Predicting Post Traumatic Amnesia Patients' Performance on Specific Cognitive Tasks

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The head injured (HI) population demonstrates a wide variety of impairment from person to person. Within single individuals the nature and severity of the injury can change rapidly as healing progresses. These complex cognitive, emotional, language and physical deficits often present cognitive rehab team members with diagnostic, prognostic, and treatment challenges (Hagen, 1981; Rollin, 1987).

A common symptom resulting from head injury is post traumatic amnesia (PTA), a mental disturbance pattern characterized by disorientation, impaired attention, memory failure for day-to-day events, illusions, and misidentification of family, friends, and medical staff (Brooks, 1984). While PTA may vary from hour to hour and day to day, its duration has been used as a guide to the extensiveness of the damage; the longer the PTA the stronger the probability of extensive damage (Walsh, 1987). The duration of PTA appears to be a sensitive and reliable index of severity (Russell & Smith, 1961).

It is suggested PTA be measured from the moment of the accident until memory becomes clear and continuous (Rutherford, Merrett & McDonald, 1977). In some patients the change from total amnesia to complete lucidity is rapid, and the FITA may be calculated with certainty, but with many, periods of increasing clarity alternating with episodes of confusion are demonstrated. The early phases of CHI recovery are usually times when patients exhibit confusion, disorientation and an inability to deal purposefully with internal and external stimuli; the random fluctuations of their performances and symptoms frequently require daily or weekly assessment (Hagen, 1981).

It is often possible to recognize the end of PFA since it corresponds with the disappearance of confusion (Jennett,1976). As PTA fluctuates throughout the initial course of recovery, treatment decisions are difficult, since many CHI patients progress from relatively brief coma to prolonged periods of confusion which change with respect to the degree of disorientation, amnesia, and behavioral disturbance (Levin & Grossman, 1978). A remediation technique might be misinterpreted as ineffective because its application was too early in the patient's course of recovery (Bigler, 1984). Similarly, the clinician may obtain a diagnosis and begin a treatment only to find that all aspects of management are inappropriate the following day (Hagen, 1981). Variations either above or below a patient's optimal level of receiving and processing stimuli may act to intensify the already impaired ability to remain organized (Mayes, 1986). Additionally, a therapy program that requires a higher level of cognitive functioning than the individual is capable of producing is antithetical to progress (Hagen, 1981).

Since the difficulty in making decisions about brain damaged patients often results from uncertainty concerning day-today recovery in the acute stage, a prognostic scale indicating performance levels and efficient alternative methods of management must be explored (Jennett, 1976). The need for a basis to determine appropriate therapy tasks while a head injured patient is experiencing PTA is apparent. The following case

reports are presented to assist the practitioner in selecting treatment entry criteria.

The purpose of this study was to assess the relationship between PTA patients' orientation and amnesia status and their performance levels on specific cognitive tasks. It was posited that such information would allow the clinician to predict the minimum level of functioning, as measured by the Galveston Orientation and Amnesia Test (GOAT), (Levin, et al, 1979), for entry into cognitive rehabilitation. The following questions were addressed.

1. Is there a relationship between a patient's GOAT score and new learning capacity?
2. Does the GOAT serve as a sensitive measure of change in CHI patients?
3. Can the GOAT score be used as a signal to begin cognitive therapies?

Method

The exploratory nature of the study and small sample size dictated case study analyses with descriptive statistics. However, a spearman's Rho statistic was also employed to assess within subject correlations and those for the combined responses for all subjects.

Case Descriptions

Three head injured patients (2 males and 1 female) were selected from the Brain Injury Rehabilitation Unit (BIRU) at Sacred Heart Medical Center in Spokane, Washington. Admission to the study required subjects to achieve a Glasgow Coma Score (GCS) (Jennett & Bond, 1975) of ten or more, and a GOAT score of 65 or less.

Case 1

The subject was a 39 year old mate who suffered a head injury in a skiing accident by striking his head on a cement structure. His GCS was four upon admittance, and 14 when admitted to the BIRU. Injuries included an epidural hemorrhage as noted on the CT scan. In addition, the subject demonstrated comminuted left parietal fracture, multiple dural lacerations, and brain lacerations.

Surgery included a left parietal craniotomy and removal of depressed skull fragments, evacuation of hematoma, and control of bleeding. An aphasia evaluation revealed receptive and expressive language deficit involving verbal comprehension and oral apraxia. Prior to his accident the subject was in good health with no history of drug or alcohol problems. He attended two years of college, and was employed as a merchandiser which required stocking displays and driving a delivery truck.

