

Clinical Predictors of Abnormal Computed Tomography Findings in Mild Head Injury

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ABSTRACT

Introduction: Whether to scan a minor head injury with Glasgow Coma Scale (GCS) 15 who appears well and has a normal physical and neurological exam or not is an issue commonly faced in all emergency departments. In this study, we tried to assess the predictability of clinical parameters in predicting traumatic intracranial lesions in Computed Tomography (CT) scans of patients with minor head injuries with GCS 15.

Methods: A prospective observational study was carried out in between January to December 2016 in Manipal Teaching Hospital, Pokhara, Nepal. Various clinical predictors of 415 cases of minor head injury with GCS 15 were assessed to see if they could predict the abnormal CT scans in these cases. Clinical variables found significant in bivariate analyses were further analyzed using logistic regression to calculate the odds of each variable to detect abnormal CT scans.

Results: There were 119 (28.7%) abnormal CT scans in the study. Vomiting, LOC (Loss of Consciousness), seizure and headache were the significant predictors of abnormal CT scans with an odds of 4.254 (95% CI: 2.373-7.627), 2.396 (95% CI: 1.258-4.562), 5.803 (95% CI: 1.110-30.336) and 1.967 (95% CI: 1.008-3.839) respectively

Conclusion: Vomiting, LOC, seizure and headache are important clinical predictors of abnormal CT scan in cases of minor head injuries with GCS 15.

Key Words: *Craniocerebral Trauma; Glasgow coma scale; Neurologic Examination*

INTRODUCTION

The management of head injury has improved in recent times especially with the advent of better assessment scales, improved diagnostic modalities and early and better forms of treatment. Even with all these developments, there are a lot of dissimilarities and confusion in the classification and management of head injuries mainly because of the diverse

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classification systems and guidelines for the management. Most of the cases presenting to the hospital are usually minor head injuries but the optimal evaluation and treatment protocols of these group remains controversial. Recommendations of use of Computed Tomography (CT) scan vary from routine in all patients to more selective use based on a constellation of findings on the history and physical examination. Unnecessary hospital admission or prolonged supervised observation remains the standard practice for many patients with minor head injuries.^{1,2,3} Case reports on patients who “talked and deteriorated” has also contributed to this practice.^{4,5} Medico-legal consideration is another factor that forces many clinicians to take extra precautions.⁶ Though routine use of CT scanning may be a costly approach most centers still prefer it as it helps direct the scarce resources, reduce unnecessary hospitalization and minimizes the likelihood of missing a traumatic intracranial lesions which do not manifest clinically. In this study, we tried to assess the reliability of clinical parameters in predicting traumatic intracranial lesions in CT scans of patients with minor head injuries with Glasgow Coma Scale (GCS) 15.

METHODS

A prospective hospital based observational study was carried out in patients with minor head injury having GCS score 15 at presentation from January 2016 to December 2016 with an aim to study the clinical parameters predicting an abnormality in CT scan. During the study period 562 cases of minor head injuries were evaluated in the Emergency department of Manipal Teaching Hospital, a tertiary care referral center in western region of Nepal. Out of these 562 cases, there were 415 cases with GCS score of 15. Patients with history of head injury were initially evaluated by the surgical resident under the supervision of consultant neurosurgeon. All the patients underwent a plain head CT, according to the trauma protocol and was interpreted by consultant radiologists. Data were collected on a preformed proforma which included the patient and trauma

characteristics (age, sex, time of presentation since injury, intoxication), accompanying symptoms (loss of consciousness, vomiting, post traumatic seizure, amnesia, headache) as well as physical and neurological assessment (any ear/nose bleeding following trauma, GCS at presentation and post resuscitation) and CT findings. CT findings were charted as normal and abnormal. The abnormal CT scan was defined as any abnormality attributed to trauma including linear or depressed skull fractures, extradural hematoma (EDH), subdural Hematoma (SDH), contusions, subarachnoid Hemorrhages (SAH) and pneumocephalus. After detailed workup patients were either discharged or admitted and treated conservatively or operated immediately or upon deterioration as needed. An informed consent was taken from each patient included in this study. Patients, who failed to give consent, who had history or evidence of previous intracranial pathology, or left the hospital against advice were excluded from the study. All data were analyzed using the SPSS software for Windows (version 20, SPSS Inc., Chicago, IL, USA). Data were expressed using descriptive statistics such as mean, standard deviation for continuous variables, frequency, and percentage for categorical variables. Statistical analysis was done using chi square or Fischer exact for categorical and unpaired t test for continuous variable with 5% significance level. All the clinical predictors found to have statistical significant differences in between normal and abnormal CT scans in bivariate analysis were subjected to logistic regression to find the probability of having an abnormal CT scan based on the clinical predictors.

