



Use of National Institute for Health and Care Excellence head injury guidelines among patients with delayed presentation after head trauma can lead to missed traumatic brain injury: a 5-year institutional review

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Introduction: In 2014, traumatic brain injury (TBI) caused 3 million ER visits, hospitalizations, and deaths in the US. The National Institute for Health and Care Excellence (NICE) guidelines, initially generated using data from patients presenting within 24 h of head trauma, are used to determine the need for head computed tomography (CT) scan in patients after 24 h. The authors wanted to determine the proportion of CT scans for head trauma performed at our center in late presenters (>24 h after head trauma), the incidence of intracranial pathology in early (24 h) versus late (>24 h) presenters, and the sensitivity of the NICE guidelines for TBI in these two subpopulations.

Methods: A retrospective chart review was conducted at a tertiary care center in Karachi. All people (>16) who had a head CT for head trauma from 2010 to 2015 were included. Age, sex, primary diagnosis, comorbid disorders, mechanism-of-injury, duration (in hours) from head trauma to presentation, site, and extent of injury (injury severity scale), hospital stay, number and details of surgical procedures, CT scan findings, other injuries, and mortality were recorded. Means were compared using the Independent Sample *t*-test, while categorical variables were compared using χ^2 . Multivariate logistic regression analyses were used to identify TBI predictors.

Results: The authors found 2009 eligible patients; seven were excluded due to incomplete medical records. The final statistical analysis comprised 2002 head trauma patients. Overall, 52% of early and late presenters had severe injuries, and 2.3% died. 32.2% of patients with head trauma had CT after 24 h. Early presenters were 46.7% traumatized, while late presenters were 63%. The NICE guidelines were 93% sensitive for early presenters and 83% for late presenters with traumatic intracranial injury.

Conclusion: Patients coming to the emergency department after 24 h of head trauma are a large proportion of the overall head trauma population. The NICE guidelines for late-presenting head injuries are less sensitive and may overlook intracranial injuries if imaging is not performed.

Keywords: neurosurgery, NICE, patient care, TBI

Introduction

According to the centers for disease control and prevention, there was ~2.87 million emergency department visits, hospitalizations, and

deaths in the United States in 2014 due to traumatic brain injury (TBI)^[1]. Head injuries account for 1.4 million emergency visits in England and Wales annually^[2]. TBI can have both short-term and

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long-term negative consequences, including death and disability. Up to 15% of people with moderate TBI have a permanent disability.^[3,4]

The National Institute for Health and Care Excellence (NICE) guidelines are widely used in clinical practice to triage patients with head trauma and establish the requirement for a head computed tomography (CT) scan. Surprisingly, this instrument was validated and built using data from patients who presented within 24 h after injury. As a result, it is uncertain if these guidelines apply to patients with head trauma who came in 24 h after the injury.

It is worth noting that there is little information comparing the use of NICE head injury guidelines with outcomes in patients who present within and after 24 h of sustaining a head injury and get a CT scan. Previous research reveals that NICE head injury guidelines are less sensitive for serious intracranial injury in individuals presenting after 24 h of injury (98% sensitivity in those presenting within 24 h versus 70% in patients presenting after 24 h)^[5].

The goal of this study was to determine the proportion of CT scans performed on late presenters, estimate the prevalence of significant injury in patients with early (24 h) and delayed (>24 h) presentation, compare the rate of intracranial abnormalities, and determine the sensitivity of NICE head injury guidelines for TBI in both groups.

Methods

A retrospective cross-sectional study was conducted at a tertiary care hospital in Karachi, Pakistan during between January 2010 and December 2015.

All adult patients who presented to the emergency room of a with any degree of head injury were included in our study. Patients other than head injury were excluded from our study.

Our study is fully compliant with the STROBE 2016 guidelines^[6]. A complete STROBE 2016 checklist has been provided as a supplementary file. Our study has been registered on Research Registry with the following UIN: researchregistry8237 <https://www.researchregistry.com/browse-the-registry#home/registrationdetails/630886af18e9e4002261e8ee/>. Our study is in accordance with the Declaration of Helsinki. Data was obtained after ethical approval from Aga Khan University Hospital.

Using a predesigned questionnaire, information on demographics (age and sex), primary diagnosis, comorbid medical conditions, mechanism-of-injury, time from injury to presentation, site, and extent of damage using the injury severity scale, and hospital course were extracted from medical records (length of hospital stay, number and details of surgical procedures performed, findings on the CT scan, other injuries besides head injury, mortality, or morbidity). The patients were then categorized as either early (within 24 h of trauma) or late (more than 24 h after trauma).

The outcome indicators evaluated were the skull radiograph, head CT, and admission requirement. The incidence of a skull fracture influences several management issues. The fracture diagnosis was solely based on the radiologist's report after radiologists reviewed all skull radiographs. The Royal College of Surgeons and the National Institute for Health and Care Excellence (NICE) guidelines were used to determine the management of each patient in the study and were compared to the actual management.

