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Mild Head Injury: Criteria for Computed Tomography Scan

Garba, I.[1] **Speelman, A.**[2] **Tabari, AM.**[3]

[1]*Department of Medical Radiography, Bayero University Kano, Nigeria*

[2]*Department of Radiography, Cape Peninsula University of Technology, Cape Town, South Africa*

[3]*Department of Radiology, Aminu Kano Teaching Hospital, Kano, Nigeria*

Corresponding Author:

Garba I.

Email: babaidi2003@yahoo.com, Phone Number: +2348034532750

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Abstract

Background/Objective: Mild Head Injury (MHI) is the most common type of head trauma, and forms a majority of the injuries seen in the trauma unit (65-85%).[1] This study was aimed at using previously identified clinical risk factors to determine which category of patients with MHI would not need to undergo Computed Tomography (CT). This may serve as cost saving measure to patients and hospitals likewise reduce collective radiation dose to the population.

Methodology: A retrospective study conducted at the trauma unit of a teaching hospital situated in the Cape Metropole. CT scan images of 50 patients aged 14 years and above who had MHI and undergone CT examination were retrieved from the archive. Patients' information, clinical history and resultant CT findings were collated. Clinical risk factors were correlated with abnormal and normal CT scan findings. Data were analyzed using chi-square statistic at 95% confidence interval.

Results: Twenty three (46%) of the patients had abnormal CT findings, and all presented with one or more of these risk factors; severe headache (10%), skull fracture (20%), scalp injury (6%), loss of consciousness (LOC)(8%) and intoxication(2%). The results were not statistically significant when compared with the normal CT scans group. Four patients (8%) with no risk factors had normal CT scans. All the patients presenting with the clinical risk factors, of nausea and vomiting 6% (n=50), seizures 4% (n=50) had normal CT scan findings.

Conclusion: Certain clinical risk factors can be used to suggest the probability of abnormal CT scan in patients with MHI. Patients with no risk factors such as patients with confusion and disorientation are more likely to have normal CT findings and may therefore be exempted from CT examination. Further studies with larger sample size may be helpful in validating these findings.

INTRODUCTION

Mild Head Injury (MHI) is commonly defined as blunt trauma to the head, after which the patient loses consciousness for <15 min or has a short, post-traumatic amnesia of <1 h, or both, as well as a normal or minimally altered mental status on presentation, indicated by a Glasgow coma scale (GCS) score of 13–15.[1, 2] Loss of Consciousness (LOC) is defined as a witness viewing the patient in a state of unconsciousness and reporting this fact to the emergency medical personnel. Amnesia is defined as a patient being unable to remember or describe the incident that led to the head trauma in the history taken directly by the examining physician.[3]

Recently, there have been debates in medical literature as to which patient requires CT scan after head trauma. Historically low GCS score has been used as a criterion for CT scans. While, patients with GCS scores of 13 and above believed to have only MHI, have often simply observed. Research has shown that a significant number of patients with the GCS of 13 and above had significant brain injuries, and early CT scan is recommended in this group of patients. [3, 4]

Other studies have shown that, very few patients with MHI and GCS score of >13 require intervention and most of the abnormalities seen on CT scans are minor. These have led to the possibility of a less conservative approach with regard to the patient's management.[1]

This study was aimed at using previously identified clinical risk factors for the South African context, to classify patients with MHI and GCS score of 13 and above who may not need to undergo CT scan. It is envisaged that this may reduce medical costs to patients and hospitals as well as contribute to the reduction of the population's collective dose from CT scans.

METHODOLOGY

Our study was retrospective and conducted at the trauma unit of a teaching hospital in Cape Town, South Africa. Ethical clearance was obtained from the Cape Peninsula University of Technology (CPUT) ethics committee, CT scan results of patients performed between January and December 2008 were retrieved from the archive. Only patients aged 14 years and above, with MHI and who had undergone CT scans of the brain were included in this study. The reason for excluding 14 years and younger was because, the abnormalities on CT scan are so common and severe in patients below this age limit.[5] All CT scans were performed on a Siemens Somatom Balance (K1508) CT scanner manufactured in Erlangen Germany.

Information derived from the patients' records include, age, sex, GCS score, clinical request, clinical history and resultant CT findings. The clinical history recorded on the request forms included, severe headache, nausea, vomiting, suspected skull fracture, LOC, seizures, scalp injury and intoxication these were all considered as clinical risk factors. However, clinical history of confusion and disorientation were regarded as non-risk factors based on the literature reviewed.[1-4, 6,8] The mechanisms of head injury were classified as: assault, Motor Vehicle Accident (MVA), Pedestrian Vehicle Accident (PVA), and others (for example domestic accident (DA) or no cause stated) [6] as recorded on the request forms. Patients' ages were classified on the basis of the WHO age classifications[7] as: adolescent (14-18) years, young adult (19-39) years, adult (40-59) years and old adult (60 and above) years.