Case 2

The subject was a 53 year old female who suffered a closed head injury in a motor vehicle accident. Her GCS was three at the time of the accident and 14 upon admission to the BIRU. No surgical intervention was required. She attended two years of junior college and worked as an accountant technician for 13 years. Her previous medical and psychosocial histories were unremarkable.

Case 3

The subject was a 35 year old male who sustained a severe head injury during an accident. Initial GCS was five, and 14 upon admission to the BIRU. His head injury consisted of depressed left skull fractures, and bilateral subdural hematoma with residual right frontal contusion. This subject had a history of alcoholism and probably intravenous drug abuse with resolving alcoholic hepatitis. He had a high school education and had worked various seasonal jobs.

Instrumentation

The GCS was used initially for assessing the level of consciousness. The patient's ability to perform three tests of neurologic function, (eye opening; motor response and verbal response) determines the total score. The standard definition of coma on the GCS is the inability to open the eyes, make any recognizable sound, or follow any commands, thus corresponding to a score of eight or less (Friedman, 1984).

The GOAT was employed to assess cognition over time during the acute stage of CHI. This scale

measures orientation to person, place, time and memory for events preceding and following the injury, and may be given at bedside to patients whose speech is comprehensible. It incorporates traditional self report measures of retrograde and post-traumatic amnesia. The total GOAT score is obtained by deducting the sum of the error points from 100, and then comparing the score to a range of severity.

Procedures

Throughout the study, each subject's performance on two basic cognitive tasks that were part of his/her regular treatment were recorded by a speech-language pathologist, a neuropsychologist, and an occupational therapist over a period of two to four weeks. The following activities which focused on memory, and auditory and visual attention, were presented at each therapy session.

Task 1:
Picture Recall (PRL) and Picture Recognition Task (PRT)

The subject was requested to recall three pictures after visual presentation. The examiner's instructions were, "I will show you some pictures and I want you to please remember them. I will ask you tomorrow to recall them." The examiner showed the subject three pictures, one at a time for five seconds, and instructed the patient to name each picture. If they could not the examiner named the picture for them. This task was repeated up to three times to enable the patient to name all three pictures. The subject was then instructed to, "Please remember the pictures because you will be asked to remember them tomorrow."

Task 2:
Word Recall Task (WRT)

The subject was requested to recall three words after verbal presentation. Instructions were, "I will say three words and would like you to remember them." The subject was then asked to repeat the words. If they could not, the examiner repeated them up to three times to assist the patient in repeating all three words. The examiner then instructed the patient to remember each one, since they would be asked to recall them on the following day.

Results
Case 1
Picture Recall & Picture Recognition Task and False-Positives

The subject's scores on the Picture Recall (PRL) task, which required spontaneous verbal identification for three stimulus pictures, fluctuated considerably during the course of the 28 day treatment period. The subject's picture recall performances did not coincide with his GOAT scores; in fact, an inverse relationship was apparent on several of the treatment days. For example, on day six, a GOAT score of 49 was recorded and two of three stimulus pictures were recalled; and on a day 28, a GOAT score of 100 was noted and no pictures were recalled.

The subject's PRC and false-positive responses fluctuated over the course of treatment, and did not correspond consistently with his GOAT scores. For example, two instances of inverse relationships between the GOAT scores and PRC scores were noted.

On day 14, a GOAT score of 65 was recorded, and three of three pictures were recalled with zero false-positive errors; and, on day 13, a GOAT score of 95 was achieved with zero of three pictures recognized, with four false-positive responses.

Word Recall & Word Recognition and False-Positive Responses

On the Word Recall Task (WRT), which required spontaneous verbal identification of dime stimulus words, subject 1 registered zero of three correct on all but three days during the four-week treatment period. Improved scores were made on day 14, with three of three correct; on day 22, with two of three correct; and on day 28, with three of three correct.

Word recognition (WRC) performance was variable during the first two weeks of treatment. The number of false-positive responses tended to coincide with the variable WRC scores; when WRC scores were low, a greater number of false-positives were present. During the second and third week, GOAT scores ranged from 90 to 100 and the number of false-positives decreased to one and 0

consistently. Inverse relationships were noted on day 13, when subject 1 achieved a GOAT score of 95, and a WRC score of zero with four false-positive responses; on day 14, the subject's GOAT score was 65, and his WRC attempts resulted in three of three correct with zero false-positives. During the fourth week, on the final day, the subject scored 100 on the GOAT, and three of three correct in the WRC task with zero false positive responses.

