WHICH MILD HEAD INJURED PATIENTS SHOULD HAVE FOLLOW-UP AFTER DISCHARGE FROM AN ACCIDENT AND EMERGENCY WARD?: A STUDY IN A UNIVERSITY HOSPITAL SETTING IN KELANTAN, MALAYSIA

HC Chan[1], WAW Adnan[1], K Jaalam[1], MR Abdullah[2] and J Abdullah[3]

[1]Department of Accident and Emergency, [2]Department of Community Medicine, [3]Department of Neurosciences, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia

Abstract. Mild head injury (MHI) is a common presentation to many hospitals in both rural and urban settings in Southeast Asia, but it is not well studied. We studied 330 patients that presented to Hospital Universiti Sains Malaysia Emergency Department with possible MHI, with the intentions to identify prognostic factors that may improve the diagnosis of MHI in the emergency setting as well as to determine which patients would need follow-up. Patients' one-year outcomes were classified as discharged well (DW) for patients without post-traumatic signs and symptoms and discharged with long term follow-up (DFU) for patients with such signs and symptoms. Four patients died and 82 were DFU. An abnormal skull X ray was associated with mode of accident and type of transportation, older age, presence of vomiting, confusion, bleeding from ear, nose or throat, abnormal pupil size on the right side associated with orbital trauma, unequal pupillary reflexes, absence of loss of consciousness (LOC), a lower Glasgow Coma Scale (GCS) score, multiple clinical presentations, and DFU. An abnormal CT scan was associated with older age, multiple clinical presentation, skull X-ray findings, and DFU. A similar analysis on outcomes revealed that mode of accident, older age, vomiting, confusion, headache, bleeding from ear, nose and throat, neurological deficits, absence of LOC, pupil size, multiple presentation, abnormal skull X ray, CT scan of the brain, and a GCS of 13 was associated with DFU. In conclusion, all patients involved in motor vehicle accidents (MVAs), especially motorcycles, aged over 30 years of age, with multiple clinical presentations, including a lower GCS, and with abnormal radiological findings should have a longer follow-up due to persistent post-traumatic symptomatology.

INTRODUCTION

Minor Head Injury (MHI) is a very common neurological condition in developing countries, with one estimate (Kurtz and Kurland, 1993) suggesting an incidence of 250 per 100,000 people. Approximately 37.5% of these patients would have disabling symptoms 1 year after their head injury. In two population studies in developed countries (Annegers *et al,* 1980; Vollmer and Dacey, 1991), about 200 out of 100,000 patients with head injury required hospital admission; 50% to 80% of these patients had sustained MHI. In addition, there were as many as 20% to 40% of patients with mild head injury who do not seek medical care (Frankowski *et al,* 1985). Current data from North Asia (Chiu *et al,* 1997) have indicated that a majority of mild head injuries occurred among motorcyclists with more serious outcomes than suggested in western reports.

The Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (Rosenthal, 1993) defines Mild Head Injury as follows:

> …a traumatically induced physiologic disruption of brain function, as manifested by one of the following: any period of loss of consciousness (LOC), any loss of memory for events immedi-

Correspondence: Prof Jafri Malin Abdullah, Departments of Neurosciences, and Accident and Emergency, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.
Tel: 609-766 4240; Fax: 609-764 8613
E-mail: deptneurosciencesppspusm@yahoo.com

ately or before the accident, any alteration in mental state at the time of the accident and focal neurologic deficit, which may or may not be transient.

MHI has also been arbitrarily defined (Rimel *et al,* 1982) as a Glasgow Coma Scale (GCS) score of 13 to 15.

There is a significant controversy regarding the best strategy for patients with MHI in developing countries, particularly regarding the emergency indication for a CT scan of the brain. In addition, because of the large numbers of patients with MHI, with nearly one-half of all patients being between the ages of 15 to 34 years old (Jennett and Frankouski, 1990), the psychosocial aspects and economic burden of care for a patient with disabling symptoms cannot be ignored, especially in developing countries (Klauber *et al,* 1989).

Most patients with MHI presenting to an Emergency Department (ED) should be managed clearly, with a local protocol on how to proceed in their evaluation and management. An improvement in morbidity and mortality from traumatic brain injury comes from a quick diagnosis by the Emergency Medicine Physician, not from radiology alone.

This study aimed to assess which clinical and radiological parameters would be helpful to predict the likelihood of intracranial injury in a rural emergency medicine setting in an ED of a developing country; and to identify patients who are at risk of a deterioration of their condition, and those who would require long-term follow-up.

PATIENTS AND METHODS

All patients, who were over the age of 12 years and who had their Malaysian identity cards, presenting at the HUSM Emergency Department from 1 January until 31 December 2001, with an initial Glasgow Coma Scale of 13 to 15, and found to be hemodynamically stable were enrolled in this study and followed up for a period of one year. All the patients were assessed upon their attendance at the Emergency Department. Information that was recorded included: vital signs, a neurological examination, primary and secondary surveys, and risk factors (Boulis *et al,* 1978; Briggs *et al,* 1984; Brown *et al,* 1994).