Clinical risk factors and mechanisms of the head injury were correlated with normal and abnormal CT scan groups respectively. The distribution of GCS scores were correlated with normal and abnormal CT scan findings. Age distribution of patients with abnormal and normal CT scans. The distribution of the abnormal CT scan findings in patients with clinical risk factors were also analyzed.

An abnormal CT scan was defined as one showing an acute traumatic lesion such as contusion, parenchymal hematoma, epidural hematoma, subdural hematoma, subarachnoid haemorrhage or a skull fracture as described in the literature.[4]

Data were analyzed with the chi-square binary analysis. Relative risk and Odd ratio (at 95% confidence interval (CI) were calculated with their corresponding *p* values.

RESULTS

A total of 50 CT scan images were evaluated. These were made up of 42 (84%) males and 8 (16%) females. Subjects whose images were used were aged between 14 and 100 years (mean ± SD 33.52±10.2 years). There were 23(46%) patients who had abnormal scans (epidural haemorrhage (4%), subdural haemorrhage (6%), skull fracture (14%), contusion (16%), subarachnoid haemorrhage (2%), intraventricular haemorrhage (4%) and 27 (54%) patients had normal CT findings.

No statistically significant difference was noted between the abnormal and normal CT scan groups with respect to the mechanism of the head injury. However, most of the injuries were sustained as a result of assault 52% (*n* =26), and the least was from others 20% (*n* =10) (Table1).

Table 1: Mechanism of head injury versus abnormal CT scans.

Mechanism of head injury	**Abnormal CT scans *n* =23 (%)**	**Normal CT scans *n* =27 (%)**	***P*=value**
Assault	12 (52)	14 (51.9)	0.9819
MVA/PVA	7 (30.4)	7 (25.9)	0.7234
Others (domestic accident or no cause stated)	4 (17.4)	6 (22.2)	0.6704
TOTAL	23 (100)	27(100)	

Table 2 compared patients with abnormal and normal CT scans with respect to the clinical risk factors. Severe headache, suspected skull fracture, LOC, scalp injury and intoxication were more likely causes of abnormal CT scan findings, even though, no statistically significant difference was noted between the two groups. About 46% of the subjects with abnormal CT findings had associated risk factors. Some 8% of the subjects without risk factors had normal CT findings. Patients presenting with the clinical risk factors of nausea and vomiting 6% (*n* =3), seizures 4% (*n* =2), had normal CT scan findings.

Table 2: Comparison of Clinical Risk Factors in Normal and Abnormal CT scan Groups.

Clinical Risk Factors	**Normal CT scan *n* =27 (%)**	**Abnormal CT scan *n* =23 (%)**	**Odds ratio (at 95% CI)**	**Relative risk (at 95% CI)**	***P* values**
Severe headache	5 (18.5)	5 (21.7)	0.8182	0.8519	0.7766
Nausea	1 (3.7)	0(0)	2.66	-	0.3512
Vomiting	2 (7.4)	0 (0)	4.608	-	0.1828
Suspected skull fracture	7 (25.9)	10 (43.4)	0.455	0.5963	0.1916
LOC	3 (11.1)	4 (17.4)	0.5938	0.6389	0.5236
Seizures	2 (7.4)	0 (0)	4.608	-	0.1828
Scalp injury	3 (11.1)	3 (13)	0.8333	0.8519	0.834
Intoxication	0 (0)	1 (4.3)	0.2727	0.000	0.2737
Non-risk factors	4 (14.8)	0 (0)	9.000	-	0.0543
TOTAL	27 (100)	23 (100)			

Contusions 8(34.8%) and skull fractures 7(30.4%) were the most frequent CT findings respectively. The least CT findings were subarachnoid haemorrhage with a 1(4.3%) (Table 3).

Table 3: Distribution of abnormal CT scan findings

Abnormal CT findings	**Number of patients with clinical risk factors *n* =23 (%)**
Epidural hematoma	2 (8.7)
Subdural hematoma	3 (13.0)
Skull fracture only	7 (30.4)
Contusion	8 (34.8)
Subarachnoid haemorrhage	1 (4.3)
Intraventricular haemorrhage	2 (8.7)
TOTAL	23 (100)

The subjects aged 19-39 years had the highest incidence of MHI 32(64%) and the highest abnormal CT findings 18(78.3%). Subjects of 60 years and above recorded the lowest incidence (Table 4).

Table 4: Age distribution of MHI for CT scans

Age	**Abnormal CT scans *n* =23 (%)**	**Number of patients *n* =50 (%)**
14-18	2 (8.7)	7 (14)
19-39	18 (78.3)	32 (64)
40-59	2 (8.7)	6 (12)
60 and above	1 (4.3)	5 (10)
TOTAL	23 (100)	50 (100)

Patients were divided into 3 groups based on their GCS score, 15(32 patients), 14(14 patients) and 13(4 patients) (Table 5).

