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Efficacy of the Glasgow Coma Scale in Determining the Severity of Traumatic Brain Injury

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ABSTRACT

Mr. D, a 52-year-old male, was in an un-helmeted motorcycle collision with a concrete barrier resulting in polytrauma and traumatic brain injury. Mr. D was assessed by emergency services to be unresponsive with a Glasgow Coma Scale (GCS) of 13. He sustained an open skull injury, subdural hematoma, multiple facial fractures, and traumatic vitreous humor hemorrhage with unresponsive, dilated pupils. He received CT and X-ray imaging before undergoing multiple surgeries for repair and debridement of injuries. After being weaned off sedation, he entered a state of post-traumatic amnesia lasting two months. Fifteen days post-accident, he began a regimen of amantadine to stimulate interaction and participation in physical therapy. Mr. D remained for two months until he progressed with physical therapy and was independent with his mobility. He was admitted to an inpatient traumatic brain injury facility because he was mentally unable to care for himself.

Keywords: Traumatic Brain Injury, Glasgow Coma Scale, Physical Medicine & Rehabilitation

INTRODUCTION

Traumatic brain injury (TBI) is abnormal brain functioning resulting from an external injury (*1*). TBIs are characterized by three periods – impaired consciousness, post-traumatic amnesia (PTA), and functional recovery (*2*). PTA is defined as a period of time when a person is unable to retain new information following a TBI (*2*). It is an important indicator of long-term outcomes post-TBI (*2*). The duration of PTA is closely tied with functional outcomes with long durations of PTA correlating with decreased functionality (*2*). The initial severity of TBI is evaluated with the Glasgow Coma Scale (GCS) whereas PTA can be assessed with the Galveston Orientation and Amnesia Test (GOAT) and the Orientation Log (O-Log).

The GCS is composed of three parts – eye opening (scored 1 to 4), verbal response (scored 1 to 5), and motor response (scored 1 to 6). Lower scores on each part indicate decreased functioning and, therefore, a more severe injury. The sum of the three scores is used to further classify TBIs as severe (GCS 3-8), moderate (GCS 9-13), or mild (GCS 14-15). This is meant to be an objective measure to gauge clinical status and outcome at the time of injury as well as progression over time. Serial GCS can be used to follow patients and assess their improvement or deterioration following a TBI (*3*).

The GOAT is a 10-item questionnaire measuring the patient's orientation to time, place, and person in addition to assessing PTA and retrograde amnesia. PTA differs from retrograde amnesia in that PTA describes an inability to form new memories for a period of time following the TBI, while retrograde amnesia is the loss of memories just prior to the accident. The GOAT is scored out of 100 with scores of less than 75 indicating ongoing PTA. Emergence from PTA is indicated by two consecutive scores of greater than 75 on the GOAT (*2*).

The O-Log is also a 10-item questionnaire that measures orientation more specifically than the GOAT; the O-Log assesses orientation to city, kind of place, name of

hospital, month, date, year, day of week, clock time, traumatic event/accident, and injury/deficits resulting from the accident. Each of these measures are scored out of three for a total of 30 points. The goal of the O-Log is to follow orientation improvements over time (*4*). This case report seeks to highlight the limitations of GCS in predicting the duration of PTA and prognosis post-TBI and to consider how the initial GCS can be improved to better evaluate patients at the scene of trauma.

CASE DESCRIPTION

Mr. D, a 52-year-old male, was an un-helmeted motorcycle driver who presented to the Emergency Department following a high-speed collision with a concrete barrier. His initial GCS was 13, and he tested positive for alcohol, amphetamines, cocaine, and opiates. He had sustained a frontal open-skull injury, bilateral frontal subdural hematomas with small contusions, minor brain contusion, multiple facial fractures, proximal ulnar and humeral medial epicondylar fractures of the left elbow, and traumatic vitreous humor hemorrhage with dilated pupils unresponsive to light. He underwent several surgeries to clean wounds, beginning a lengthy treatment process. Surgeries included tracheostomy, facial fracture repair, maxillomandibular fixation to wire his jaw shut, washout of the left elbow fracture with external fixation, irrigation and debridement of left elbow open fracture, and partial extensor tendon repair to left middle finger.