The following were defined according to standard protocols (Cooper and Ho, 1983): mild head injury, focal neurological deficits, deterioration, amnesia, headache, medical therapy, neurosurgical intervention, neurological observation, polytrauma, seizure, alcohol influence, loss of consciousness (LOC), and outcome on discharge.

Using a single-blind method, all CT scans were reviewed by two physicians, one from the emergency medicine and the one from radiology, and classified according to the respective craniocerebral terminology (Culotta *et al,* 1996).

Data were entered, cleaned and analyzed using SPSS® software, version 11.1. Statistical significance was taken at the 5% level.

RESULTS

Three hundred and thirty patients were seen and evaluated by the end of the study period. Their characteristics and their associations with the mode of accident and transportation, clinical parameters, results of investigations, and patient outcomes on discharge are summarized in Tables 1-5. Two-thirds of the patients sustained multiple soft-tissue injuries, but these were not life threatening. About 8% had maxillofacial or neck injuries. Out of the 284 patients who had motor vehicle accidents, motorcyclists constituted the highest proportion (73.2%).

Skull X rays were performed on 317 patients, of which 86% were normal. Of those with skull fractures, most had linear fractures, except for 13 patients who had depressed fractures. CT scans were performed on 105 of the 330 patients, of which 78% were abnormal scans. The majority of patients (75.2%) were admitted and observed in the ward. The others were treated either medically or surgically, except for one who refused treatment. In the ward, 7 patients deteriorated, of whom 4 died, while 96 (29.1%) improved compared with their conditions on admission. The majority of patients were discharged well (DW), with only 24.9% requiring neurology outpatient clinic follow-up due to persistent post-traumatic signs and symptoms.

Table 1
Characteristics of the respondents/patients with mild head injuries.

Variables	No. of respondents (%)/ Mean (SD)
1. Age (years)	30.4 (17.46), Range : 12-81
2. Sex	
Male	238 (72.1)
Female	92 (27.9)
3. Ethnic groups	
Malays	314 (95.2)
Chinese	10 (3.0)
Indians	1 (0.3)
Others	5 (1.5)
4. GCS score	
15	221 (67.0)
14	64 (19.4)
13	45 (13.6)
5. Mode of accidents	
Motor vehicle accidents	284 (86.1)
Fall	3.4 (10.3)
Others[a]	12 (3.6)
6. Mode of transportation during accidents	
Not applicable	47 (14.2)
Pedestrian/bicyclist	38 (11.5)
Motorcyclist	208 (63.0)
Motorist/passenger	37 (11.2)
7. Clinical presentations	
Loss of consciousness (LOC)	309 (93.6)
Confusion	58 (17.6)
Headache	99 (30.0)
Bleeding from Ear, Nose, Throat (ENT)	20 (6.1)
Neurological deficits	20 (6.1)
Traumatic right pupil response	
- non-reactive	5 (1.5)
- sluggish	4 (1.2)
Traumatic left pupil response	
- non-reactive	4 (1.2)
- sluggish	4 (1.2)
Unstable hemodynamics	2 (0.6)
Vomiting	80 (24.2)
Amnesia	51 (15.5)
Seizures	5 (1.5)
Pupil size (right) - abnormal	148 (44.8)
Pupil size (left) - abnormal	148 (44.8)
Left and right pupillary reflexes	
Equal	317 (96.1)
Unequal	13 (3.9)
8. Systolic BP mm Hg	134.9 (22.20) [Range : 90-233]
9. Diastolic BP mm Hg	75.9 (13.61) [Range: 50 -122]
10. Pulse/minute	87.1 (16.61) [Range : 48-153]
11. Presence of alcohol/drug influence	4 (1.2)
12. Multiplicity of complaints on admission	
Single sign/symptom	168 (50.9)
2 or 3 signs/symptoms	147 (44.5)
4 or more signs/symptoms	15 (4.5)
13. Skull X-ray findings (n=317)	
Linear fractures	31 (9.4)
Depressed fractures	13 (3.9)
14. CT scan abnormality (n=105)	82 (78.1)
15. Mode of treatment	
Observation	248 (75.2)
Medical treatment	59 (17.9)
Neurosurgical intervention	22 (6.7)
Refused treatment	1 (0.3)
16. Progress in ward	
Status quo	227 (68.8)
Improved	96 (29.1)
Deteriorated	7 (2.1)
17. Outcome	
Discharged well	244 (73.9)
Discharged with follow-up	82 (24.9)
Died	4 (1.2)

N=330;
[a]Others include occupational and sports injuries, and assaults.

These patients, discharged with neurology out-patient follow-up, are referred to as DFU.

Out of the 330 patients, 13 patients were not sent for skull X rays. However, CT scans were performed, of which 11 were abnormal CT scans. Of the 270 patients where the skull X ray appeared normal, 32 were found to have abnormalities on their CT scans.