RESULTS

Out of the 562 cases of mild head injury evaluated during the study period, there were 415 cases with GCS score 15. The mean age of these patients was 30.22 years (SD 20.32) ranging between 1 to 95 years. The male to female ratio was 1.88. Road traffic accidents (RTA) and fall from height were the commonest mode of injuries. Fifty six patients

(13.5%) were under alcohol influence at the time of presentation. There was no significant statistical difference in between the normal and abnormal CT scan groups in terms of age, sex and duration since injury, mode of injury and alcohol intoxication at the time of injury (Table 1). There were 296 (71.3%) normal CT scans and 119 (28.7%) abnormal CT scans in the study. Contusions (10.4%) and linear fractures (8.4%) were the commonest abnormalities seen in CT scan followed by EDH (6.5%), traumatic SAH (6.3%), SDH (5.3%) and depressed fractures (2.7%) (Table 2).

Vomiting, loss of consciousness, seizure, amnesia, ear/nose bleed and combination of all these symptoms were the different clinical variables studied to look for their ability to predict abnormal CT scans in this study. All the variables other than ear/nose bleed were found to have significant statistical difference in between normal and abnormal CT scan groups in the bivariate study (Table1). These variables were further subjected to binary logistic

regression which indicated that vomiting, loss of consciousness (LOC), seizure and headache were the significant predictors of abnormal CT scans (chi-square=95.607, df=6 and $p<0.05$). The other two predictors, amnesia and combination of all the symptoms were not significant. All the six predictors explained 29.5% of the variability of abnormal CT scans in mild head injury. Vomiting, LOC, seizure and headache were significant at the 5% level (Vomiting Wald=23.625, $p=0.000$; LOC Wald=7.064, $p=0.008$; Seizure Wald=4.342, $p=0.037$; Headache Wald =3.929, $p=0.047$). The Odds ratio (OR) for vomiting was 4.254 (95%CI: 2.373-7.627), for LOC was 2.396 (95%CI: 1.258-4.562), for seizure was 5.803 (95%CI: 1.110-30.336) and for headache was 1.967 (95%CI: 1.008-3.839) (Table 3). Out of 415 cases, 194 (46.7%) were discharged after primary care and further instructions; 203 (48.9%) were admitted and managed conservatively and 18 (4.3%) needed surgery at some point of admission. None of the patients having a normal scan required surgery (Table 4).

Table 1: Various parameters of patients with normal and abnormal CT scans

S.N.	Variables	Normal CT 296 (71.3%)	Abnormal CT 119 (28.7%)	Total 415	P
1	Age(years), mean (SD)	31.26 (19.35)	27.70 (22.39)	30.22 (20.32)	0.105
2	Duration of Injury in hours, mean (SD)	5.85 (9.37)	121, 7.26 (8.83)	6.26 (9.23)	0.156
3	Sex				1.000
	Male	192 (46.3%)	79(19.0%)	271 (65.3%)	
	Female	102 (24.6%)	42 (10.1%)	144 (34.7%)	
4	Mode of Injury				0.345
	RTA	133 (32%)	48 (11.6%)	181 (43.6%)	
	Fall from Height	115 (27.7%)	55 (13.3%)	170 (41%)	
	Assault	44 (10.6%)	13 (3.1%)	57 (13.7%)	
	Others	4 (1.0%)	3 (0.7%)	7 (1.7%)	
5	Alcohol	41 (9.9%)	15 (3.6%)	56 (13.5%)	0.755
6	Vomiting	111 (26.7%)	84 (20.2%)	195 (47%)	0.000
7	LOC	97(23.4%)	69(16.6%)	166 (40%)	0.000
8	Seizure	2 (0.5%)	9 (2.2%)	11 (2.7%)	0.000
9	Amnesia	2 (0.5%)	6 (1.4%)	8 (1.9%)	0.008
10	Headache	73 (17.6%)	50 (12%)	123 (29.6%)	0.001
11	Ear/Nose Bleed	43 (10.4%)	22 (5.3%)	65 (15.7%)	0.370
12	Combined Symptoms	71 (17.1%)	78 (18.8%)	149 (35.9%)	0.000