Case 2

Picture Recall & Picture Recognition Task and False-Positives

On the picture recall task (PRL) which required spontaneous verbal identification of three stimulus pictures, the second subject's treatment performance did not coincide with scores on the GOAT; although the GOAT scores were consistently above 65, they failed to reflect gains on the PRL task.

The second subject's performance on the picture recognition task (PRC) also resulted in scores which did not coincide with performance on the GOAT. However, a trend was noted for the subject's increased number of false-positive responses which were obtained by her non-selective identification of several stimulus cards. Lower GOAT scores appeared to have occurred with a higher false-positive responses, and higher GOAT scores with fewer false-positive responses. For example, on day 9, the subject obtained a GOAT score of 75, and a total of three false positive responses on the PRC task. On day 3, she achieved a score of 85 on the GOAT, and zero false-positives during the PRC task.

Word Recall & Word Recognition and False-Positives

On the word recall task (WRL), which required spontaneous verbal identification of three stimulus words, subject 2 registered zero of three correct on six of seven days during a two week treatment period. On day 11, she correctly recalled one word of the possible three choices. Similar to the subject's picture recall task (PRL) effort, her performance on the WRL task did not agree with her GOAT.

The subject's performance was slightly improved on the Word Recognition Task (WRC), with a score

of one of three correct on day 2, and three of three correct on day 9. Remaining WRC scores registered at zero of three correct. A WRC score of three of three was obtained on the same day the subject registered her lowest GOAT score of 75. During the first week, false positive responses decreased to two and to zero during the second week. However, the number of false-positive responses did not tend to shadow the changing GOAT scores. Overall, a relationship between the subject's GOAT scores and the WRL and WRC tasks was not identified.

Case 3

Picture Recall & Picture Recognition and False-Positive Responses

On the picture recall task (PRL), subject 3 registered scores of zero and one of three correct during the first week, and achieved a slightly improved score of two of three on the ninth day. Although his GOAT scores were consistently above 65, they failed to coincide with gains on the PRL task.

Conversely, the subject's performance on the picture recognition task for which he received scores of three of three correct for a period of four consecutive treatment days and two of three correct on two consecutive days was partially in agreement with his GOAT score. It is necessary to note that the subject's performance on the PRC task also included a number of false positive responses by his non-selective identification of several stimulus cards. For example, when given a choice of eight items, three of which were targets, he would respond to all presentations with a "yes" on all but one of the treatment days. The response pattern, although not accurate, credited the subject with spurious positive scores. The number of false-positive responses varied, and did not tend to comply with the GOAT scores.

Word Recall & Word Recognition and False-Positive Responses

On the word recall task (WRL), Subject 3 registered scores of zero correct for six of seven days within a two-week treatment period; on day eight he recalled one word of the possible three choices. Similar to his performance on the picture

recall task, his scores on the word recall task did not parallel scores on the GOAT.

The subject demonstrated higher scores on the word recognition task (WRC), although various false-positive responses were apparent. For example, on day 11, the subject received credit for identifying the three target pictures, but also had four false-positive responses, and displayed spurious positive scores. The corresponding GOAT of 80 failed to reflect positive correspondence with the WRL and WRC tasks.

Analysis of the Data

To assess statistical relationships between GOAT scores and the auditory and visual tasks, a Spearman's Rho correlation was computed for within subject correlations and the combined totals for responses for all subjects. With the exception of a significant correlation between the GOAT score and WRC for S-1 (rho = 0.7816, $p < 0.001$), the GOAT score and PRC for S-2 (rho = 0.8208, $p < .05$) and the GOAT score and WRC for S-3 (rho = 0.8528, $p < 0.05$), significance was not attained for within subject or conglomerate data. Since false positive scores were not considered representative of the S's valid response capability, they were not included in the correlational computations.