Patients' outcomes, as entered on the day of discharge from the hospital, were classified as died, discharged with follow-up (DFU) (neurology clinics, neurosurgery clinics and other specialist clinics), and discharged well (DW). Discharged with follow-up (DFU) indicates the presence of post-traumatic symptoms and signs, such as headache, giddiness, amnesia, blurred vision, neurological deficits, etc that continue as significant problems for patients. Patients who were discharged well (DW) had no residual com-

Table 2
Association between patients' characteristics and clinical presentations and CT scan results.

Variables	No. of respondents (%)		χ^2/t-test (p-value)
	Normal	Abnormal	
1. Sex			
Female	6 (22.2)	21 (77.8)	0.002 (N/S)
Male	17 (21.8)	61 (78.2)	
2. Ethnic group			
Malays	21 (21.2)	78 (78.8)	0.486 (N/S)
Others	2 (33.3)	4 (66.7)	
3. Mode of accidents			
MVA	16 (19.5)	73 (76.8)	1.253 (N/S)
Other injuries	7 (30.4)	16 (69.6)	
4. Mode of transport			
Not relevant	7 (29.2)	17 (70.8)	6.009 (N/S)
Pedestrian and bicyclist	1 (7.7)	12 (92.3)	
Motorcyclist	15 (26.3)	42 (73.7)	
Car (Direct/passenger)	0 (0)	11 (100)	
5. Vomiting			
Absent	16 (26.2)	45 (73.8)	1.592 (N/S)
Present	7 (15.9)	37 (84.1)	
6. Confusion			
Absent	18 (27.3)	48 (72.7)	2.993 (N/S)
Present	5 (12.8)	34 (87.2)	
7. Fit			
Absent	22 (21.8)	79 (78.2)	0.023 (N/S)
Present	1 (25.0)	3 (75.0)	
8. Amnesia			
Absent	20 (21.3)	74 (78.7)	0.207 (N/S)
Present	3 (27.3)	8 (72.7)	
9. Headache			
No	16 (25.8)	46 (74.2)	1.347 (N/S)
Yes	7 (16.3)	36 (83.7)	
10. Bleeding ENT			
No	22 (24.7)	67 (75.3)	2.704 (N/S)
Yes	1 (6.3)	15 (93.8)	
11. Pupil compared			
Equal	22 (23.2)	73 (76.8)	0.916 (N/S)
Unequal	1 (10.0)	9 (90.0)	
12. Loss of consciousness			
Absent	2 (16.7)	10 (83.3)	0.217 (N/S)
Present	21 (22.6)	72 (77.4)	
13. Neurological deficits			
Absent	20 (21.7)	72 (78.3)	0.012 (N/S)
Present	3 (23.1)	10 (76.9)	
14. GCS score			
15	12 (32.4)	25 (67.6)	5.575 (N/S)
14	7 (24.1)	22 (75.9)	
13	4 (10.3)	35 (89.7)	
15. Multipresentation			
One sign/symptoms	10 (33.3)	20 (66.7)	6.230 (p=0.044)
2 or 3 signs/symptoms	13 (21.3)	48 (78.7)	
≥4 symptoms	0 (0)	14 (100.0)	
16. X-ray findings			
Not done	2 (15.4)	11 (84.6)	20.988 (p<0.001)
Normal	21 (39.6)	32 (60.4)	
Abnormal	0 (0)	39 (100)	
17. Patients prognosis in ward			
Improved	11 (18.3)	49 (81.7)	3.382 (N/S)
Status quo	12 (30.0)	28 (70.0)	
Deteriorated	0 (0)	5 (100)	
18. Outcome			
1. D/C well	21 (75.0)	7 (25.0)	62.930 (p<0.001)
2. D/C with flu	2 (2.7)	73 (97.3)	
3. Death	0 (0)	2 (100)	

Table 3
Association between skull X-ray findings and patients' characteristics and clinical presentations.

