Title: Evaluating mild traumatic brain injury management at a regional emergency department.

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Abstract

Background

Emergency departments (EDs) are usually the first point of contact, and often the only medical service available, for patients with mild traumatic brain injury (mTBI) in rural and regional areas. Clinical practice guidelines (CPG) have been created to ensure best practice management of mTBI in EDs. Adherence to mTBI CPGs have rarely been evaluated in rural and regional areas.

Aim

The aim of this paper is to assess a regional health service's adherence to their mTBI CPG.

Method

A 12-month retrospective audit of 1280 ED records of patients ≥16 years presenting with an mTBI to a regional Australian ED. Case selection used the Victorian Admitted Episodes Dataset codes for suspected head injury: principal diagnosis codes (S00-T98); concussive injury recorded in diagnosis codes (S06.00-S06.05); and unintentional external cause code (V00-X59). Data was collected to determine: 4-hour observation rates; Computed Tomography (CT) scan rates; safe discharge and appropriate referral documentation

Results

Less people received a CT scan than qualified (n=245, 65.3%), only 45% had 4-hour observations recorded, safe discharge occurred in 55.6% of cases and 33% received educational resources.

Discussion/Conclusion

Several key elements for the management of mTBI were under-recorded, particularly 4-hour observations, safe discharge, and education. Acquired Brain Injury (ABI) clinic referrals were received in overwhelmingly fewer cases than received a CT scan (n=19, 6.3%). Overall, this

study suggests that the regional health service does not currently fully adhere to the CPG and the referral services are potentially underutilised.

Introduction

Mild traumatic brain injury (mTBI), a term used interchangeably with concussion, is a growing public health concern.[1] Mild traumatic brain injury is caused by a forceful impact to the brain, resulting in neurometabolic dysfunction of the brain, rather than a structural injury.[2] There is high cost associated with mTBI, with both monetary costs to the healthcare system and also the physical, emotional and psychological burdens to patient.[3] The estimated cost of mTBI to the United States healthcare system is $17 billion annually,[3] and in Australia, mTBI has been shown to account for up to 332/100,000 hospitalised patients annually.[4] Many patients experience latent concussive symptoms such as headache, dizziness, nausea, and fatigue, that may continue for months after the initial injury.[5-7] As a result, mTBI can affect a person's ability to return to work and daily activities after injury.[8] Due to the potentially high combined cost burden and impact on the individual, the importance of evidence-based treatment and management of mTBIs is imperative.

In order to ensure best practice management of mTBI, clinical practice guidelines (CPG) have been developed to standardise assessment, discharge education and referral of mTBI. Clinical practice guidelines have been defined as statements developed through research, used to guide decisions making of patients and clinicians about best practice and level of care in medical practice.[9] Despite the availability of high quality evidence-based guidelines, current literature suggests that there is inconsistent use of these recommended practice guidelines both in Australia and internationally.[8] This is potentially due to a lack of knowledge of existing guidelines and use of institution specific policies.[10,11]

Regardless of the differences between the existing CPGs, adherence to CPGs have rarely been evaluated, or only in metropolitan settings.[10,12] It is well recognised that healthcare differences exist between metropolitan and rural/regional settings.[13] Previous research recognises that regional areas experience a higher number of hospital presentations for mTBI than persons living in metropolitan areas.[14] It is thought that this may be due to the

emergency department (ED) often being the main and often only point of medical contact for these patients, particularly in regional areas.

The appropriate management of mTBI was identified as an important problem at a large regional health service. The health service is the principal referral hospital for a region covering 48,000 square kilometres and more than 224,000 people. The health service has an Acquired Brain Injury (ABI) program that is able to provide follow up for patients with mTBI presenting to the ED. At the time of this study, compliance with the existing mTBI CPG had not previously been evaluated and the lack of follow-up of mTBI patients was a recognised issue. Therefore, the aim of the study is to assess the regional health service's adherence to their mTBI CPG. In doing so, the profile of the mTBI patients in this regional area will be explored to identify if any differences exist from previous studies, based predominately in urban areas.

Methods

A 12-month retrospective audit was conducted of ED records for persons ≥16 years who presented with an mTBI to a regional Australian ED between February 1st, 2014 and January 31st, 2015. The study was conducted in a large regional health service in Victoria, Australia, receiving over 53,000 ED presentations annually. The health service has an mTBI CPG that covers: (1) symptoms to record; (2) criteria for Computed Tomography (CT) scanning, including the use of recognised guidelines, such as the Canadian Head Rule,[15-16] (3) specification for observation time and higher risk patients; (4) outline of the discharge procedure, including the multiple educational resources to be provided; and (5) guidelines for the referral and follow-up to be provided, particularly to patients that have received a CT scan.