For continuous variables with normal and non-normal distributions, respective means with SD and medians with interquartile ranges were calculated. Categorical variables were

HIGHLIGHTS

- Traumatic brain injury (TBI) caused 3 million ER visits, hospitalizations, and deaths in the US.
- We wanted to determine the proportion of computed tomography scans for head trauma performed at our center in late presenters (> 24 h after head trauma), the incidence of intracranial pathology in early (24 h) versus late (> 24 h) presenters, and the sensitivity of the National Institute for Health and Care Excellence guidelines for traumatic brain injury in these two subpopulations.
- Patients coming to the emergency department after 24 h of head trauma are a large proportion of the overall head trauma population. The National Institute for Health and Care Excellence guidelines for late-presenting head injuries are less sensitive and may overlook intracranial injuries if imaging is not performed.

determined using percentages and proportions. Means were compared using *t*-tests on independent samples, whereas categorical data were analyzed using χ^2 testing. A 0.05 *P*-value was considered significant. For data analysis, version 21 of SPSS IBM was utilized. Multivariate regression was used to identify independent predictors by removing confounders.

Results

After excluding 22 patients due to lacking information in their medical records, there were 9227 eligible patients. The demographics and symptoms are detailed in Table 1. The average age of the patients was 39.47 years; 79% were male, and 21% were female. The most prevalent comorbid seen were diabetes and hypertension, which were present in 81.8% of the research participants (6.7% of patients). 35.5% of the patients who presented to the emergency room were involved in a car collision.

Eighteen hundred patients were determined to have needed a CT scan by the NICE head injury guidelines' CT scan criteria (Table 1).

Two thousand two patients underwent a CT scan; of these, 809 (40.4%) were admitted, 47 (2.3%) died after hospital admission, and 565 (28.2%) were observed in the emergency department (with 75% of these patients being followed for >3 h). However, 60% of patients were discharged within 6 h.

Figure 1 depicts why our patients require a CT scan (certain patients had multiple reasons). According to NICE recommendations, the most common indication for a CT scan in our study population would be suspected skull fractures, followed by disturbed mental status.

One thousand four hundred and fifty three patients (72.6%) who received CT were early presenters, while 549 patients (27.4%) presented late. TBI was diagnosed in 46.7% of early presenters and 63% of late presenters. The sensitivity of the intracranial damage NICE guidelines was 89.1, 93 in early presenters, and 83% in late presenters, as shown in Table 2.

Discussion

Our study shows that TBI on CT imaging is more commonly seen in patients presenting greater than 24 h after head trauma. Further,

Table 1
Showing the demographics of the included patients

	Frequency (n)	Percentage (%)
Sex		
Male	4030	79.0
Female	1071	21.0
Age groups		
16–20 years	285	14.3
21–30 years	601	30.1
31–40 years	357	17.9
41–50 years	262	13.1
51–60 years	195	9.8
61–70 years	141	7.1
71–80 years	98	4.9
81–90 years	49	2.5
91–100 years	8	0.4
≥ 101 years	1	0.1
Mechanism-of-injury		
RTA – pedestrian	96	4.8
RTA – motorcycle	423	21.3
RTA – car	187	9.4
Fall	393	19.8
Assault/nonaccidental trauma	128	6.4
Other	758	38.2
Symptoms		
Vomiting	215	10.8
Focal deficit	156	7.8
Seizures	50	2.5
Amnesia	172	8.6
Irritability/alterd behavior	200	10.0
Loss of consciousness	435	21.8
GCS = 15	3480	37.81

NICE guidelines have a sensitivity of 93% for TBI among early presenters and 83% among late presenters.

Mild TBI is predicted to occur between 100 and 300 per 100 000 persons^[7]. Traumatic brain damage can be caused by motor vehicle accidents, falls, assaults, and falls^[8]. Mild TBI is characterized by a

transient neurological impairment that typically resolves on its own. It is a functional disorder rather than a structural injury, and loss of consciousness may or may not occur. Six to 12% of patients with TBI exhibit abnormalities on CT head scans^[9,10]. In our study, 52% of the 2002 patients who received imaging for moderate TBI had positive CT scan findings.

Prospectively, prediction or decision criteria derived from patient populations can be integrated. These recommendations are used to determine which patients with relatively modest head injuries should undergo a CT scan. It is possible to decide on the patient's probability of developing neurocranial sequelae due to a minor head injury by applying prediction criteria. Following this, the decision rules for risk assessment are used to establish whether or not CT is advised^[11].