Variables	Skull X-ray finding No. of respondents (%)		χ^2 test (p-value)
	Normal (%)[a]	Abnormal (%)[a]	
1. Sex			
Female	77(88.5)	10 (11.5)	0.571 (N/S)
Male	196 (85.2)	34 (14.8)	
2. Ethnic groups			
Malays	260 (86.4)	41 (13.6)	0.334 (N/S)
Others	13 (81.3)	3 (18.8)	
3. Mode of accidents			
Motor vehicle accidents	242 (88.6)	31 (11.4)	10.489 (p=0.001)
Others	31 (70.5)	13 (29.5)	
4. Transportation on accidents			
Not applicable	15 (71.4)	6 (28.6)	20.660 (p<0.0001)
ped/bicyclist	197 (91.6)	18 (8.4)	
motorist/passenger	31 (68.9)	14 (31.1)	
motorcyclist	30 (83.3)	6 (16.7)	
5. GCS Score			
15	201 (91.4)	19 (8.6)	23.340 (p<0.0001)
14	51 (81.0)	12 (19.0)	
13	21 (61.8)	13 (38.2)	
6. Vomiting			
Absent	219 (90.5)	23 (9.5)	16.386 (p<0.0001)
Present	54 (72.0)	21 (28.0)	
7. Confusion			
Absent	238 (88.5)	35 (72.9)	8.249 (p=0.004)
Present	31 (11.5)	13 (27.1)	
8. Headache			
Absent	198 (88.4)	26 (11.6)	3.300 (N/S)
Present	75 (80.6)	18 (19.4)	
9. Bleeding ENT			
Absent	262 (87.9)	36 (12.1)	13.470 (p<0.0001)
Present	11 (57.9)	8 (42.1)	
10. Amnesia			
Absent	228 (85.4)	39 (14.6)	0.748 (N/S)
Present	45 (90.0)	5 (10.0)	
11. Fit			
Absent	269 (86.2)	43 (13.8)	0.159 (N/S)
Present	4 (80.0)	1 (20.0)	
12. Loss of consciousness			
Absent	12 (63.2)	7 (36.8)	8.915 (p=0.003)
Present	261 (87.6)	37 (12.4)	
13. Neurological deficits			
Absent	260 (86.7)	40 (13.3)	1.399 (N/S)
Present	13 (76.5)	4 (23.5)	
14. Hemodynamics			
Stable	271 (86.0)	44 (14.0)	0.324 (N/S)
Unstable	2 (100)	0 (0)	
15. Pupil size(right)			
Abnormal	118 (81.9)	26 (18.1)	3.848 (p=0.05)
Normal	155 (89.6)	18 (10.4)	
16. Pupil size (left)			
Abnormal	120 (83.3)	24 (16.7)	1.714 (N/S)
Normal	153 (88.4)	20 (11.6)	

Table 3 (continued).

Variables	Skull X-ray finding No of respondents (%) Normal (%)[a]	Abnormal (%)[a]	χ^2 test (p-value)
17. Pupillary reflexes			
Equal	265 (86.9)	40 (13.1)	3.948 (p=0.047)
Unequal	8 (66.7)	4 (33.3)	
18. Alcohol/drug influence			
Absent	269 (85.9)	44 (14.1)	0.653 (N/S)
Present	4 (100)	0 (0)	
19. Clinical presentations			
1 Symptoms	151 (91.0)	15 (9.0)	46.483 (p<0.0001)
2 or 3 symptoms	119 (86.2)	19 (13.8)	
4 or more symptoms	3 (23.1)	10 (76.9)	
20. Patients progress in ward			
Improved	65 (76.5)	20 (23.5)	15.429 (p<0.0001)
Status quo	204 (90.7)	21 (9.3)	
Deteriorated	4 (57.1)	3 (42.9)	
21. Outcome			
Died	3 (75.0)	1 (25.0)	122.066 (p<0.0001)
Discharged with follow-up	33 (46.5)	38 (53.5)	
Discharged well	237 (97.9)	5 (2.1)	

[a](%) = percentage of variables with normal or abnormal skull X ray.

Table 4
Differences in mean of age, systolic and diastolic blood pressure, and pulse rate of the respondents according to skull X ray, CT scan and outcome of patients.

Investigations/Outcome	Mean (SD) Age	Mean (SD) Systolic BP	Mean (SD) Diastolic BP	Mean (SD) Pulse rate/min
1. Skull X-ray findings				
Abnormal	34.27 (19.278)	134.01 (23.033)	76.24 (14.125)	84.85 (19.772)
Normal	28.84 (16.171)	134.85 (21.962)	75.58 (13.241)	87.95 (15.513)
t-test (p-value)	2.501 (p<0.0001)	-0.304 (p<0.0001)	0.387 (N/S)	-1.455 (N/S)
2. CT scan result				
Abnormal	34.41 (19.430)	136.72 (26.681)	77.13 (15.546)	85.23 (20.04)
Normal	27.91 (18.820)	133.96 (20.803)	77.39 (14.209)	83.35 (13.381)
t-test (p-value)	-1.454 (N/S)	-0.459 (N/S)	0.387 (N/S)	-0.426 (N/S)
3. Outcome				
Discharged well	34.27 (19.278)	134.01(23.033)	76.24 (14.125)	84.85 (19.772)
Discharged with follow-up	28.84 (16.171)	134.85 (21.062)	75.58 (13.241)	87.95 (15.513)
t-test (p-value)	2.501 (p=0.013)	-0.304 (N/S)	0.387 (N/S)	-1.455 (N/S)

plaints and thus, no follow-up at any clinic.

Clinical presentations that were found to be highly associated with DFU include vomiting, confusion, headache, bleeding ENT, neurological deficits, multiple clinical presentations, and a GCS score of 13. As with the other analyses, absence of LOC was also associated with abnormal CT scan results. A higher proportion of patients with abnormal CT scans were those who sustained injuries not related to MVA. As expected, DFU was statistically associated with both abnormal skull X rays and CT scans. They also had a higher mean age (34.27 years versus 28.84 for DFU and DW, respectively).

