Brain Injury, 2006, 1–6, preview article

informa
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REVIEW

A proposal for an evidenced-based emergency department discharge form for mild traumatic brain injury

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(Received 19 December 2005; accepted 26 May 2006)

Abstract

Primary objective: To examine and compare a sample of head injury care instruction forms available in hospital emergency departments (EDs) against evidence-based factors predictive of haemorrhage or traumatic lesions and to propose an easy-to-understand discharge instruction form for patients with concussion or mild traumatic brain injury (MTBI).

Research design/methods: Fifteen hospital discharge instruction forms were reviewed for inclusion of six factors known to be associated with the presence of haemorrhage after MTBI. ED instruction forms were also evaluated for readability.

Results: The 15 hospital ED instruction forms varied in what patients' caretakers were instructed to observe. Some but not all important factors associated with haemorrhage were included. The mean Flesch-Kincaid reading grade level of the discharge instruction forms was 8.2 with a mean Reading Ease score of 59.9%.

Conclusion: EDs use discharge instruction forms listing signs and symptoms that are highly variable, confusing, not all evidence-based and often not easy to understand. This review proposes a discharge instruction form containing the six best evidence-based variables (according to the current literature) as being useful and understandable to patients and their families for home observation after MTBI.

Keywords: *Mild, traumatic, brain, trauma, concussion, head, injury*

Introduction

According to data from the Head Injury Task Force, National Institute of Neurologic Disorders and Stroke, ~2 million traumatic brain injuries (TBIs) occur in the USA per year [1]. The majority are considered to be mild [2–6]. Emergency and family physicians see a large number of patients with minor traumatic brain injury (MTBI) and routinely discharge them home with instructions for observation. While less than 10% of patients with MTBI will have positive findings on CT scans and less than 1% require neurosurgical intervention [7, 8], it is haemorrhage that can lead to death. The responsibility rests with the parent/guardian or caretaker to monitor the patient for a rare but life-threatening cerebral pathology requiring surgery or hospital monitoring, e.g. an intra-cranial haematoma or cerebral oedema. In addition, it is the responsibility of the attending physician to inform the family what to observe and what actions to take if the patient's neurologic condition deteriorates significantly after discharge from the ED.

The majority of the research that evaluates factors associated with haemorrhage identifies a change in the Glasgow Coma Scale (GCS) as a risk factor for intra-cranial complications following mild head injury [2, 3, 5, 6, 9–19]. GCS < 15, for example, is listed in many studies as a risk factor [3, 6, 10, 12, 13, 16, 18–20]. A GCS of 15, however, does not rule out radiographic intra-cranial lesions given that 3% of patients with a GCS of 15 in one study had CT evidence of head injury [12]. Loss of consciousness and change in mental status have also been associated with the risk of intra-cranial complications [2, 3, 5, 9, 11, 15, 16, 20]. Palchak et al. [21] suggest that loss of consciousness alone, however,

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ISSN 0269–9052 print/ISSN 1362–301X online/06/000001–6 © 2006 Informa UK Ltd.
DOI: 10.1080/02699050600831934

is not predictive of TBI on CT or of requiring surgical intervention.

Various mechanisms of injury have been shown to be associated with intra-cranial pathology. Seven studies [2, 5–7, 10, 11] either specifically state the form of, or imply, a high energy mechanism such as bicyclist/pedestrian struck by a motor vehicle. The use of drugs and/or alcohol has also been identified as a significant risk factor for developing a brain injury complication [3, 6, 10, 13, 22]. A number of studies state that a neurologic deficit is associated with intra-cranial lesions and haemorrhage [3, 6, 11, 13, 15–17]. Nee et al. [23] demonstrated that vomiting after MTBI is associated with a four-fold increase in the risk of a skull fracture, which in turn increases the risk of an extradural haematoma. Numerous studies have identified vomiting as an important risk factor for CT lesions post-MTBI [3, 5, 6, 8–11, 13–15, 17, 22].

Headache is a common symptom post-MTBI; however, the nature and intensity of the headache is described inconsistently over selected studies. Nevertheless, headache has been significantly associated with head injury complications identified by CT scanning [3, 6, 8, 10, 13–15, 22].

Amnesia is an important risk factor for haemorrhage; although the manner in which amnesia is described and evaluated is inconsistent across studies. Memory loss, whether retrograde or anterograde, has been identified as a potential risk factor in 10 recent studies [3, 5, 6, 9–11, 13, 15, 17, 22]. Conversely, one recent study concluded that isolated amnesia was not predictive of TBI on CT or of requiring surgical intervention [21].