Cases were selected using the Victorian Admitted Episodes Dataset codes for suspected head injury using the ICD 10 AM codes used in previous research:[7] principal diagnosis codes (S00-T98); concussive injury recorded in diagnosis codes (S06.00-S06.05); and

unintentional external cause code (V00-X59). Cases were included if they satisfied the following criteria: age ≥16years and met the clinical definition of mTBI; history of blunt trauma, Glasgow Coma Scale score of 13-15, and one or more of: witnessed or reported loss of consciousness ≤ 30 minutes, post traumatic amnesia <24 hours, witnessed disorientation, confusion, external evidence of injury above the clavicles, vomiting, severe headache or focal neurology.

Data collected included demographic, mTBI signs and symptoms and mTBI management information. The data collected was audited against the health services' CPG for mTBI management to assess the management of this injury. Key management criteria included: 4-hour observation data; criteria met for CT scan adapted from the Canadian Head rule and New Orleans procedure (Figure 1);[15-16] referrals provided, in particular ABI referrals; and education provided at discharge.

Descriptive analysis was performed for the demographic and medical data for all participants. Descriptive analysis, cross tabulation and chi square analysis were used to determine: number of mTBI cases; mTBI characteristics – injury mechanism, demographic characteristics of mTBI patients - age, gender; and completion rates of ABI referrals and associated medical record documentation, audited against the hospital's mTBI CPG.

Ethics approval was granted by the relevant health service and university Human Research Ethics Committees.

<Insert Figure 1 about here>

RESULTS

Demographic Profiles

There were 1280 mTBI records identified during the 12-month period. After the inclusion criteria was applied, a total of 540 ED presentations were eligible for inclusion in this study. The demographic data for those patients are presented in Table 1. Males aged between 16-

24 years had a significantly higher proportion of mTBI (χ25=14.454, p=0.013) than all other ages and gender. Males sustained a significantly higher number of mTBI's from being struck or colliding with a person or object (χ^2_3=22.073, p <0.01).

Table 1. Demographic information of mTBI cohort

Demographic Variables	Participants (N=540)
Gender, *n* (%)	
Male	336 (62.2%)
Female	204 (37.8%)
Age (years), *n* (%)	
16-24 years	194 (35.9%)
25-34 years	87 (16.1%)
35-44 years	61 (11.3%)
45-55 years	55 (10.2%)
55-64 years	45 (8.3%)
65+ years	98 (18.1%)
Injury Mechanism	
Colliding with object or person	191 (35.3%)
Falls (<1m Low and >1m High)	187 (34.7%)
External cause of injury	54 (10%)
Motor Vehicle Accident	39 (7.2%)

Management of mTBI

Less than half the patients (45%) were kept in the hospital for the recommended 4-hour time period. One quarter of the cohort had no observations or times recorded in their medical records. The association between age and 4-hour observations was found to be statistically significant (χ^2_{10}=46.837, p <0.01), with those in the youngest and oldest age brackets observed for the recommended four hours more frequently than all other age brackets.

Over two-thirds of patients met the criteria for a CT scan (69.4%). Figure 2 shows the breakdown of CT scans received via each pathways.

<Insert Figure 2 about here>

Not all patients that met the criteria received a CT scan (n=245, 65.3%). However, the most symptomatic mTBI patients (those who qualified for both pathways) received a greater proportion of CT scans (χ^2_6=19.368, p=0.04) compared to those that only qualified for one pathway. A significantly greater proportion of people in the youngest and oldest age brackets received a CT scan to assess their injury (χ^2_{10}=23.326, p= 0.009).

The health service's CPG states that all patients that required a CT scan should be referred to the ABI clinic for follow-up on discharge. Only 19 patients that received a CT (6.3%) were referred to the ABI clinic. An additional 20 patients (6.6%) received a CT scan and were seen in the ABI clinic, however, no referrals were found in their files.

A total of 341 patients (63.1%) received at least one type of referral for follow-up at discharge; each case was not restricted to only one type of referral. The most common types of recorded follow-up for mTBI were General Practitioner (55.6%), and "All Other Referrals" (16.1%). The "All Other Referrals" category included referrals to community services, specifically named persons, surgery, among others. No follow-up was recorded in 37.1% of cases.

The CPG states that education is to be provided at discharge for all mTBI cases. Education included: a Head Injury Instruction booklet and DVD and a Head Injury Advice Card. The Head Injury Instruction booklet/DVD was provided to 174 patients (32.2%), additionally the Head Injury Advice Card was provided to 178 patients (33%). Further to this, 223 patients (41.3%) received advice or instructions on if and when to return to ED after discharge.

Safe discharge practices are necessary to improve the safety of a patient once they have left the care of ED and reduce the likelihood of a return ED visit. Safe discharge was recorded in 74.1% of patients (n=400), however, over a fifth of patients had no discharge information documented in their ED record. Over half of the patients were discharged into the care of a responsible adult (n=300, 55.6%). However, many patients (n=211, 39.1%) had no

information recorded regarding releasing patients into the care of a responsible adult or time of release.