Table 5
Association between patients' characteristics and clinical presentations with the outcome of patients on discharge.

Variables	Outcome on discharge: No. of respondents (%) Discharged with follow-up	Discharged well	χ^2 *t*-test (p-value)
1. Sex			
Female	19 (20.9)	72 (79.1)	1.225 (N/S)
Male	63 (26.8)	172 (73.2)	
2. GCS score			
15	25 (11.4)	195 (88.6)	86.344 (p<0.0001)
14	24 (38.7)	38 (61.3)	
13	33 (75.0)	11 (25.0)	
3. Ethnic groups			
Malays	79 (25.4)	232 (74.6)	0.222 (N/S)
Others	3 (20.0)	12 (80.0)	
4. Mode of accidents			
MVA	65 (23.2)	215 (76.8)	3.963 (p=0.047)
Others	17 (37.0)	29 (63.0)	
5. Transportation on accidents			
Not applicable	18 (38.3)	29 (61.7)	5.157 (N/S)
Ped/bicyclist	8 (21.6)	29 (78.4)	
Motorcyclist	47 (22.8)	159 (77.2)	
Cars	9 (25.0)	27 (75.0)	
6. Amnesia			
Absent	72 (26.2)	203 (73.8)	0.988 (N/S)
Present	10 (19.6)	41 (80.4)	
7. Vomiting			
No	45 (18.2)	202 (81.8)	26.036 (p<0.0001)
Yes	37 (46.8)	42 (53.2)	
8. Confusion			
Absent	47 (17.5)	222 (82.5)	48.216 (p<0.0001)
Present	35 (61.4)	22 (38.6)	
9. Headache			
Absent	49 (21.5)	179 (78.5)	5.403 (p=0.020)
Present	33 (33.7)	65 (66.3)	
10. Alcohol/drug influence			
Absent	80 (24.8)	242 (75.2)	1.328 (N/S)
Present	2 (50.0)	2 (50.0)	
11. Loss of consciousness			
Absent	10 (47.6)	11 (52.4)	6.017(p=0.014)
Present	72 (23.6)	233 (76.4)	
12. Bleeding ENT			
Absent	68 (22.2)	238 (77.8)	22.762 (p<0.0001)
Present	14 (70.0)	6 (30.0)	
13. Neurological deficits			
Absent	71 (23.2)	235 (76.8)	10.082 (p=0.001)
Present	11 (55.0)	9 (45.0)	
14. Pupil size right			
Abnormal	37 (25.2)	110 (74.8)	0.995 (N/S)
Normal	45 (25.1)	134 (74.9)	

Table 5 (continued).

Variables	Outcome on Discharge: No of respondents (%) Discharged with follow-up	Discharged well	χ^2 *t*-test (p-value)
15. Pupil size left			
Abnormal	36 (24.5)	111 (75.5)	0.063 (N/S)
Normal	46 (25.7)	133 (74.3)	
16. Pupil response right			
Reactive	74 (23.3)	243 (76.7)	20.443 (p>0.0001)[a]
Sluggish	4 (100.0)	0 (0)	
Nonreactive	4 (80.0)	1 (20.0)	
17. Pupil response left			
Reactive	75 (23.6)	243 (76.4)	17.597 (p>0.0001)[a]
Sluggish	3 (75.0)	1 (25.0)	
Nonreactive	4 (100.0)	0 (0)	
18. Pupil compared			
Equal	71 (22.7)	242 (77.3)	25.429 (p>0.0001)[a]
Unequal	11 (13.4)	2 (15.4)	
19. Clinical presentation			
1 Symptoms/signs	19 (11.4)	147 (88.6)	53.419 (p<0.0001)
2 or 3 Symptoms/signs	50 (34.5)	95 (65.5)	
4 or more Symptoms/signs	13 (86.7)	2[a] (13.3)	
20. Skull X ray			
Not done	11 (84.6)	2 (15.4)	139.679 (p<0.0001)
Normal	33 (12.2)	237 (87.8)	
Abnormal	38 (88.4)	5 (11.6)	
21. CT scan results			
Not done	7 (3.1)	216 (96.9)	246.358 (p<0.0001)
Normal	2 (8.7)	21 (91.3)	
Abnormal	73 (91.3)	7 (8.8)	
22. Patients progress in ward			
Improved	50 (52.6)	45 (47.4)	65.647 (p<0.0001)
Status quo	28 (12.4)	198 (87.6)	
Deteriorated	4 (80.0)	1 (20.0)	

[a]= more than 25% cells have expected count <5.

