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Role of brain CT scan in the diagnosis of patients with minor head injury in trauma emergency center

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ABSTRACT

Currently, a large burden of hospital admissions is related to minor head trauma and its related imaging studies. One of the challenging issues for emergency physicians is brain computed tomography scan. Sensible use of computed tomography studies could minimize unnecessary radiation exposure and resource use. On the other hand, it can result in delayed or missed early treatment of intracranial injury.

The aim of this review is to evaluate and summarize the costs and benefits of using diagnostic measurements in minor head trauma with particular focus on computed tomography scan and the advances and limitations of available guidelines. We studied different issues related to the current approach to minor head trauma in emergency departments.

Altogether, it seems using brain computed tomography scan in the setting of emergency is a cost-effective method for the selected patients with minor head injury. However, concerning considerable costs of caring for patients with head injury and high sensitivity of brain computed tomography in terms of minor head injury, it seems reasonable to use brain computed tomography scan for a wider range of patients with minor head injury.

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Introduction

Minor head injury (MHI) is one of the most important public health problems, which is frequently seen in emergency departments (ED) (1). It is typically defined as minor by a Glasgow Coma Scale (GCS) of 13-15 on initial ED evaluation and a history of contact or acceleration/deceleration forces to the head (2). One of the accepted modality in

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order to diagnose the intracranial lesions is brain computed tomography (CT) (3).

Indications for CT scan are a discussing issue in patients with MHI. Although a liberal use of CT scan was accepted for any patients with MHI, nowadays concerning high costs (4), irradiation complications (5) and restricted accessibility in some areas. Various guidelines tried to define comprehensive criteria. However, there are considerable disagreements about these criteria in the large number of MHI cases (6).

Care pathways are clearly structured in moderate or severe head injury management in hospitals (7,8). However, approximately 8% of MHI will result in intracranial injury and only 1% of them will need neurosurgical intervention (8).

Management of this large proportion of patients involves a balance between under-investigation, which result in missing early treatment for intracranial injury and over-investigation, which risks unnecessary radiation exposure and wasting of health system resources.

Incidence

Head injury accounts for approximately 700,000 ED attendances in England and Wales each year (8), 90% of which are classified as minor GCS (9-11).

Furthermore, in EDs, in Canada and the United States, annual incidence of head and neck trauma is more than six million cases (12). Most of these patients are minimal or minor head injury. However, neurosurgical intervention is needed in about 1% of patients due to deterioration and intracranial hematoma (13,14). Additionally, it should be mentioned that about 90% of CT scans do not suggest clinically important brain injury (9,10,15).

The Canadian CT Head Rule (CCHR)

Among various guidelines and rules, which are available regarding diagnostic approach to the patients with MHI, the Canadian CT Head Rule (CCHR) (15) seems to be the most widely validated adult rule. However its sensitivity is high and ranges between 80 and 100%, the unique characteristic of this rule is its acceptable specificity, which is the highest among other rules and ranges between 37 and 77%, depends on using the high- or medium-risk criteria. Available rules for children and infants are less validated. Although high sensitivity with satisfactory specificity has been reported in cohort studies, it has been mentioned that specificity is poor yet in limited validation data.

On the basis of point estimated for positive likelihood ratio (PLR), the risk factors of intracranial injury (ICI) stratified into 3 groups. In adults, depressed, basal or radiological skull fracture and post-traumatic seizure (PTS) are the factors which increase likelihood of ICI dramatically (PLR>10). Persistent vomiting, GCS declining, focal neurological deficit and previous neurosurgery, moderately increase the likelihood of ICI (PLR 5-10). And finally, fall from a height, any seizure, chronic alcohol use, undefined vomiting, age over 60 years, coagulopathy, pedestrian motor vehicle accident (MVA), amnesia, GCS <14 and GCS<15 are considered as the risk factors, which increase the likelihood slightly (PLR 2-5). There is equivalent risk stratification in children the same as adults with only few differences.

Many other rules were also assessed such as New Orleans CT rule (NOC) (11), Scottish Intercollegiate Guidelines Network (SIGN) (16), NEXUS II (17) and the European Federation of Neurological Sciences (EFNS) (18) guidelines. None were as accurate in the prediction of neurosurgical injury (NSI) or ICI as the CCHR.

Economic issues

Geijerstam et al. (19) compared two strategies including in hospital observation

versus early CT and home care. This concluded that the latter strategy is as effective as the former one in patients with MHI (21.4% vs. 24.2% not fully recovered at 3 months) and costs less than hospital admission (mean cost of £314 vs. £462 per patient). Additional two contemporaneous cohort studies (20,21) and other uncontrolled before/after studies evaluated the effect of changes in management and implementation of guidelines, but they failed to provide any conclusive evidence due to methodological weaknesses and lack of general ability.

Conclusion

In currently available guidelines in minor head trauma, Canadian CT Head Rule seems to be precise and reliable. Therefore, clinicians can determine with confidence that minor head injury patient would benefit of CT imaging. It is particularly useful when CT imaging is not available or it is important to make decision about patients transferred to a higher equipped center. There are some barriers to implement this rule and future investigations should identify strategies to deal with these barriers and discover more effective methods to knowledge translation.

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Conflict of Interest

The authors declare no conflict of interest.

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