DISCUSSION

The ED is often the first and potentially the only point of medical contact for patients who sustain an mTBI, particularly in rural and regional areas. Therefore, the use of mTBI evidence-based CPGs are critical to ensure these patients are managed appropriately. The findings of this study provide valuable information for this and similar regional health services, affirming that the management of mTBI in this health service ED is not fully consistent with the current CPG.

A quarter of mTBI patients did not have 4-hour observations recorded, which is concerning as it is not compliant with current practice. As this study was retrospective in design, it is not possible to determine if the observations were completed and not recorded or if no observations were conducted. Kowalski and Yoder-Wise,[17 p.272] stated that “Legally, if you didn’t chart it, you didn’t do it”, thus the lack of recording of observations is potentially a major issue in the care of these patients. The recording of observations, such as GCS and time in ED, are used to track a patient’s condition. If this is not recorded consistently it could lead to people being released from hospital before they are ready and may lead to adverse consequences for the patient. ED staff may be using their clinical judgement on specific cases to determine if someone is safe to go home, rather than enforcing the 4-hour observation criteria. Given that mTBI patients may present to ED hours to days after the initial injury, it is possible that the 4-hour time period may not be necessary in every case.

Computed Tomography scans were a common management process for mTBI, with just over half of the 540 cases in this study receiving a CT scan. This finding was fairly consistent with other research which have reported that 44% of patients and 62% children received a CT scan for their mTBI.[18-19] However, not all patients that met the criteria for a CT scan received a scan. It was evident that the most symptomatic or at-risk patients (those that

qualified for CT Pathway 1 & CT Pathway 2) were more likely to receive a CT than patients with less symptoms, suggesting that those who need it most are receiving the scans. The patients who were eligible for a CT under the current CPG that did not receive one, highlights an area for improvement to ensure best practice is being implemented.

The CPG recommends that patients with mTBI who receive a CT scan are referred to the ABI clinic. Given that over half of the cohort received a CT scan, the percentage of ABI clinic referrals should be considerably higher than the 6.3% of patients in this study. In their study, Tavender et al suggested that there were concerns raised about potentially flooding the ABI clinic with unnecessary patients if an auto-referral policy was put in place in the hospital. [12] However, it is believed that this is not the case in the current study, as a total of 29 patients were found to be referred, seen or recommended to be referred in the cohort of 540 patients, thus the opposite appears to be true. The ABI clinic is a substantial resource available in this regional health service for follow-up of mTBI patients to assess their recovery, their needs for further management of their injury and to provide any necessary additional treatment. It is believed that improving the referral system could improve injury outcomes and better track recovery of mTBIs in this region.

Documentation of discharge was insufficient; one fifth of patients had no discharge information, including referrals or follow-up, recorded when leaving the hospital. Similarly, follow-up and referrals were not fully recorded. Though it is reasonable to assume that not all patients will require follow-up after their injuries, just over 60% received some form of follow-up and referral on discharge. There is still improvement to be made, Bazarian et al. reported near identical figures with 37.2% of cases discharged without a referral, proving this area hasn’t seen growth.[18]

It was also evident that clinicians overall are infrequently providing education upon discharge, as under half of the cohort received education, consistent with previous studies.[10] Bay & Strong noted that education was provided in the form of standardised

printed information 90% of the time, but only by 44% of the nurses surveyed.[10] The CPG states that all patients with a suspected mTBI should receive the education when they leave the hospital; in the cohort examined this requirement was not satisfied. It was not clear if education provided is not being recorded or if people are not receiving the information they need. Education plays a vital role in helping a patient take care of themselves once they have left the hospital but also to help prevent future mTBI presentations, so it is important that its dissemination is recorded.[10,12]

The large sample size in a regional area was a strength of this study; however, a limitation was that all records supplied were scanned versions of hand written paper records which were often illegible or difficult to decipher due to handwriting and high use of medical shorthand. In addition, it is possible that not all files were uploaded and missing symptom documentation have led to underreporting in some cases.

Overall, this study suggests that the regional health service does not currently fully adhere to the CPG in place and the referral services are potentially underutilised. Compliance with the CPG is important to ensure consistency and optimal care outcomes for these patients. With higher numbers of mTBI presentations to EDs in regional areas and limited access to health services, it is crucial that the care provided in ED is consistent and evidence-based.

Key Messages

What is already known

- Emergency departments are often the first medical contact for patients with mTBI
- Clinical practice guidelines exist to ensure evidence-based management of mTBI in EDs

What this study adds

- Compliance with key elements of assessment of patients with mTBI, such as 4-hour observations and CT scans, is not consistent with current CPG guidelines.

- Valuable educational resources for mTBI management post discharge exist but are not always disseminated.
- Referral services for patients with mTBI are underutilised and may result in less than optimal follow up

Contributorship Statement:

Anna Wong Shee and Dara Twomey conceived the study, contributed to the analysis plan and contributed to the paper writing. Ashlee Brown collected the data, undertook the data analysis and had major responsibility for the writing of the paper.

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