

Classification of Traumatic Brain Injury



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There are different systems for classifying traumatic brain injury (TBI). Systems include classifying traumatic brain injury by severity, which is generally based on clinical indexes at the time of presentation. TBI can be classified by pathoanatomic type i.e. type of injury such as diffuse axonal injury, haematoma and haemorrhages.¹ Further classification systems include classification of TBI by outcome and prognosis.^{1,2} This paper will focus on classification of traumatic brain injury by severity, outcome, and prognosis. Classification by severity

In terms of the classification of severity, historically TBI was classified as mild, moderate or severe by using the Glasgow Coma Scale, a system used to assess coma and impaired consciousness. The Glasgow Coma Scale is divided into three components – eye opening, verbal response and motor responses. These are usually summed to produce a total score. A Glasgow Coma Scale score of 13-15 is defined as mild, 9-12 as moderate, 3-8 as severe.³ This is an example of classification of TBI severity during the acute phase of injury. However, clinically it is important to provide the individual scores (particularly the motor score) in addition to the total score.

Post-traumatic amnesia (PTA) is another important index of the severity of traumatic brain injury.⁴ PTA is the interval from injury until the patient is orientated, and can form and later recall new memories.⁴ A PTA of 1-24 hours used to be considered to indicate a TBI within the category of moderate severity.⁴ Current classifications of moderate TBI generally refer to PTA extending beyond 24 hours.^{4,5}

The diagnosis of mild traumatic brain injury (MTBI) is a good example of severity of TBI based on multiple acute injury indices. These include the Glasgow Coma Scale, length of post-traumatic amnesia, results of neuroimaging and focal signs. The American Congress of Rehabilitation Medicine, Centre for Disease Control, and the World Health Organisation include the criterion for a MTBI as: loss of consciousness less than 30 minutes following the injury and posttraumatic amnesia of less than 24 hours following the injury.^{5,6}

The Mayo Classification System for Traumatic Brain Injury Severity was developed to address the issue of the unreliability of some TBI severity indicators and the frequency of missing documentation in medical records. The Mayo Classification System has three main classifications including definite moderate-severe TBI, probable MTBI, and possible TBI.⁷ Multiple criteria are used in each diagnosis including loss of consciousness, post-traumatic amnesia, skull fracture, and evidence of neuroradiological abnormalities including subdural haematoma, cerebral contusion, and hemorrhagic contusion.

A TBI would be classified as definite moderate-severe in the Mayo system if one or more of the following criteria apply: death due to this TBI, loss of consciousness of 30 minutes or more, PTA of 24 hours or more, and worst GCS full score in first 24 hours is <13 providing this not invalidated by other factors such as intoxication or sedation. In addition if there is evidence of neurological injury such as haematoma, contusion, haemorrhage then the TBI would be in the definite moderate-severe category. A TBI would be classified as probable mild if there is loss of consciousness below 30 minutes, PTA is less than 24 hours, and there is a depressed, basilar, or linear skull fracture (dura intact). A possible TBI is diagnosed if there are one or more of the following symptoms: blurred vision, confusion, feeling dazed, dizziness, headache, or nausea.⁷

The authors compared the Mayo system i.e. multiple indicators versus single indicators such as PTA, GCS, and loss of consciousness. The Mayo system far outperformed any single indicator in classifying severity of TBI.⁷ Sensitivity and specificity for moderate-severe TBI was calculated to be 89% and 98% respectively.⁷

Classification by outcome

Outcome can be measured in many different ways including scales such as the Glasgow Outcome Scale, neuropsychological functioning, and mood. There are also scales measuring dimensions such as challenging behaviour, community participation, and neuropsychiatric difficulties.⁸

The Glasgow Outcome Scale originally had five categories – dead, vegetative state, severe disability, moderate disability and good recovery.⁹ A eight point scale was subsequently described as the extended eight point Glasgow Coma Outcome Scale which subdivides moderate and severe disability into upper and lower categories. A questionnaire has been developed to assist with classification. The Glasgow and extended Glasgow Outcome Scores have been extremely valuable adjuncts to the management of patients with TBI and in particular as endpoints in clinical trials.

Classification by prognosis

The recent paper by Nakase-Richardson et al (2011) looked at duration of PTA and outcome.⁴ This study included a large sample of approximately 4000 individuals who suffered a TBI, and who had been productive prior to the TBI. In this study a PTA of 0-14 days was classified as a moderate TBI, PTA of 15-28 days was classified as a moderately severe TBI, and a PTA of 29-70 days was classified as a severe TBI.

