Traumatic brain injury: a patient with a temporal contusion

by Andrew Maas

A forty-nine year old male suffered a traumatic brain injury (TBI) during a recreational cycling tour. Most likely his front wheel hit a small obstacle on the road surface, causing him to fall. The estimated speed at the time of the accident was 30 km/hr. The reported duration of loss of consciousness was 10 minutes. When the ambulance arrived, the GCS was 12 (eye opening to verbal stimuli (E3); obeying commands (M6) and a verbal reaction of inadequate (V3)). On arrival at the neurotrauma centre his level of consciousness had improved to a GCS of 14 (eyes spontaneously open (E4); obeying commands (M6); disorientation (V4)). There was a small laceration of the skin in the right temporal region and some blood coming out of the right ear as evidence of a fracture of the middle skull base. CT examination showed a hemorrhagic contusion of the right temporal lobe but no skull fracture. There was no midline shift or obliteration of the basal cisterns.

1. Would you consider this a mild head injury?
2. Would you admit this patient to the ward or to the intensive care unit?
3. Should intracranial pressure (ICP) be monitored?

Traditionally traumatic brain injury is classified as mild (GCS 13-15), moderate (GCS 9-12) or severe (GCS ≤ 8). According to the GCS on arrival, the injury in this patient might be classified as mild. However, a hemorrhagic contusion in the temporal region should not be underestimated and may enlarge, either due to expansion of the hemorrhage or due to the development of perifocal edema with a direct local mass effect which may cause uncal herniation, a life threatening situation. Despite the relatively good GCS, this could be considered a potentially severe injury.

Because of the substantial risk of lesion progression causing neurological deterioration this patient requires frequent clinical assessments of the GCS and pupillary reactivity. For this reason he should be admitted to the intensive care unit.
The admission CT scan did not show signs of generalized raised intracranial pressure. Moreover, the local mass effect of this hemorrhagic contusion is in the direction of the tentorial notch and may cause herniation in the absence of increased intracranial pressure, such as (partial) obliteration of the basal cisterns and/or midline shift. The risk in this patient is therefore not directly related to raised ICP, but more to a local mass effect. The guidelines (www.tbiguidelines.org) for the management of severe TBI recommend monitoring intracranial pressure in all patients with a GCS ≤ 8 with abnormalities on the CT scan as also in patients with a GCS ≤ 8 and a normal CT scan if two of the following three criteria are present:

- Age < 40
- Documented episode of hypotension
- Abnormal motor response

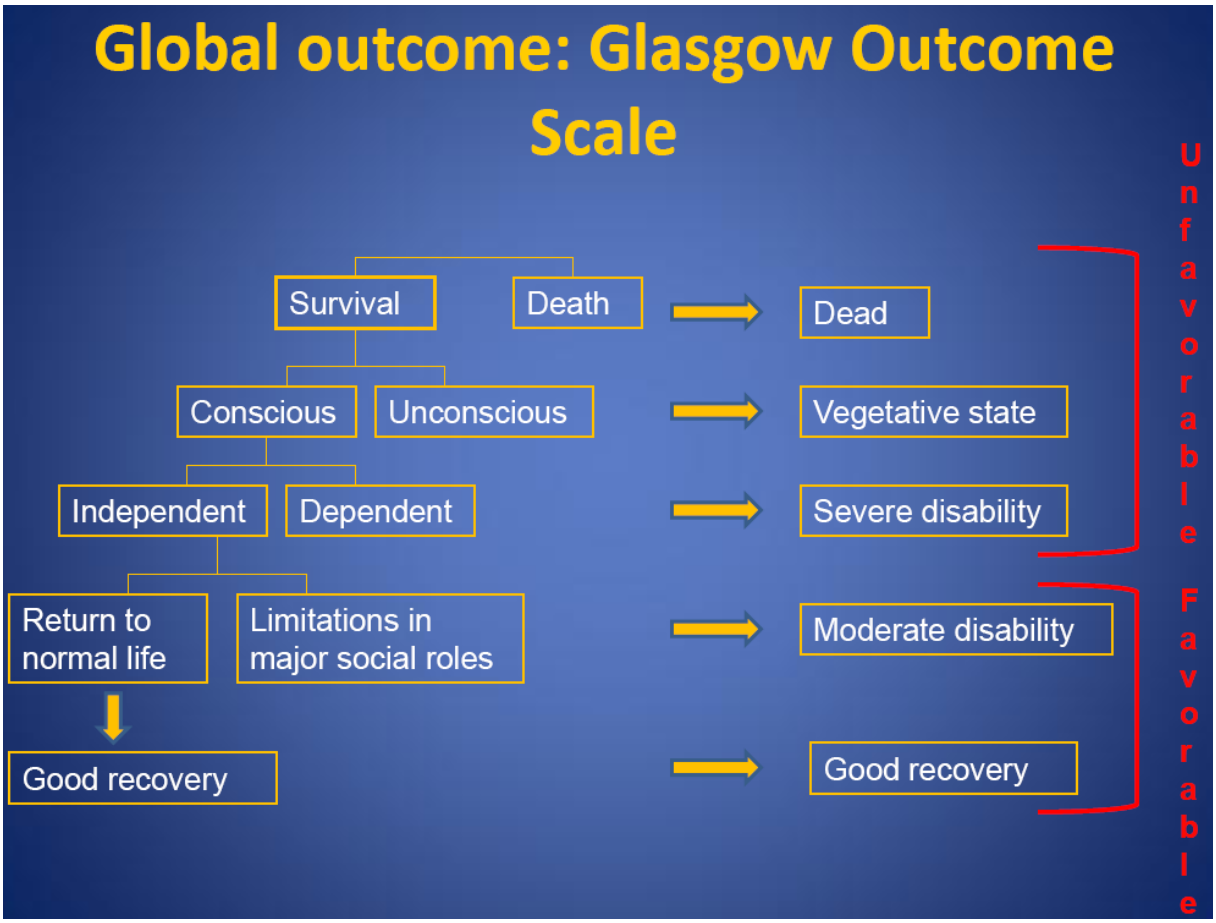
This patient does not meet the criteria recommended in the guidelines for monitoring ICP and also from a pathophysiologic perspective raised ICP is not considered an immediate risk.

Clinical course
The patient was observed in the intensive care unit with frequent examinations of GCS and pupillary reactivity. The next day the patient suffered a secondary deterioration to a GCS of 9-10 (eyes opened to pain (E2), motor response: localizing (M5), verbal response variable between groaning and inadequate (V2-V3)). The pupils remained equal and reactive to light. The control CT scan showed increased perifocal edema. Again there were no radiological signs of generalized increased ICP.

Would you recommend surgical or medical treatment?

In this patient the secondary deterioration was considered to be most likely caused by increased local mass effect. Because of the local mass effect and clinical deterioration, surgery was performed with evacuation of the hemorrhagic contusion. The surgery was performed according to the principles of brain tumor surgery with fixation of the skull in the Mayfield clamp and resection of the contused tissue with the CUSA ultrasonic aspirator.

The further clinical course was uneventful; the day after surgery the GCS has improved to 12 with the patient again obeying commands. On day 12 he could be discharged home in a good clinical condition, no neurological abnormalities and a GCS of 15 (maximum score). The treating physician rated his outcome on discharge as good recovery on the 5 point Glasgow Outcome Scale (GOS).



Six months after injury however, he had not been able to return to work and problems were noted in the social re-integration. The outcome at that time was assessed as moderate disability (GOS 4). He was completely independent in all activities of daily life. This outcome rating is considered “favorable” on the dichotomized GOS. Despite being grateful for being able to return to all normal activities of daily life, the patient was less enthusiastic about his condition than the rating physicians: his self perception was as if he looked at himself in a broken mirror. Substantial strains in the family relation had resulted from his changed personality.

Discussion

This case illustrates three important aspects:

- The inadequacy of our current approaches to classification of TBI
- The complexity of managing cerebral contusions
- Long-term sequelae after TBI and a different perspective on outcome between physician and patient.

