of recovery soon after the TBI.

Confabulation

Previous researchers have determined that confabulatory behaviors were present in the head-injured population up to three to five years post head injury (Weinstein, 1995). In the patient population examined in this study, all confabulations ceased in all patients, with the exception of one, by six-months post-TBI. The specific amount of time this patient continued to confabulate is unknown, as he was discharged from the facility. Findings of the present research also contradict previous research that found that 59% of patients continued to confabulate at 6-months post-head injury (Weinstein & Lyerly, 1968). Only one of 40 patients in the present study (2.5%), continued to demonstrate confabulation at 6-months post-TBI. One possible explanation for the discrepancy between studies is the number of patients in the research population (101 versus 40 patients). There may also be specific facility differences in types and severity of patients accepted into brain-injury treatment programs. As a result, patients may demonstrate variability in progression when recovering from a brain injury. Another possibility for differences between studies may be the variance in amount of treatment that patients in the research population received in the acute care hospital setting before being admitted to the rehabilitation program.

Severity of Memory/Attention and Time Post-TBI

Eighteen percent of brain-injured patients in a previous study (MacFarland, et al., 2001) were found to have continuing deficits in orientation and memory beyond 4-months post injury. Of all the patients in the present study who had reached four months post injury within the research time frame (n = 26), all patients except one exhibited at least minimally impaired memory/attention. Patients who were initially severely/profoundly impaired improved to only minimally impaired within four months post-injury. Previous researchers (Kersel, et al., 2001) found that when patients with TBI suffered post-traumatic disorientation periods that were shorter than one month and longer than one month, 92% and 45% of patients, respectively, improved memory skills to within normal function after one-year. Two patients in the present study were one year-one month to one year-four months post-TBI, and both continued to have at least minimally impaired attention/memory as assessed by their speech therapist.

Summary and Conclusions

Based on the current study, there are several possibilities for future research that should be considered. First, one could examine memory/attention in specific types of brain injury (i.e., closed versus open head injuries, frontal lobe versus temporal lobe versus diffuse damage, etc.). In addition, patients' performance on type-specific tasks to track progression could be examined to get more objective data versus an overall assessment of all therapy tasks in memory/attention as judged by speech therapists. A larger number of patients would result in more realistic numbers that could be more reliably generalized to many patients with TBI.

The findings of the present research could provide invaluable information to therapists working with patients who have suffered traumatic brain injuries. Understanding the progression of attention and memory in brain injury will result in improved overall care and treatment planning for each patient with TBI. Using information about the time period during which patients are most likely to demonstrate behaviors or skills related to confabulation, long and short term memory, and severity levels will help patients, families, and medical staff to better understand the progression of memory and attention skills in a person with TBI. This can ultimately result in improved care for patients and better understanding of memory and attention deficits commonly found in traumatic brain injury.

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Acknowledgements

I would like to thank my colleagues at Missouri RehabilitationCenter for all of their assistance in helping me complete the data collection needed for my research. Thanks to Debbie Conway, research specialist at Missouri Rehabilitation Center, for all of her assistance throughout this entire research process. Thank you to my husband, Rob, for his support and understanding during the time I have conducted research that I have felt to be so very important. Finally, I would like to thank all the patients I have had the pleasure of treating, who have taught me so much more than any book could ever teach.