This prognostic classification system is a development on Russell and Smith's classification system where a PTA of 1-7 days was viewed as severe, and a PTA of 7+ days was viewed as very severe.⁴ It is difficult to see how a TBI may be clas-

sified as severe according to Russell and Smith's categorisation when Nakase-Richardson's study showed that 67% of individuals with a PTA of 0-14 days returned to productivity within one year.⁴ The one issue that is not clear is how many of the sample stayed in productive work beyond the one year mark as studies have shown that individuals with a TBI do not necessarily have a stable, uninterrupted return to productivity.¹⁰

Reasons for classifying TBI severity

Acute management

The Glasgow Coma Scale score is used to guide management of TBI from a neurosurgical perspective.¹¹ It is an essential part of the assessment of a patient with TBI. In terms of MTBI it is one of the criteria used to determine the need for CT scan as defined by the NICE guidelines.¹¹ Severe TBI (i.e. coma defined as GCS less than or equal to 8) is an indication for a definitive airway i.e. cuffed tube in the trachea. However, patients with moderate TBI particularly in association with agitation invariably also benefit from sedation and ventilation prior to a CT scan. Of critical importance is not to regard GCS as a static measure; repeating it by the process of regular (usually 30 minute observations) is a fundamental part of the management of patients with TBI.

Avoiding misclassification

An obvious but important question is whether a patient has actually suffered a TBI. A clinician must ask whether they could be misclassifying a patient with a TBI who does not meet the criteria for such an injury.

Factors which may lead to misclassification include mistaking the patient's difficulty in recalling events post injury as post-traumatic amnesia when in fact the patient's memory has been affected by other factors such as intoxication with alcohol or drugs at the time of the injury. Medication administered at the scene of the accident for pain such as morphine can cause memory gaps which could be mistaken for PTA.¹² Kemp et al's (2010) study of orthopaedic patients who did not sustain a TBI but received opioids, underwent surgery, and were suffering clinical levels of anxiety at an early stage resulted in patients reporting PTA-like phenomenon at follow up.¹³ Acute stress disorder due to the traumatic nature of an event may also be mistaken for post-traumatic amnesia.¹⁴

Cognitive, physical, and emotional symptoms following MTBI are common. However, in reviewing the outcome studies Iverson and Lange (2011) conclude that following a mild traumatic brain injury neuropsychological deficits are not seen in athletes in 1-4 weeks following injury, and in trauma patients after 1-3 months.¹⁵ In contrast cognitive difficulties following moderate-severe traumatic brain injuries can persist.¹⁵ Thus, misclassifying a patient who has suffered a MTBI as having a moderate-severe TBI may lead a clinician to

explain that ongoing cognitive symptoms after three months is to be expected. There is a risk that this may then become a case of 'expectation as aetiology'. This may be even more of the case if a patient is told they suffered a TBI when in fact they did not.

The value of classification by severity in terms of guiding treatment and prognosis

Classification can help the clinician to predict outcomes in the longer term which may help to guide treatment decisions in the post-acute stages i.e. does the patient need intensive inpatient rehabilitation or can they be better managed by a rehabilitation team in the community. Secondly, it allows the clinician to be able to provide some information to the relatives/family of the patient with regards to prognosis in the long-term.

Conclusions

A useful starting point is to be explicit about the classification system used given the range of different classification systems. There is a general trend now to classify a MTBI as an injury in which the individual is not unconscious for more than thirty minutes, post-traumatic amnesia does not extend beyond 24 hours, and there are no abnormalities on neuroimaging.^{5,6,7,15} If any of these criteria are exceeded then the TBI is more likely to fall in the moderate to severe range. Classification of TBI is important in terms of differentiating a MTBI from a moderate-severe TBI given the difference in cognitive outcome.¹⁵

A system such as the Mayo system for classification of TBI has several advantages including using as much positive evidence as possible to classify TBI and does not rely on a single indicator.⁷ The Mayo system is structured in a conservative way to reflect severity of brain trauma based on the strength of available evidence i.e. by the use of distinctions such as definite, probable, and possible when classifying TBI, in addition to the use of multiple indicators.

The Mayo system is a useful classification system in the community rehabilitation setting, and has been used by the Hertfordshire Acquired Brain Injury Team. It provides a clear system for differentiating between mild versus moderate-severe TBI, which in turn guides rehabilitation. If a patient has suffered a probable MTBI, and they are reporting ongoing cognitive difficulties 3 months post-injury, this could guide clinicians to look at, and treat other factors such as pain, anxiety, depression, and disrupted sleep.

If a patient has suffered a moderate-severe TBI there is no guide as to long-term prognosis in the Mayo system. At this point, and if duration of PTA is known, it may be useful to then refer to Nakase-Richardson et al's prognostic classification system.⁴ This could help clinicians provide family members with a more accurate prognosis. It could also help guide intensity and type of neuro rehabilitation required. ♦

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