An initial assessment by the Physical Medicine & Rehabilitation (PM&R) physician predicted a mild TBI with short-lived, if any, agitation. This proved to be an inaccurate prediction. The patient remained sedated for three days after his accident. After being weaned off sedation, he continued to be somnolent and difficult to arouse. During his hospital stay, the patient required non-violent restraints at several points. He was in a state of PTA and had difficulty paying attention and following commands. After being in the hospital for 15 days, the patient was given 100-mg Amantadine twice a day to help stimulate interaction and his participation in therapies. He remained in a PTA state for approximately two months. He was not qualified for admission into inpatient rehabilitation because adequate supervision after discharge is required at the time of admission, so he remained in the acute care surgery unit for the entirety of his hospital stay. He progressed with therapies during his hospitalization to the point where he became independent with his mobility and no longer had any physical therapy goals necessitating an inpatient rehabilitation admission. The PM&R physician recommended that Mr. D be transferred to an inpatient TBI facility for further care.

DISCUSSION

Mr. D is a 52-year-old male who sustained a TBI and polytrauma after an un-helmeted high-speed motorcycle collision with a concrete barrier. His TBI was initially judged to likely be mild at the time of presentation, though his GCS of 13 indicated a moderate TBI. His hospital course was prolonged with PTA and agitation lasting two months, an indication of severe TBI and a poor prognosis of decreased functional recovery.

There are several factors of TBI that make assessment of injury and treatment difficult. Patients are often assessed with the GCS soon after traumatic injuries, which also gives a rough estimate of the severity of TBI (*3*). The patient's initial GCS was scored at 13, indicating a moderate TBI. His recovery in the hospital was prolonged, and his orientation was assessed every few days with the O-Log and GOAT to determine the duration and severity of PTA. He remained in PTA for just over two months, suggesting that the TBI he incurred was severe. This can be assumed because patients with severe TBI often have PTA, the length of which can be used as a prognostic indicator of long-term outcomes post-TBI (*2*). The length of time the patient remained in PTA, just over two months, suggests that he will have less functional outcomes and goals and is unlikely to ever be able to return to work or recover fully from this accident.

The disconnect between the patient's GCS and resulting estimated prognosis was found to be highly inaccurate compared to the reality of his prolonged hospital stay and duration of PTA. The GCS is commonly used to assess TBI in emergent situations because it is easily administered. However, the inconsistency of the initial GCS and the patient's outcomes in this case has raised concerns about whether GCS is the best scale for initial assessment of TBI. A highly inaccurate prognosis given too early to patient families can cause distress when patients do not recover as quickly or as completely as estimated. The GCS will need modification to improve its accuracy in determining TBI severity. GCS needs to give a more accurate representation of severity of TBI and better estimation of functional recovery. O-Log and GOAT both include measures of orientation whereas GCS only assesses body functions – do the eyes open? are they responsive to light? – which fail to account for mental functioning and orientation. In the initial patient assessment with GCS, it would be helpful to include parts of the GOAT or O-Log to create a more accurate modified GCS and allow for a better assessment of patients following trauma.

CONCLUSIONS

The length and severity of PTA is a good indicator of long-term functional outcomes following a TBI. The GCS is quick and easily administered, though it is not always adequate in determining the severity of a TBI and is not always accurate in estimating prognosis. In the future, research should evaluate whether the GOAT or the O-Log are better measures for determining severity and length of PTA and which allows for better monitoring over time. More precise protocols are needed for the treatment of patients with severe TBI, and future controlled studies should work to improve the efficacy of the assessments as well as the treatments used.

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