Analyses were performed to examine the associations of variables with abnormal skull x-ray findings. The mean age of patients with abnormal skull X rays was significantly lower than patients with normal skull X rays. Other variables associated with abnormal skull X rays include vomiting, confusion, bleeding ENT, abnormal pupil size on the right side, unequal pupillary reflexes to light, multiple clinical presentations (especially with 4 or more signs and symptoms), and a GCS of 13. Interestingly, a higher proportion of patients with absence of LOC, who had sustained injury not related to MVA, had abnormal skull X rays. A similar analysis was performed to look at the associations between respondents' characteristics and CT scan results. Only multiple clinical presentations, X-ray findings, and patients' outcomes were statistically associated with abnormal CT scan results.

Multiple Logistic Regressions analyses were performed to examine whether patients' characteristics, mode of accidents and other details, as well as clinical presentations could predict the likelihood or presence of brain or skull injuries as shown or suggested by CT scan and skull X-ray findings. A step-wise backward likelihood ratio procedure was used, and the variables were selected based on univariate analyses with a statistical cut-off point of 0.1.

Three independent variables were tested: skull X-ray findings, CT scan results, and patients' outcomes on discharge. For all three, no variables were found to be predictive of the results or outcomes. Although by univariate analysis, many variables were highly associated with the outcomes of patients on discharge, none of the variables emerged as predictors of outcomes on multivariate analysis.

DISCUSSION

This study was based on the local management of the Mild Head Injury (MHI) group, as it constitutes the majority of ED attendance. ED staff are challenged from time to time regarding the decision to admit or discharge the patients, as there is a small yet significant subset of population who may harbor intracranial hematoma that may later deteriorate and that may consequently have medico-legal issues if missed. This also effects the decision to ward patients who need 24-hour observation in accident and emergency wards that are small (less than 8 beds) or virtually non-existent in most developing countries.

MHI affected mainly our young and adults in the productive age group. This agrees with studies by Lee *et al* (1995) in Taiwan, and Kurtz and Kurland (1993) in USA, where 50 to 80% of patients were between the ages of 16 and 45 years. Both studies concurred with our findings where they also found that males were involved more than females, especially in association with motorcycle accidents.

In our study, 317 out of 330 patients (96.1%) underwent skull x-rays where 86 percent were normal. This can be compared to a study by Gorman (1987), in which skull X rays were performed on 5,484 patients (44%) where skull fracture, or diastasis, was present in 206 patients (3.8%). The difference in the incidence of positive skull fractures as compared with our study may be related to the mechanism of injury, as the injuries of our MHI patients were mainly caused by motor cycle accidents, which contributed 63.0% as compared to the other study where the percentage of motor vehicular accidents were less.

Our patients who were in the DFU group had post-traumatic symptoms such as headache, giddiness, amnesia, blurred vision and other cognitive problems that were associated with history and physical examination findings of vomiting on admission, confusion, headache, bleeding from ear, nose and throat, and a GCS score of 13. These patients had abnormal skull X rays and CT scan and were in the above age of 30 years old. This is similar to a study done in another Asian country (Thiruppathy and Muthukumar, 2004) where an admission GCS of 13, focal neurological deficits, skull fractures on radiography, and CT scan were associated with DFU. In a study in Pakistan (Raja *et al*, 2001), patients with mild head injury with DFU were followed up to a mean period of 11 months after accident and emergency management.

Our results, compared to a head injury study in Taiwan (Chiu *et al*, 1997), revealed that, although there was a high (79.5%) incidence of mild head injury in the Taiwanese study, there was a lower rate of DFU (up to 4%) as compared with our rate of 24.9%. This could be due to the higher number, in our study, of motorcycle riders who do not use helmets, and so there is more intracranial trauma. Our multivariate analysis unfortunately was not significant when mode of transport was analyzed, although univariate analysis was significant. This could have been due to a smaller population of 330 patients.

In a larger study of 2,484 patients (Gomez *et al,* 1996), the proportions of patients having GCS scores of 15, 14, and 13 were 94.6, 3.5, and 1.3%, respectively. Of those patients, 187 (7.5%) had cranial CT scans of which 50.8% (95 patients) were abnormal CT scans. Based on GCS scores of 15, 14 and 13, the prevalence of abnormal CT scans of the brain were 41.1, 15.55, and 66.7%, respectively. Therefore, the incidence of both skull fracture and abnormal CT findings were significantly higher in patients with a GCS of 13.

Other studies (Shackford *et al,* 1992;

Gomez *et al,* 1996) have also shown that both the risk of deterioration and the outcome are significantly different between patients with scores of 13 and 15. The incidence of abnormal CT findings in the MHI literature varies as authors use different selection criteria for CT scans. However, when all or nearly all patients are scanned, the incidence of abnormal findings ranges around 15%. By contrast, when only those patients showing neurological abnormalities are scanned, the percentage of abnormal scans increases to 50%, as found in our study.