Classification

Characterization and classification of TBI are multidimensional concepts, but most previous approaches have focused on a single dimension, e.g. clinical severity as measured by the Glasgow Coma Scale (GCS) or the presence of structural damage assessed by computerized tomography (CT scanning). Moreover these approaches have generally used over-simplified constructs. The GCS broadly characterizes TBI as severe (GCS 3-8), moderate (GCS 9-13) and mild (GCS 14-15). This construct ignores the clinical reality that TBI severity lies along a continuum, ranging from very mild to virtually insurvivable injuries. Moreover, GCS-based classification of TBI by clinical severity is nowadays more limited because its measurement is often confounded by intoxication due to alcohol or recreational drug use, or by therapeutic sedation and neuromuscular blockade. Stocchetti et al (2004) reported that approximately 13% of non-surgical cases were mistakenly classified as severe. A workshop organized by NIH-NINDS in October 2007 concluded that a new and improved multidimensional classification system is needed (Saatman et al 2008).

These concerns on the use of the GCS for purposes of classification do not detract in any way from the clinical value of the GCS as instrument for assessing and quantifying the (depressed) level of consciousness in individual patients. For these purposes however, the individual components of the GCS (eye, motor and verbal score) should be reported separately rather than the overall GCS score. Standardization of approaches to assessment is equally important. The best motor score is defined as the best response of the best arm. When necessary to elicit a response, painful stimuli may need to be administered. These also should be standardized, and consist of nail bed pressure and supra-orbital pressure (testing for a localizing response).

Surgical management of contusions

Cerebral contusions are the most frequent intracranial lesions in TBI, particularly resulting from injuries where either an object strikes the head or the head hits an object. Contusions particularly result from falls and these are the most common causes of injury in older patients (Maas et al 2008). As the population is aging, and the elderly have greater mobility, contusions are seen more often compared to one or two decades ago. Guidelines on the surgical management of brain contusions have been published, but all are based on class III evidence and are heavily focused on volumetric criteria.

Indications (Bullock et al 2006)
Patients with parenchymal mass lesions and signs of progressive neurological deterioration referable to the lesion, medically refractory intracranial hypertension, or signs of mass effect on computed tomographic (CT) scan should be treated operatively.
Patients with Glasgow Coma Scale (GCS) scores of 6 to 8 with frontal or temporal contusions greater than 20 cm3 in volume with midline shift of at least 5 mm and/or cisternal compression on CT scan, and patients with any lesion greater than 50 cm3 in volume should be treated operatively.
Patients with parenchymal mass lesions who do not show evidence for neurological compromise, have controlled intracranial pressure (ICP), and no significant signs of mass effect on CT scan may be managed nonoperatively with intensive monitoring and serial imaging.

Surgical evacuation of a hemorrhagic contusion may however not only be motivated by volume or mass effect but also by mitigation of a toxic effect. Possible benefits of surgical excision in the clinical situation are suggested by an analysis of 182 patients with cerebral contusion registered in the Japan neurotrauma databank (Kawamata et al 2006). Surgery for evacuation of contusions can be challenging and requires experience. In general, technical approaches are very similar to surgery for an intracerebral tumor. Often, the contused tissue is sharply demarcated from the surrounding brain tissue (penumbra) and resection should be as extensive as is clinically considered safe; the motivation for surgery in the case presented was first the deterioration of level of consciousness (consistent with the guidelines), the increased local mass effect with imminent risk for tentorial herniation, and removal of the toxic effect. The rapid improvement in GCS following surgery and the uneventful post-operative clinical course provide retrospective support for this decision to operate.

Outcome

Despite the rapid improvement in this patient post surgery, the long term outcome was less favorable. This is not uncommon after TBI and long term sequelae are frequent. Also in patients with milder injuries (GCS 13-15) long term sequelae may occur in up to 1/3 (Yuh et al 2012). Outcome after TBI is multidimensional, including disability in daily life, neuropsychological impairment (e.g. memory and executive function), psychological problems and consequently difficulties in social re-integration. The patients' perspective on outcome may be different from that of health care professionals as illustrated also in this case study. Nevertheless, the patients' perspective is not routinely assessed primarily due to the misconception that patients with brain injury might not be able to rate their own quality of life reliably. More recent studies have shown that self-assessment of health related quality of life is feasible and yields complementary insights. Disease specific HRQoL scores are currently available to facilitate such assessments (Von Steinbuchel et al 2010; Von Steinbuchel et al 2012). We strongly recommend standardized follow up assessments in patients after TBI and these should include an instrument for assessing HRQol to capture the patients' perspective.

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Recommended reading

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Overview of guidelines: www.tbiguidelines.org