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A second look at the utility of serial routine repeat computed tomographic scans in patients with traumatic brain injury

Ansab A. Haider, M.D., Peter Rhee, M.D., Tahereh Orouji, M.D., Narong Kulvatunyou, M.D., Tania Hassanzadeh, M.D., Andrew Tang, M.D., Adil Farman, M.D., Terence O'Keeffe, M.D., Rifat Latifi, M.D., Bellal Joseph, M.D.*

Division of Trauma and Acute Care Surgery, Department of Surgery, University of Arizona Medical Center, 501 North Campbell Avenue, Room 5411, PO Box 245063, Tucson, AZ, 85724, USA

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Abstract

BACKGROUND: The practice of a routine repeat head computed tomographic scans in patients with traumatic brain injury (TBI) is under question. The aim of our study was to evaluate the utility of a more than 1 repeat head computed tomography (M1CT) scans in patients with TBI.

METHODS: We performed a 3-year analysis of a prospectively collected database of all TBI patients presenting to our level I trauma center. Patients who received M1CT scans were included. Findings and reason (without neurologic decline vs after neurologic decline) for M1CT were recorded. Primary outcome measure was neurosurgical intervention.

RESULTS: A total of 296 patients that underwent M1CT were included. Of those, 291 patients (98.6%) had M1CT without a neurologic decline, and neurosurgical intervention was performed in 1 patient (.3%) who was inexaminable (Glasgow coma scale score = 6). The remaining (n = 5) had M1CT due to a neurologic decline; 4 patients (80%) of the 5 had worsening of ICH; and neurosurgical intervention was performed in 3 (75%) of the 4 patients.

CONCLUSIONS: The practice of multiple repeat head computed tomographic scans should be limited to inexaminable patients or patients with neurological deterioration.

With the development of regionalized trauma centers and improvement in the capabilities of emergency medical services, the transport of trauma patients has expedited tremendously, and most patients arrive at the trauma centers within the 1st 1 or 2 hours of injury.[1] A large number of these patients have traumatic brain injury (TBI), with many of them having their only complaint being a history of loss of consciousness.[2,3] Computed tomographic (CT) scan is the modality of choice for the initial evaluation of

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* Corresponding author. Tel.: +1-520-626-5056; fax: +1-520-626-5016.

E-mail address: bjoseph@surgery.arizona.edu

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these patients which provides evidence of the pattern of intracranial injuries, and these findings have been correlated with the outcome of these patients.[4]

With increasing expedited CT scans, more recently concerns have been raised that very early CT scans may fail to identify intracranial injuries that progress later on and may lead to adverse outcomes.[5,6] This concern is particularly raised when the initial CT scan is performed within 1st 6 hours of the insult while the injury is still progressing.[7] This has led to a widely rampant practice of multiple follow-up CT scans in all TBI patients to determine the final extent of a head injury. It is well known that many repeat scans demonstrate progression of the initial lesion or the development of a new lesion.[8] However, numerous studies have argued that most often this progression is only radiologic which does not lead to any change in management in the absence of neurologic deterioration.[9–14] Moreover, radiologic worsening of a repeat CT scan provokes further imaging leading to multiple repeat head scans till there is evidence that radiologic progression has stopped. Clinical suspicion, high-risk features, and history of anticoagulation also provoke many of these multiple repeat scans. Although many including us have argued the need for a follow-up CT scan, the value of multiple CT scans after the 1st repeat scan is unknown.

The aim of this study was to evaluate the utility of further repeat imaging in TBI patients after the 1st repeat head CT (RHCT) scan. We hypothesized that performance of more than 1 repeat CT scans is not associated with neurosurgical intervention in the absence of neurologic decline.

Methods

After approval from the Institutional Review Board of the University of Arizona, College of Medicine, we performed a 3-year (2009 to 2011) analysis of our prospectively collected database of all patients with TBI presenting to our level I trauma center.

Inclusion and exclusion criteria

We included all patients who presented to our level I trauma center with a diagnosis of TBI after blunt trauma and received 2 or more RHCT scan after the initial CT scan. TBI was defined as presence of an intracranial hemorrhage (ICH) and/or a skull fracture on the initial head CT. We excluded patients who were on antiplatelet or anticoagulant therapy, intoxicated patients, and patients who underwent immediate neurosurgical intervention.

Data collection

A prospective database for all TBI patients who present to our level I trauma center is maintained. For each patient, we recorded the following data points: patient demographics (age, sex, race, ethnicity), vital parameters at the time of presentation including systolic blood pressure, heart rate, temperature, Glasgow coma scale (GCS) score, loss of consciousness, intoxication (drug or alcohol), antiplatelet/anticoagulation medication, and details of neurologic examination. The head CT scan findings (type and size of ICH, skull fracture and its type) and reasons and findings of RHCT scans were also collected. Type of skull fracture was defined as displaced or nondisplaced. We also collected information on the need for neurosurgical intervention, hospital and intensive care unit (ICU) length of stay (LOS), ventilator days, discharger disposition, and inhospital mortality. The injury severity score and head–abbreviated injury scale score were recorded from the trauma registry.

Neurologic examination and head computed tomographic scan

Patients were stratified into 2 groups based on the need for repeat scan: patients who received the 2nd RHCT (3rd scan) without a neurologic decline and patients who received the second RHCT (3rd scan) after a neurologic decline. Neurologic decline was defined as decline in mental status, development of focal neurologic deficits, or abnormal pupillary examination. The findings of the initial and RHCT scans were reviewed by the on-call attending radiologist. Each repeat scan was classified as either progressed or stable. Progression was defined as an increase in the size of ICH on repeat scan or the development of a new ICH. A repeat scan with no increase in the bleed size or any new bleed compared with the previous scan was classified as stable.

Outcome measure

Our primary outcome measure was the need for neurosurgical intervention, which was defined as craniotomy/craniectomy, extraventricular drain placement, or intracerebral pressure (ICP) monitoring. Other outcome measures were hospital LOS, ICU LOS, ventilator days, and discharge disposition.

Statistical analysis

Data are reported as the mean ± standard deviation for continuous variables, as the median (interquartile range) for ordinal variables, and as the proportion for categorical variables. We used chi-square test to identify differences in categorical outcome variables between the 2 groups. We used independent sample t test to identify differences among parametric continuous outcome variables and Mann Whitney U test for nonparametric continuous outcome variables between the 2 groups. We considered P value of less than .05 as statistically significant for our study. All statistical analyses were performed using the