The Miller criteria published in 1996 define a population of patients with a GCS of 15 after minor head trauma that may safely be released from the ED without obtaining a head CT [4]. Conversely, the Miller criteria suggest that a CT scan is recommended if there is significant headache or nausea, vomiting or signs of depressed skull fracture. Subsequently, a prospective, observational study by Holmes et al. [4] applied these criteria for CT scanning in a population with a GCS of 14 and identified 18 of 35 cases with abnormalities on CT. Haydel et al. [22] selected seven clinical items to apply to 520 patients with minor brain injuries. The sensitivity and specificity for the constellation of items was 100% (95% CI: 95–100%) and 25% (95% CI: 22–28%), respectively, for identifying patients with a positive CT scan. The clinical items selected were: short-term memory deficits, drug or alcohol intoxication, physical evidence of trauma above the clavicles, age > 60 years, seizure, headache and vomiting.

The Canadian CT Head Rule [5] identifies clinical factors for predicting intra-cranial lesions in adult patients with MTBI: GCS < 15 at 2 hours post-injury, suspected open or depressed skull fracture, any sign of basilar skull fracture, vomiting two or more times, age > 65 years, retrograde amnesia > 30 minutes and dangerous mechanism of injury. These were found to be 98.4% sensitive (95% CI: 96–99%) and 49.6% specific (95% CI: 48–51%) with a 99.7% negative predictive value (95% CI: 99.3–99.9%) for predicting the need for neurosurgical intervention.

With regard to children, a 1999 practice parameter developed by the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) concluded that, based upon two studies of children with minor head injury, head CT scans could be foregone in children meeting the following criteria: normal neurologic examination, no loss of consciousness and no amnesia, vomiting, headache or mental status abnormalities. Otherwise, paediatric patients with any of these findings should undergo brain imaging [24].

There is no consensus regarding the frequency or need to awaken patients after discharge from the ED [25]. Ingebrigtsen et al. [16] recommend that the patient sent home from the ED be awakened twice during the first night. Their in-hospital observation recommendations are to awaken the patient every 15 minutes the first 2 hours and thereafter every hour until at least 12 hours after injury. The AAP/AAFP guidelines endorse observation in a variety of settings under the care of a competent caregiver [24]. Livingston et al. [26] stated that the negative predictive power of a CT scan is 99.7%, suggesting that a patient with a negative head CT and no other signs or symptoms may be discharged without observation. Monitoring may be crucial, however, since deterioration may occur minutes to hours after a head injury. Out of 834 subjects in the in-home monitoring study arm of Fabbri et al. [27], 5.3% (44 out of 834) returned to the ED after a median of 27 hours and six were found to have had a post-traumatic lesion, although none required surgical intervention. Servadei et al. [20] showed that 22 of 27 cases of extradural haematoma clinically deteriorated within 7 hours post-injury, with a mean of 3 hours. However, there is no evidence in any of these studies that waking the patient resulted in more rapid recognition of the factors associated with cerebral haemorrhage.

In summary, although there is considerable research on factors associated with neurologic complications following mild brain injury there is no true consensus on which factors are most predictive. That being said, the factors most consistently associated with the presence of haemorrhage or intra-cranial pathology (such as cerebral oedema) following a mild brain injury are: (1) vomiting, (2) headache

(especially a worsening headache), (3) developing amnesia or evidence of short-term memory loss, (4) worsening mental status, (5) neurologic signs such as loss of motor function, vision or speech and (6) seizure. Parents and other family members who are watching over individuals with MTBI should be informed of these factors and the best means to inform family members is with a discharge instruction form.

Objective

Most emergency departments (EDs) provide discharge information forms or brochures to patients with head injuries. The discharge instruction forms generally present a list of symptoms that patients may experience after a concussion. Patients are likely to regard these information forms as official and endorsed by the hospital and physicians. However, there are no standards or guidelines for these information forms. Further, it is possible that critical information for monitoring the patient may be left out. The purpose of the present study was to examine a sample of discharge information forms from a sample of hospitals and compare them to the critical signs and symptoms of haemorrhage that the best evidence in the literature says should be observed. Information forms for family members should also be readable and understandable and, therefore, this review evaluated reading levels of existing discharge forms. Finally, an information form was proposed that captures all of the known factors associated with haemorrhage that is readable at a grade six level.