Table 5: Distribution of GCS in patients with normal and abnormal CT scans.

GCS score	**Abnormal CT scans *n* =23(46%)**	**Normal CT scans *n* =27(54%)**	**TOTAL *n* =50(100%)**	***P* = values**
15	14(28%)	18(36%)	32(64%)	0.7984
14	7(14%)	7(14%)	14(28%)	0.7640
13	2(4%)	2(4%)	4(8%)	0.8725

DISCUSSION

Mild head injury is the most common type of head trauma, and represents the vast majority seen in the trauma unit (65-85%).[1]Some authors have reported that, a 10% reduction in the number of CT scans of these patients would save more than 20 million rands per annum, beside the reduction in radiation dose.[8]

Despite the high incidence and numerous studies performed, there is much controversy about correct evaluation of these patents[9]. The question of how best to define MHI is of great importance, and is a source of controversy. Some of these patients will harbour a life threatening injury, while some may have neurocognitive sequelae for days to months after the head injury. The challenge to the emergency physician is to identify which patients will have acute intracranial brain injury, and which patients could be safely sent home.[10]

Saboori *et al*[9], reported that, some clinical risk factors could be used to predict the probability of abnormal CT scans.[9]The use of these clinical risk factors as predictor of intracranial lesions in patients with MHI has been evaluated in several studies. In two studies it has been found that, selective use of CT on the basis of clinical findings such as severe headache, vomiting and age over 60 years after MHI with GCS score of >13 identified 96 percent and 98 percent respectively of patients with abnormalities on CT scans.[8]

Similarly, Miller *et al*[2] studying the clinical significance of risk factors like severe headache, nausea, vomiting and depressed skull fracture found that significant number of patients with CT abnormality had these risk factors identified in our study. They concluded that if CT scans in minor head injury were done only on patients with these risk factors there would be 61% reduction in number of CT scan done, and still identifying all patients who require neurosurgical intervention. This correlates with findings of this study, in which severe headache, LOC, suspected skull fracture; intoxication and scalp injury were likely causes of abnormal CT scan findings. In this study, however, these risk factors identified 46% (*n* =23) of the patients with abnormal CT scans (Table 2). Similar findings have been reported by the previous studies.[3,8, & 11] All the patients presented with risk factors like nausea and vomiting 6% (*n* =3), seizures 4% (*n* =2) had normal CT scan findings (Table 2). Even though, all the values were not statistically significant, this could probably due to our small sample size.

GCS is a numerical expression of the severity of head injury that can be used to correlate various levels of coma with later clinical outcome.[12] Jagoda *et al*[10] reported that, the use of GCS score alone is not a good predictor of underlying brain/skull injury in patients with MHI. This may perhaps provide an explanation for the findings in this study in which, 28% (*n*=14) of the patients, with a GCS score of 15 had abnormal CT scans (Table 5).

Abdullatip *et al* in their study noted that, most of the patients with MHI were young-adults.[13] This is in line with finding in the present study in which patients in this age group represented 64% of the patients with MHI, and 78.3% of the patients with abnormal CT findings (Table 4). However, most of the mechanisms of the injuries were as a result of assaults 52% (*n* =26) (Table 1).This might be due to the fact that, young adults engaged themselves with activities that could easily cause violence like alcohol abuse and, or reckless driving. Similar finding had also been reported by Bordignon *et al.*[14] However, more males 84% (*n* =42) presented with MHI than females. This is in keeping with findings from the previous studies.[10, 13, 15 &16] Contusions 34.8% (*n* =8) and skull fractures 30.4% (*n* =7) were the most common abnormal CT findings found in this study (Table 3), which correlates with findings of Bordignon *et al*.[14]

The results show that, 46% (*n* =23) with abnormal CT scan findings, and all had one more of these clinical risk factors namely; severe headache, LOC, suspected skull fracture, scalp injury and intoxication (Table 2). These included 14 patients with GCS score of 15, 7 patients with GCS of 14, and 2 patients with GCS of 13 (Table 5). Likewise, patients with non-risk factors (confusion and disorientation) 8% (*n* =4), had normal CT findings in this study (Table 2). This correlated with the result reported by Heydel *et al* whereby all the patients with positive CT scans had at least one of the risk factors such as (headache, vomiting, alcohol intoxication, and seizures), and all the patients without any of the risk factors had normal CT scans.[8]

It may therefore be necessary for CT scan investigation in patients with MHI to be preserved only for patients with certain clinical risk factors such as severe headache, suspected skull fracture, intoxication, LOC, and scalp injury, because, a significant number of these patients have abnormal CT scan findings. Whereas, those patients without any of the clinical risk factors for MHI should be exempted from CT scanning, as the probability of abnormal CT scans in this group of patients is a remote possibility.