Table 2: Various CT scan findings in patients with mild head injury and GCS15

CT Findings	Number	Percentage
EDH	27	6.5
SDH	22	5.3
Depressed Fracture	11	2.7
Linear Fracture	35	8.4
Contusion	43	10.4
SAH	26	6.3
Pneumocephalus	23	5.5

Table 3: Regression analysis for predictors of abnormal CT scans

Clinical Predictors	B	Wald	Sig	Odds Ratio	95 % CI
Vomiting	1.448	23.625	0.000	4.254	2.373-7.627
LOC	0.874	7.064	0.008	2.396	1.258-4.562
Seizure	1.758	4.342	0.037	5.803	1.110-30.336
Amnesia	1.328	1.933	0.164	3.775	0.580-24.565
Headache	0.676	3.929	0.047	1.967	1.008-3.839
Combination of Symptoms	0.556	1.995	0.158	1.744	0.806-3.774

Table 4 : Intervention in Minor Head injury with GCS 15

Intervention	Normal CT 296 (71.3%)	Abnormal CT 119 (28.7%)	Total 415
Discharged	194 (46.7%)	0	194 (46.7%)
Conservative	102 (24.6%)	101 (24.3%)	203 (48.9%)
Surgery	0	18 (4.3%)	18 (4.3%)

DISCUSSION

Since the introduction of CT scans in the early 1970s, the question of which patient should undergo scanning has remained a huge controversy. Earlier as CT was a scarce resource, it used to be reserved for severely injured patients only. Later with more readily available CT scanners, numerous studies have been carried out on patients with minor head injuries having intracranial lesions. The decision to obtain CT imaging in the trauma patient with clear-cut signs of neurological dysfunction should not be mysterious. Patients with any of these clinical features deserve immediate non-contrast CT imaging of the brain without any delay. The more vexing issue

is what to do with the mild TBI patient who appears well and has a normal physical and neurological exam not forgetting the medico legal aspects.

Stein et al⁷ justify routine CT scan based on their experience on MTBI patients. In 1990 they reviewed 658 cases of mild head injury (GCS 13-15) where 18% of cases had abnormal CT scan and 5% required surgery.⁷ They continued their study up to 1922 including 1538 patients and found that 17% had positive findings on CT, and 58 patients required surgery. None of the patient with normal CT scan had neurologic deterioration while being observed.⁸ Similarly Falimirski et al⁹, Miller EC et al¹⁰ and Harad FT et al³ also have suggested routine use of CT

in minor head injuries based on the findings of his study of GCS 15 patients. Studies of patients who may be categorized as "talk and deteriorate" also support the practice of scanning all MTBI patients.^{11,12,13,14} Mishra RK et al¹⁵ found that 43% of their patient with mild head injury and GCS 15 had abnormal CT scan. In our study there were 28.7% of cases of minor head injury with GCS 15 with some abnormality in CT scans.

Proponents of routine scanning argue that high incidences of intracranial abnormalities has been seen in cranial CT scans of minor head injury patients whereas those advocating the use of selective scanning argue that, while a small percentage of patients may indeed have abnormal scans, the overwhelming majority of these will not be clinically significant.^{16,17,18} A number of researchers have sought to answer the question of which patients with mild TBI need a CT scan, and in which group (if any) imaging can be safely deferred. To obviate unnecessary CT scans, many guidelines are available for indication of CT scan for minor head injury in adults. Among these, Canadian CT Head Rule is the most widely validated rule, with a sensitivity of 99–100% and a specificity of 48–77%.^{19,20}

In our study we found that vomiting, LOC, seizure and headache were statistically significant predictors of abnormal CT scan in minor head injury with GCS 15. The odds of such abnormal CT scans were high for Seizure, Vomiting, LOC and headache in a decreasing order. Mishra RK et al¹⁵ in his study suggested that combination of any symptoms (LOC, vomiting, seizure, ear/nose bleeding) with an odds of 2.36 and vomiting with an odds of 1.89 were the clinical predictors significantly associated with abnormal CT scans. Sharif-Alhoseini M et al²⁰ in their study described that the presence of headache, vomiting, and LOC or amnesia was separately associated with abnormal brain CT scan related to the trauma.

CONCLUSION

Our study suggests that vomiting, LOC, seizure and headache are important clinical predictors of abnormal CT scan in cases of minor head injuries with GCS 15. These predictors can be used to properly select patient requiring CT scan in conscious patients with minor head injury in emergency department.

CONFLICT OF INTEREST

None

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None

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