Methods

Study design

Based on the review of the literature, the head injury discharge instructions were rated on the number of evidence-based predictors of intra-cranial lesions/haemorrhage. The literature review identified 11 risk factors that were considered to be predictive of intra-cranial haemorrhage or lesions post-MTBI: GCS < 15, vomiting, headache, amnesia, age, trauma, drug/alcohol intoxication, seizure, high energy mechanism of injury, neurological deficit and historical factors (coagulopathy, hydrocephalus with shunt, pre-existing neurological disease). These were condensed into six factors that had at least two research investigations to support their predictive relationship with neurologic complications: GCS < 15, amnesia, headache, vomiting, neurologic deficit and seizure.

The rating of each discharge instruction sheet was conducted by two of the authors and simply looked at whether the instruction sheet mentioned the need to observe any of the six factors associated with neurologic complications. On the rare occasion when the reviewers disagreed they discussed the information presented and reached consensus. The instruction forms were also evaluated for readability with the Flesch-Kincaid grade and reading ease formulae [28–30]. The two Flesch-Kincaid formula scores are based on the average number of syllables per word and words per sentence. The Flesch-Kincaid Grade Level score rates text based on the US academic level system. The Flesch Reading Ease score is on a spectrum of 0–100; the higher the score, the easier it is to comprehend.

Study setting

Five hospitals from Southern Ontario, Canada and 10 hospitals in the Western New York, USA region were contacted in order to obtain the discharge instructions form given to patients who were discharged home after MTBI. Hospitals varied from local community hospitals to major trauma centres.

Population

Fifteen hospital ED head injury discharge information forms from Canada and the USA.

Outcomes

This study compares a sample of information forms available to patients after MTBI against the best available scientific evidence for the signs and symptoms of haemorrhage. The study also provides a sample information form that is evidence-based and readable.

Results

Various signs and symptoms were included in the 15 discharge instruction forms (Table I). A multitude of formats were employed to present the information. Some information forms were narrative and lengthy while others were exceedingly brief. The Flesch-Kincaid formula grade level reading ranged from 5.8–12.0 with a mean of 8.2. The Flesch-Kincaid Ease formula ranged from 39.0–72.3% with a mean of 59.9%.

Of the 15 discharge instruction forms reviewed, only one contained all six items in the recommended list of risk factors for neurologic complications. The remainder of the discharge instruction forms' conformity to these six chosen items ranged from 50–83%. Only two of the selected six items were listed in every discharge instruction form: GCS < 15

Table I. Discharge instruction form conformity with six evidence-based risk factors.

	Risk factors							
Hospital #	GCS < 15	Vomiting	Headache	Amnesia	Seizure	Neurologic deficit	Percentage conformity*	Range from baseline**
1	•	•	•		•	•	83%	2.5×
2	•	•			•	•	67%	1.8×
3	•	•	•		•	•	83%	1.8×
4	•	•	•		•		67%	1.3×
5	•	•	•				50%	1.7×
6	•	•			•	•	67%	1.7×
7	•	•	•		•	•	83%	1.8×
8	•	•	•		•	•	83%	1.7×
9	•	•	•		•		67%	1.7×
10	•	•	•	•	•		83%	1.7×
11	•	•	•				50%	0.7×
12	•	•	•		•	•	83%	1×
13	•	•	•				50%	0.8×
14	•	•	•	•	•	•	100%	2×
15	•	•	•	•		•	83%	1.3×

• denotes risk factor addressed in the institution's discharge instruction sheet; * calculated from number of identified risk factors on institution's discharge instruction sheet divided by total number of evidence-based risk factors (6); ** calculated from total number of elements on institution's discharge instruction sheet divided by total number of evidence-based risk factors (6).

and vomiting. The least frequently cited item was amnesia, with only four discharge instruction forms having included this variable.