The limitation of our study includes: small sample size used due to time constrain, thus, the results were not significant. Study with larger sample size could be carried out to validate the findings of this study.

CONCLUSION

The study has established clinical risk factors that could be used to screen patients with MHI that are likely to have abnormal CT findings such as severe headache, LOC, intoxication, scalp injury or suspected skull fracture. Other group of patients without any of these factors may have normal CT findings hence do not need to undergo CT scan.

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REFERENCES

1. Süleyman, T., Altug H., Abdulkadir G., and Mustafa Y. Clinical Decision Instruments for CT scan in Minor Head Trauma. *The Journal of Emergency Medicine,* 2008 34(3):253-259.
2. Lisa R.M., Shu B.C., Julio C.S and Teresina M.H. The Use of Head Computed Tomography in Elderly Patients Sustaining Mild Head Trauma. *The Journal of Emergency Medicine,* 2003, 24(2):157-162.
3. Miller, E.C., Holmes, J.F., and Derlet, R.W. Utilizing Clinical Factors to Reduce Head CT scan Ordering for Minor Head Trauma Patients. *The Journal of Emergency Medicine,* 1997 15(4):453-457.
4. Miller, E.C., Derlet R.W., Kinser D. Minor Head Trauma: Is Computed Tomography Always Necessary? *Ann Emergency Med*, 1996, 27:290-294.
5. Murgio, A., Patrick, P.D., Andrade, F.A., Boettos, S., Leung, K.M., Munoz, S.M.A. International Study of Emergency Department Care for Paediatric Traumatic Brain Injury and the Role of CT Scanning. *Child's Nerv Syst*, 2001, 17:257-262.
6. Smits, M., Dippel, D.W.J., de Haan, G.G., Dekker, H.M., Vos, P.E., Kool, D.R., Nederkoorn, P.J., Hofmann, P.A.M., Twijinstra, A., Tanghe, H.I.J. and Hunink, M.G.M. External Validation of the Canadian CT Head Rule and the New Orleans Criteria for CT Scanning in Patients with Minor Head Injury. *JAMA*, 2005, 294(12):1519-1525.
7. World Health Organization (WHO). Provisional Guidelines on Standard International Age Classification. Department of International Economic and Social Affairs. Series M, No. 74. United Nations, New York, 1982.
8. Haydel, M.J., Preston, C.A., Mills, T.J., Luber, S., Blaudeau, E., and Deblieux, P.M.C. Indication for Computed Tomography in Patients with Minor Head Injury. *The New England Journal of Medicine*, 2000, 343:100-5.
9. Saboori M., Ahmadi, J. And Farajzadegan, Z. Indications for Brain CT in Patients with Minor Head Injury. *Clinical Neurology and Neurosurgery,* 2007, 109:399-405
10. Jagoda, A.S., Bazarian, J.J., Bruns, Jr J., Cantrill S.V, Gean, A.D., Howard, P.K., Riggio, J.G.S, Wright, D.W., Wears R.L., Bakshy, A., and Burgess, P. Clinical Policy: Neuroimaging and Decision making in Adult Mild Traumatic Brain Injury in the Acute Setting. *Ann Emergency Medicine*, 2008, 52:714-748.
11. Borczuk, P. Predictors of Intracranial Injury in patients with Mild Head Trauma. *Ann Emergency Medicine*, 1995, 25:731-736.
12. Zimmerman, R.A., Gibby, W.A. and Carmody, R.F. .*Neuroimaging Clinical and Physical Principles*. Springer-Verlag New York Inc. New York NY USA, 2000.
13. Abdul-latip, L.S., Alias, N.A.A, Ariff, A.R., Shuaib, I.L., Abdullah, J and Naing, N.N. CT in Minor Head Trauma: A guide for Rural Doctors.

Journal of Clinical Neuroscience, 2004, 11(8):835-839.

14. Bordignon, K.C., and Arruda, W.O. CT scans Findings in Head Trauma. *Arq Neuropsiquiatr*, 2002, 60(2-A):204-210.
15. Udgiri, .N.R., Tewari, M.K., Dwarakanath, S., Khandelwal, N., and Sharma, B.S. Role of Computed Tomography in Minor Head Injury. *Indian Journal of Neurotrauma*, 2004, 1(1):33-36.
16. Vilke, G.M., Chan, T.C., and Guss, D.A. Use of Complete Neurological Examination to Screen for Significant Intracranial Abnormalities in Minor Head Injury. *American Journal of Emergency Medicine*, 2000, 18:159-163.
17. Geijertam, J.L., Britton, M. Mild Head Injury: Reliabilty of Early Computed Tomographic Findings in Triage for Admission. *Emergency Medicine Journal*, 2005;22:103-107.