Discussion and Conclusion

An evaluation of the three closed head injured subjects' scores on various clinical activities did not appear to reflect a solid congruence with their GOAT scores. Subjects 1 and 2 produced patterns of high variability and some instances of inverse relationships between their memory task scores (PRL, PRC, WRL, WRC) and GOAT scores. Although Subject 2 demonstrated an inverse relationship PRC task, this relationship was weak at best. The subjects' memory attempts were ineffective despite reaching GOAT scores of 80 and above. These findings are in sharp contrast to those of Artiola, Fortuny, Briggs, Newcombe, Ratcliff and Thomas (1980) who assessed post traumatic amnesia with a simple orientation questionnaire and a request to identify three colored pictures presented the previous day; they found PTA ended on the first of three successive days of correct recall. The severity of the subjects' impaired memory function was apparent when comparing their test results to the nonhead-injured individuals examined in a study by Freed (1989) who commented on the amazing ability of people to remember photos, noting they may be shown 100 pictures for five seconds each, and weeks later recall them with 60 or 70 percent accuracy.

An analysis of the subjects' performances on the various therapy tasks within this context did not support the GOAT as a sensitive index for measuring readiness levels for initiating specific therapy activities. However, this behavior is not to be unexpected, since head injuries unlike many other types of disabilities, produce deficit patterns that may be excessively unpredictable and varied (Vogenthaler, 1987). Clients who are slowly improving may make sudden gains, while those rapidly improving may level off inexplicably. One is left to infer that data such as ours is not a criticism of any particular instrumentation, but rather further support for the variability of the head injured patient's performance.

Since orientation is a critical issue in embarking upon a therapeutic process, a score of 65 or less was assumed by the writers to have alerted clinicians to question the efficacy of entering a client into specific treatments. However, this study revealed conflicting results for all subjects. For example, Subject 1 registered GOAT scores below 65 for three days, while recalling two of three pictures on the PRL task. On the fourth day, he achieved a GOAT score of 95, and failed to recall any of the target pictures. Although subjects generally improved on the memory tasks as GOAT scores increased, the GOAT did not appear to be a solid indicator for patient readiness for specific therapy tasks. The authors recognize the limitations of the study and caution against over-generalization of these results to other rehabilitation settings. Clearly, the findings for all subjects suggest further investigations involving a longer period of data collection across specific therapy tasks.

REFERENCES

Artiola, L., Fortuny, I., Briggs, M., Newcombe, F., Ratcliff, G. & Thomas, C. (1980). Measuring the duration of post traumatic amnesia. *Journal of Neurology, Neurosurgery, and Psychiatry, 43,* 377-379.

Bigler, E. (1984). *Diagnostic clinical neuropsychology. Austin:* University of Texas Press.

Bracy, O. (1988). Foundations I & II. Psychological Software Services, Indianapolis.

Brooks, N. (1984). *Closed head injury: Psychological, social, and family consequences.* New York: Oxford University Press.

Freed, M. found in Ramond, C. (1989). Scientists examining behavior of a man who lost his memory gain new insights into the workings of the human mind. *The Chronicle of Higher Education.*

Friedman, W. A. (1984). Head injuries. *Clinical Symposia, 35,* 12-13.

Hagen, C. (1981). Language disorders secondary to closed head injury: Diagnosis and treatment. *Topics in Language Disorders, 1,* 73-87.

Jennett, B. (1976). Assessment of the severity of head injury. *Journal of Neurology, Neurosurgery, and Psychiatry, 39,* 647-655.

Jennett, B. & Bond, M. (1975). Assessment outcome after severe brain damage: A practical scale. *The Lancet, 1,* 484-489.

Levin, H. & Grossman, R. (1978). Behavioral Sequelae of closed head injury: A quantitative study. *Archives of Neurology,* 35, 720-727.

Levin, H., O'Donnell, V. & Grossman, R. (1979). The Galveston orientation and amnesia test: A practical scale to assess cognition after head injury. *The Journal of Nervous and Mental Disorders, 11,* 675-684.

Mayes, A. (1986). Learning and memory disorders and their assessment *Neuropsychologia, 1,* 25-39.

Rollin, W.J. (1987). *The psychology of Communication disorders in individuals and their families.* New Jersey: Prentice-Hall.

Russel, R. & Smith, A. (1961). Post-traumatic amnesia in closed head injury. *Archives of Neurology, 5,* 16-29.

Rutherford, W., Merrett, J. & McDonald, J. (1977). Sequelae of concussion caused by minor head injuries. *The Lancet, 5,* 1031-1034.

Sohlberg, M. & Mateer, C. (1986). The attention process training. Association for Neuropsychological Research & Development. L Puyallup, WA.

Vogenthaler, D. (1987). An overview of head injury. Its consequences and rehabilitation. *Brain Injury,* 1, 113-127.

Walsh, K. (1987). *Neuropsychology: A clinical approach.* New York : Churchill Liningstone.