Discussion

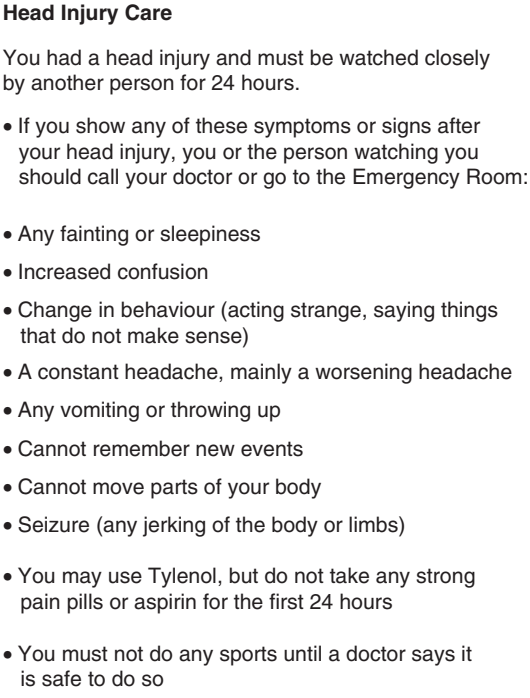
Patient discharge instruction forms for MTBI are important because of the potential for neurologic deterioration after seemingly minor brain injury. Instructions to caregivers should be simple, precise and relevant. The written word is superior to verbal explanations, both in terms of compliance with instructions and for retaining the information [16]. Therefore, a simple and evidence-based discharge instruction form for mild head injuries may help caregivers to properly monitor post-MTBI patients after discharge from the ED.

The discharge instruction forms reviewed in this study varied a great deal in terms of the information given to families, the reading grade level for understanding the information and the type of information included. Wording on most of the discharge forms was vague. 'Mental confusion' and 'neurologic deficit' were terms often used but absent any clarifying statements. If the instruction forms were intended to instruct family members on what to look for in case the injured person had developed a haemorrhage, then virtually all of the instructions forms were inadequate. None of the instruction forms specifically mentioned this as the primary reason for continuing observation.

There was wide variation for inclusion of the six evidence-based risk factors. Only one discharge instruction form listed all six criteria; from an institution, interestingly, that is not a major trauma centre. This may reflect the fact that major trauma centres see the more severely injured patients and may not be as concerned with the instructions given to patients with MTBI discharged to home.

The only children's hospital discharge instruction sheet in the sample scored an 83% compliance rate with the selected risk factors, but at a cost of including a lot of extraneous information (2.5-fold greater). The evidence-based risk factors were distilled from adult studies; therefore, these criteria need to be re-evaluated with respect to paediatric MTBI patients. More study of factors associated with haemorrhage in children is required.

According to the Flesch-Kincaid readability formulae, a high education level is required to interpret the discharge instructions reviewed. The optimal readability for the general population is recommended to be a grade 6 level [30, 31]. The 15 handouts reviewed had a mean 8.2 grade level. The reading ease score varied widely as well, ranging from 39.0–72.3%. Standard documents aim for a score of 60–70%. Print sizes and formats also varied considerably. A minimum font size of 12 is recommended. A discharge instruction form (Figure 1) that is easy to read and understand is proposed. The Flesch-Kincaid reading ease is 78.4% and the grade level is 6.5. These scores were altered as a result of including the words 'tylenol' and 'aspirin'. By removing these two words, the Flesch-Kincaid reading ease becomes 84.9% with a grade level of 5.4. Nonetheless, it is believed that this information is important to include in the discharge form and that these two words will be understood as they are in common usage. The proposed form



Head Injury Care

You had a head injury and must be watched closely by another person for 24 hours.

- If you show any of these symptoms or signs after your head injury, you or the person watching you should call your doctor or go to the Emergency Room:
- Any fainting or sleepiness
- Increased confusion
- Change in behaviour (acting strange, saying things that do not make sense)
- A constant headache, mainly a worsening headache
- Any vomiting or throwing up
- Cannot remember new events
- Cannot move parts of your body
- Seizure (any jerking of the body or limbs)
- You may use Tylenol, but do not take any strong pain pills or aspirin for the first 24 hours
- You must not do any sports until a doctor says it is safe to do so

Figure 1. Proposed patient discharge instruction sheet for MTBI.

has the font size 14 Arial with 1.5 line spacing with a simple format to account for visually impaired individuals (those with diabetic retinopathy, cataracts, glaucoma, scotoma, etc).

Results of the research on the significance of clinical risk factors for predicting structural intracranial lesions after MTBI are occasionally contradictory and some are plagued by methodological issues [22]. Other problems include the lack of a uniform definition of MTBI. Nevertheless, there is enough evidence that certain clinical factors have sufficient sensitivity and predictive value to alter the index of suspicion for the risk of intra-cranial lesions in adult patients with MTBI. Until more research has been conducted it is assumed that all factors are important to observe for and that no factor is more important than another. It is critical that information forms distributed by hospitals use current and relevant information to instruct family members on signs and symptoms after MTBI. This review has attempted to improve the quality of information and guidance given to family members by providing a sample information form that is readable at a grade six level and that includes only those factors that are evidence-based and related to the possibility of intracranial hemorrhage or cerebral oedema after MTBI.

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