Culotta *et al* (1996) proposed that the indiscriminate grouping of GCS scores of 13 to 15 permits excessive heterogeneity in determining the severity of injury and contributes to the variability in neurobehavioral outcomes. They reviewed the records of 3,370 patients and found statistically significant differences between the frequency of positive CT scans and the need for neurosurgical intervention in patients with GCS scores of 13 versus 14, 14 versus 15, and 13 versus15. These results indicate that there are significant differences among patients with different admission GCS scores, of 13 to 15, in terms of the severity of injury. They suggested that consideration must be given to the segregation of patients with GCS scores of 15 from those with scores of 14 and 13.

A study (Deb *et al,* 1998) to assess neuropsychiatry sequelae 1 year after MHI using home interviews with patients and their relatives included 148 adults who were admitted to hospital and showed clinical or radiological evidence of brain injury. Main outcome measures used were the Glasgow outcome scale, Edinburgh rehabilitation status scale, Barthel index, clinical interview schedule-revised, mini mental state examination, and assessment of symptoms of post-concussion syndrome. At one year follow-up, four (2.9%) patients had a severe disability, 35 (25.5%) had a moderate disability, and 95 (69.3%) had no disability according to the Glasgow outcome scale. Various studies (Evans, 1992; King *et al,* 1999; Van der Naalt *et al,* 1999; Dischinger *et al,* 2003) showed that the most common neurobehavioral problems were irritability, sleep disturbance, and impatience. They concluded that, one-year after MHI, a substantial proportion of patients showed neuro-psychiatric sequelae.

Conclusion

The management of MHI in the ED of a developing country remains a challenge. There are no local guidelines, and most centers have no protocols for their standard of practice, even though new literature has provided certain guidelines (Hsiang *et al,* 1997; Wade *et al,* 1998; Hofman *et al,* 2000; Iverson *et al,* 2000; De Kruijk *et al,* 2001; McCallagh *et al,* 2001; Servadei *et al,* 2001; Jogada *et al,* 2002; Wardlaw *et al,* 2002; Falimirski *et al,* 2003).

MHI affects the young and productive age group in developing countries, however, most of them only sustain non-life threatening injuries (Lee *et al,* 1995; Hsiang *et al,* 1997; Falimirski *et al,* 2003). Because of such characteristics, the aim of an ED department should be to improve the diagnosis of MHI and its case management, thus lowering the chances of negative sequelae. With the selective use of a cranial CT scan, an emergency medicine center would be able to identify the majority of abnormal cranial CT scans and select patients for either medical and/or neurosurgical intervention when indicated (Iverson *et al,* 2000; Falimirski *et al,* 2003). With this approach, we can optimize of our resources for the maximum benefit of patients without compromising the quality of care that can be achieved in developing countries (Lee *et al,* 1995). We concluded that patients involved in motor vehicle accidents, mainly motorcycles, age over 30 years of age, with multiple clinical presentation including lower GCS with abnormal radiological findings should have follow-up after discharge from an accident and emergency center, or be referred directly to a center with neurological or neurosurgical facilities for the management of their acute and chronic disabilities.

REFERENCES

Annegers JF, Grabow JD, Kurland LT, *et al*. The incidence, causes and secular trends of head trauma in Olmstead County, Minnesota. *Neurology* 1980; 30: 912.

Boulis ZF, Dick R, Barnes NR. Head injuries in children-etiology, symptoms, physical findings and X-ray wastage. *Br J Radiol* 1978; 51: 851-4.

Briggs M, Clarke P, Crockard A, Jennett B. Guidelines for initial management after head injury in adults : suggestion from a group of neurosurgeons. *British Medical Journal* 1984; 288: 983-5.

Brown SR *et al*. Management of minor head injuries in the accident and emergency department : the effect of an observation ward. *J Accident Emerg Med* 1994; 11: 144-8.

Chiu WT, Yeh KH, Li YC, Gan YH, Chen HY, Hung CC. Traumatic brain injury registry in Taiwan. *Neurol Res* 1997; 19: 261-4.

Cooper PR, Ho V. Role of emergency skull x-ray films in the evaluation of head injured patient : A retrospective study. *Neurosurgery* 1983; 13 : 136.

Culotta VP, Sementilli ME, Gerold KDO, Watts CC. Clinicopathological heterogeneity in the classification of mild head injury. *Neurosurgery* 1996; 38: 245-50.

De Kruijk JR, Twijnstra A, Leffers P. Diagnostic criteria and differential diagnosis of mild traumatic brain injury. *Brain Inj* 2001; 15: 99-106.

Deb S, Lyons I, Koutzoukis C. Neuropsychiatric sequelae one year after a minor head injury. J Neurol Neurosurg Psychiatry 1998, 65: 899-902.

Dischinger P, Read K, Kerns T, *et al*. Causes and outcomes of mild traumatic brain injury : an analysis of CIREN data. *Annu Proc Assoc Adv Automot Med* 2003; 47: 577-89.

Evans RW. The postconcussion syndrome and the sequelae of mild head injury. *Neurol Clin* 1992;10: 815-47.

Falimirski ME, Gonzalez R, Rodriguez A, Wilberger J. The need for head computed tomography in patients sustaining loss of consciousness after mild head injury. *J Trauma* 2003; 55: 1-6.