NICE recommendations aim to integrate clinical practice for managing head injuries based on a single set of guidelines based on the best available evidence. This was initially published in 2003 (NICE clinical guideline 4), revised in 2007 (NICE clinical guideline 56), and superseded in 2014 (NICE clinical guideline 176)^[12]. While there is a considerable body of research on managing acute head trauma, there are no guidelines for individuals with moderate TBI who present after 24 h. Our study's purpose was to externally validate the NICE guidelines for CT indications in patients with mild head trauma and a presentation delay of greater than 24 hours in Pakistan. Due to the lack of intensity of symptoms, patients with mild head injuries may not seek treatment. 15% of the population getting CT for the examination of head trauma may have a TBI, skull fractures, and delayed hemorrhage due to venous bleeding. Less intracranial injury rates have been recorded in patients with delayed presentations. At the same time, some studies indicate that the rate of TBI in patients who present after 24 h is comparable^[13,14]. Injuries are reported in 46.7% of early presenters and 63.3% of late presenters.

All validated guidelines show a trade-off between sensitivity and specificity, as well as sensitivity and the proportion of patients who require CT scanning according to the guidelines, in identifying patients with traumatic CT findings and patients who require neurosurgical intervention for a complication after a minor head injury.

It has been observed that the NICE criteria can minimize the number of CT scans conducted while maintaining a fair sensitivity for

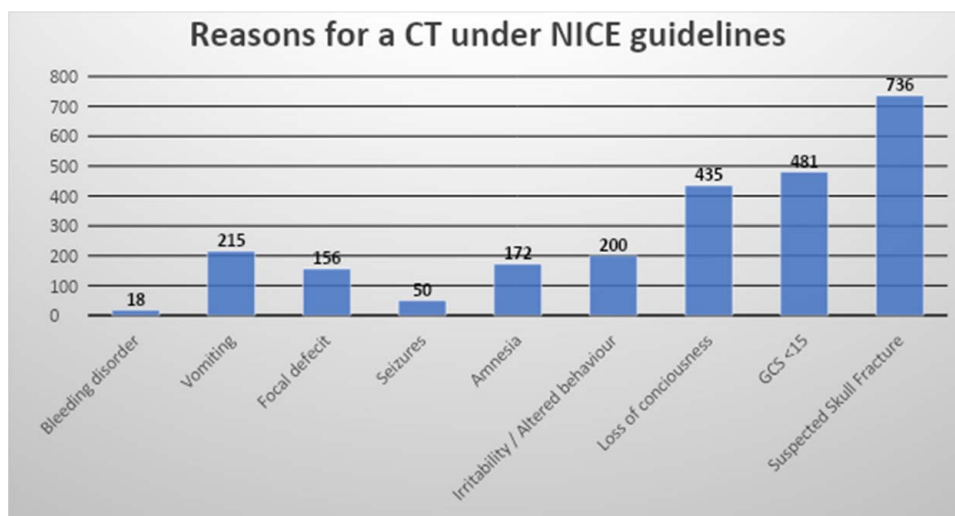


Figure 1. Reasons for computed tomography under the National Institute for Health and Care Excellence guidelines.

Table 2
The sensitivity of the intracranial damage NICE guidelines

Management of patients with head injury		
	CT scan	Hospital admission
Actual management, <i>n</i>	2002	809
Early presenters, <i>n</i> (%)	1101	466
Late, <i>n</i> (%)	901	343
NICE guideline, <i>n</i>	1800	661
Early, <i>n</i> (%)	1015	361
Late, <i>n</i> (%)	785	300

identifying patients with TBI and those requiring neurosurgical intervention^[9]. In our study, the sensitivity of the intracranial damage NICE criteria was 93% for early presenters and 83% for late presenters. According to our interpretation of these results, applying the NICE head injury guidelines in patients presenting after 24 h may fail to identify severe damage. This outcome is consistent with findings from a previous study^[5].

Among the limitations of our study are its retrospective nature and inherent biases. Our findings from a single Pakistani center may not apply to other environments. In addition, data were collected between 2010 and 2015, suggesting that the mechanism of trauma and its incidence may have evolved with time. The long-term results of hospitalized versus discharged patients were not compared.

Conclusion

Patients who present after 24 h and have suffered a head injury account for a considerable proportion of the population. For patients who present more than 24 h after sustaining a head injury, the NICE recommendations have low sensitivity. If a CT scan is not performed, injuries may go unnoticed in these patients, who comprise a significant proportion of trauma patients.

Ethical approval

Data was obtained after the ethical approval from Aga Khan University Hospital.

Consent

The informed consent from the patients was obtained considering Helsinki's Declaration.

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No funding has been received.

Author contribution

F.K., M.S.K., and M.S.A.: substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; J.I., A.A., and B.G.: drafting the work or revising it critically for important intellectual content; H.M., W.A.M., and A.A.: final approval of the version to be published; S.I., N.S., and N.K.: agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflicts of interest disclosure

No conflict of interests declared by the authors.

Registration of research studies

1. Name of the registry: Research Registry.
2. Unique identifying number or registration ID: researchregistry8237. Register Now - Research Registry.

Guarantor

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