Prediction of outcome following mild traumatic brain injury

de Koning, Myrthe Elisabeth

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General introduction
GENERAL INTRODUCTION

Most people either know someone who has, or have themselves experienced mild traumatic brain injury (mTBI), commonly known as a concussion (in Dutch: hersenschudding). Historically, patients were advised to adhere to strict bed rest, especially during the first days of recovery.¹ This archaic view on the management of mTBI has long been abandoned. In general, patients recover within several weeks without any specific therapy. However, somehow a subgroup of mTBI patients continues to experience disabling problems months after injury limiting their daily activities. This dissertation sets out to explore these issues relating to the mTBI population, by addressing the role of injury characteristics, provided care, posttraumatic complaints, and psychological distress on the general outcome and specifically return to work up to one year after injury.

Mild traumatic brain injury

Mild traumatic brain injury is defined as a “hit on the head by an external mechanical force, leading to a brain displacement inside the skull”, resulting in a Glasgow Coma Scale (GCS) score of 13-15.²,³ Differentiation between mTBI and head trauma without brain injury may be difficult, especially when a patient regained a maximum GCS after initial impairment. Therefore, the presence and duration of posttraumatic amnesia (PTA)⁴ and loss of consciousness (LOC) in addition to the GCS, are required for the diagnosis of mTBI.⁵,⁶ MTBI is a common disorder, affecting at least 600 per 100,000 persons per year.⁵,⁷⁻¹⁰ Globally, road traffic accidents account for most of the traumatic brain injuries. In developing countries, the increasing use of motor vehicles contributes to rising incidence rates, whereas a constant decline of road traffic accidents is observed in industrialized countries in the past decades. It is in these countries that the ageing population is associated to more fall-related TBIs among the elderly, making falls the second most common cause for mTBI. Other major causes are interpersonal violence, recreational and sporting activities.² These injury etiologies explain the peak incidence of mTBI among children, young adults and elderly, with a male/female ratio of 3:1.⁹ In approximately 30% of cases extra-cranial injuries such as limb fractures or internal injuries occur.¹¹⁻¹³

Posttraumatic complaints

Posttraumatic complaints (PTC) such as headache, dizziness, forgetfulness, and fatigue are relatively normal to experience the first days after injury, with a decline of complaints over time.¹⁴ An estimated 15-25% of patients however – a group that is sometimes referred to as the miserable minority – develop chronic PTC that may persist up to years after injury.¹⁵⁻¹⁸ The question comes to mind as to why some patients develop persistent PTC and others recover without complaints, and the answer remains an ongoing subject of debate. Persistent complaints have been tied to structural intracranial abnormalities. However, recent studies have been focusing more on pre-injury patient characteris-
tics in an attempt to explain the variation in outcome after seemingly identical traumas. Personality traits and psychological wellbeing have been indicated as important factors in adapting to complaints.\textsuperscript{19–21} Seemingly, some patients are better able to cope with the consequences of an injury than others. Coping refers to the ability to adapt responses and regulate emotions after a distressing event. The use of active problem-directed coping styles have been linked to better outcome, whereas inadequate coping styles are linked to increased feelings of anxiety and depression, which in their turn have a strong relation to posttraumatic complaints.\textsuperscript{22,23}

**Outcome of mTBI**

In the mid-20\textsuperscript{th} century, clinicians and researchers started to reported that recovery of mTBI was not always without problems.\textsuperscript{24} Physical, cognitive, and affective complaints as well as problems with returning to work or resuming other daily routines became a focus of research. Meanwhile, globally rising health care costs provided physicians, scientists and governments with incentives to study the societal financial burden of diseases. MTBI causes direct costs related to hospital admission but especially high indirect societal costs when patients struggle with work resumption, especially since many patients are within the working population.\textsuperscript{25,26} The Glasgow Outcome Scale (GOS) is the most common applied measure for TBI outcome. Originally designed to measure outcomes in a multicenter study, it subsequently became the foremost measure to be used for comparison of outcomes on a global level.\textsuperscript{27–29} Soon after the development of the scale, an extended 8-point version was developed to facilitate differentiation in the upper range of outcome (the GOS-extended, GOS-E). Outcome after mTBI is generally described as being either favorable or unfavorable. Some plea that given the lightness of the injury, mTBI patients should recover fully and therefore any GOS-E score below 8 is an unfavorable outcome.\textsuperscript{30} However, most studies define scores from 1-6 as unfavorable, whereas 7 and 8 are considered favorable outcome.