Frankowski RF, Annegers JF, Whitman S. The descriptive epidemiology of head trauma in the United States. In: Becker DP, Povlinshock JT (eds): Central Nervous System trauma Status Report. Bethesda, MD NINCDS, National Institutes of Health, 1985.

Gomez PA, Lobato RD, Ortega, JM, Cruz JDL. Mild head injury: differences in prognosis among patients with a Glasgow Coma Scale score of 13-15 and analysis of factors associated with abnormal CT findings. *British J of Neurosurg* 1996; 10: 453-60.

Gorman DF. The utility of post-traumatic skull x-rays. *Archives of Emergency Medicine* 1987; 4: 141-50.

Hofman PA, Nepemans P, Kemerink GJ, Wilmink JT. Value of radiological diagnosis of skull fracture in the management of mild head injury: meta analysis. *J Neurol Neurosurg Psychiatry* 2000; 68: 416-22.

Hsiang JN, Yeung T, Yu AL, Poon WS. High-risk mild head injury. *J Neurosurgery* 1997; 72: 234-8.

Iverson GL, Lovell MR, Smith S, Franzen MD . Prevalence of abnormal CT-scans following mild head injury. *Brain Inj* 2000; 14: 1057-61.

Jennett B, Frankowski RF. The epidemiology of head injury. In: Braakman R, ed. Handbook of Clinical Neurology, vol 13. New York, Elsevier, 1990: 1-16.

Jogada AS, Cantrill SV, Wears RL, *et al*. American College of Emergency Physicians. Clinical policy: neuroimaging and decision making in adult mild traumatic brain injury in the acute setting. *Ann Emerg Med* 2002; 40: 231-49.

King NS, Crawfard S, Wenden FJ, Caldwell FE, Wade DT. Early prediction of persisting post-concussion symptoms following mild and moderate head injuries. *Br J Clin Psychol* 1999; 38 (Pt1): 15-25.

Klauber MR, Marshall LF, Luerssen TG, *et al*. Determinants of head injury mortality: Importance of the low risk patient. Neurosurgery 1989; 24: 31.

Kurtz JF, Kurland LT . The epidemiology of neurologic disease. In: Joynt RJ, ed. Clinical Neurology. Chapter 66. Philadelphia: JB Lippincott, 1993.

Lee ST, Liu TN, Wong CW, Yeh YS, Tzaan WC. Relative risk of deterioration after mild closed head injury. *Acta Neurochir (Wein)* 1995; 135: 136-40.

McCallagh S, Oucherlony D, Protzner A, Blair N, Feinstein A. Prediction of neuropsychiatric outcome following mild trauma brain injury: an examination of the Glasgow Coma Scale. *Brain Inj* 2001; 15: 489-97.

Raja IA, Vohra AH, Ahmed M, Neurotrauma in Pakistan. *World J Surg* 2001; 25: 1230-7.

Rimel RW, Giordani B, Barth JR, *et al*. Moderate head injury: Completing the clinical spectrum of brain trauma. *Neurosurgery* 1982; 11: 344.

Rosenthal M. Mild traumatic brain injury syndrome. *Ann Emerg Med* 1993; 22: 1048.

Royal College of Radiologists. A study of the utilization of skull radiography in 9 A&E units in the UK *Lan-*

cet 1980; ii: 1234-6.

Savola O, Hillbom M. Early predictors of post-concussion symptoms in patients with mild head injury. *J Neurol* 2003; 10: 175-81.

Servadei F, Teasdale G, Merry G, Neurotraumatology Committee of the World Federation of Neurosurgical Societies. Defining acute mild head injury in adults:a proposal based on prognostic factors; diagnosis and management. *J Neurotrauma* 2001; 18: 657-64.

Shackford SR, Wald SL, Ross SE, *et al*. The clinical utility of computerized tomography scanning and neurologic examination in the management of patients with minor head injuries. *J Trauma* 1992; 33: 385.

Thiruppathy SP, Muthukumar N. Mild Head Injury : revisited. *Acta Neurochia* (Wien), 2004; 46: 1075-82.

Van der Naalt J, Van Zomeren AH, Shuiter WJ, Minderhond JM. One year outcome in mild to moderate head injury : the predictive value of acute injury characteristics related to complaints and return to work. *J Neurol Neurosurg Psychiatry* 1999; 66: 207-13.

Vollmer DG, Dacey RG . The management of mild and moderate head injury. *Neurosurg Clin N Am* 1991; 2: 437.

Wade DT, King NS, Wenden FJ, Crawford S, Cadwell FE. Routine follow up after head injury : a second randomized controlled trial. *J Neurol Neurosurg Psychiatry* 1998; 65: 177-83.

Wardlaw JM, Easton VJ, Statham P. Which CT features help predict outcome after head injury. *J Neurol Neurosurg Psychiatry* 2002; 72: 188-92.