**Return to work**

Apart from the GOS-E as a way of measuring outcome, an important parameter for recovery is return to pre-injury vocational activities. Successful return to work (RTW) has been associated with more positives outcomes in terms of quality of life, social integration and psychosocial health for both patients and significant others.\textsuperscript{32–36} In terms of economic consequences of injury, loss of work productivity is considered to be the largest determinate of TBI-related costs.\textsuperscript{25} Most patients with mTBI return to work within 3 to 6 months after injury, but approximately 5-20% continues to struggle with their vocational reintegration.\textsuperscript{37} Furthermore, the majority of patients that do return to work still report complaints, raising the question whether these patients will develop problems in a later stage, outside the scope of most studies that are conducted between 3-6 months after injury. Return to work after mTBI is a multifactorial process in which patient characteristics (such as
age, gender, and education) and factors related to adaptation to injury (e.g. depression, posttraumatic stress, and coping) play a role.\textsuperscript{14,37–39} In the transition from sick leave to complete work resumption not only are these aforementioned factors at hand but also occupational and environmental factors that may either advance or thwart endeavors to return to work.\textsuperscript{40,41}

\textbf{Aftercare}

Brain trauma patients are generally assessed and treated according to regional protocols. For mTBI, multiple guidelines are available concerning management in the acute phase, for instance providing criteria for performing Computed Tomography scan (CT-scan) and/or hospital admission.\textsuperscript{42–47} With regard to aftercare, guidelines provide generic advise on follow-up, since only few studies have been conducted on care after hospital discharge. Scheduled outpatient follow-up is advised after discharge from the ward, which would ideally prevent or reduce the chances for patients developing persistent PTC and disability.\textsuperscript{48} Providing patients with adequate information with regard to their injury and its clinical course, is supposed to be the largest contributor of beneficial outcomes during follow-up.\textsuperscript{49} Evidence supporting this theory however, is sparse, with few studies reporting on specialized follow-up and its influence on outcome.\textsuperscript{32,50} In the absence of clinical risk factors or CT-abnormalities, patients are generally discharged home directly from the ED. Given the expectation of good recovery of these non-hospitalized patients, there is no recommendation of scheduled follow-up. In case of persistent complaints or problems when resuming activities, general practitioners may refer patients to the outpatient clinic. These general advises for follow-up have been part of European guidelines since 2002,\textsuperscript{48} yet no studies have been published on guideline compliance or frequency of follow-up. Moreover, considering the economic burden of mTBI, it is important to assess which specialists mTBI patients consult in the sub-acute and chronic phase.

\textbf{General aim and outline of this dissertation}

All studies presented in this dissertation are part of the UPFRONT-study, which is described in detail in \textbf{chapter 2}. In \textbf{chapters 3 and 4} the aftercare is discussed for the entire mTBI population, and separately for non-hospitalized patients. In these chapters, outpatient follow-up is related to outcome in terms of GOS-E and posttraumatic complaints. The specificity of posttraumatic complaints and their relation to anxiety and depression is studied in \textbf{chapter 5}, by comparing mTBI patients with an orthopedic control group. In \textbf{chapter 6}, the influence of an acute alcohol intoxication on recovery is investigated. A multifactorial prediction model for successful return to work is proposed in \textbf{chapter 7}. The penultimate chapter of this dissertation, \textbf{chapter 8}, suggests an alternate approach to mTBI research, by investigating only those patients without complaints early after injury. A summary of the results and an integrated general discussion as well as future perspectives is provided in \textbf{chapter 9}. 
REFERENCES


General introduction


