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ETIOLOGY AND TREATMENT OUTCOME OF PEDESTRIANS WITH TRAUMATIC BRAIN INJURIES FROM ROAD TRAFFIC CRASHES

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ABSTRACT

Context: That unconscious man on the road being taken into the ambulance was knocked down by a vehicle. The energy he absorbed from the impact was proportional to the weight of the vehicle with its occupants, and to the square of the velocity of the vehicle. That is a regular scenario for the most unprotected and the most vulnerable road user, the pedestrian. The need to know about him and protect him cannot be overemphasized. **Objective:** To determine the etiologies, severity of traumatic brain injuries and treatment outcome in pedestrians involved in road traffic accident. **Methods:** It was a prospective, cross-sectional study involving pedestrians with traumatic brain injuries from road traffic accidents managed in our center over a four year period. Data were collected using structured proforma which was component of our prospective data bank that was approved by our hospital research and ethics committee. The analysis was done using Environmental Performance Index (EPI) info 7 software. **Result:** Seventy three patients were studied. There were 48 males. The mean age was 25.08 years. Elderly patients were three. Fifty five patients had vehicular accident. Twenty two patients were injured between 6AM and 10AM. Thirty two patients had mild head injuries. Favorable functional outcome was seen in 82.19%, while mortality was 17.81%. Severity of injury significantly affected the outcome. **Conclusion:** Our study showed that the commonest cause of traumatic brain injuries in pedestrians was vehicular accident. The mortality from traumatic brain injuries among pedestrians was high. Severity of injury significantly affected the outcome.

INTRODUCTION

Road traffic accident is one of the leading causes of mortality and morbidity in the world with an estimated mortality of 1.2 million and morbidity of 5million people yearly all over the world.[1,2] Human factor has been the most prevalent contributing factor for road traffic accident.[3,4] Crashes between vehicles and pedestrian had been documented to be responsible for over a third of all traffic-related deaths and injuries worldwide.[5] The commonest cause of death among pedestrian was traumatic brain injury.[6] We studied pedestrians with traumatic brain injuries from road traffic accidents managed in our center over a four year period.

METHODS

Study design: It was a descriptive prospective, cross-sectional study
Ethical approval & inform consent: It was component of our prospective data bank that was approved by our Research and Ethics Committee.
Inclusion criteria: Pedestrians with traumatic brain injuries managed in our neurosurgical center.
Exclusion criteria: Patients we could not ascertain the etiology, especially those picked up along the roads by security agents in the night, were excluded from the study. Those discharged against medical advice were also excluded.
Sample size: Sample size was calculated using Fisher's formulae: $n=Z^2pq/d^2$ and $n_f = n/1+n/N$. With prevalence of 23%, the calculated sample size was 72.
Research work place & duration: The study was done at University of Calabar Teaching Hospital, Calabar from 1st August, 2010 to 31st July, 2014.
Methodology:
The patients were managed using our unit protocols: Patients were managed in accident and emergency using Advanced Trauma Life Support (ATLS) protocols, primary and secondary surveys. In primary surveys, patients were resuscitated ensuring patent airways and Oxygen saturation of 95% and above. We used Normal saline to maintain blood volume aiming at euvolemia and normotension. We gave adequate analgesia, antiepileptic drugs in post-traumatic seizures, and calm aggressive patients with Chlorpromazine. Quick checks of other organ injuries that could be life threatening to patients were made. In secondary survey, we took detailed history and physical examinations. Glasgow Coma Scores after resuscitation were assessed. Appropriate investigations were carried out based on need and affordability.

Patients who had mild, moderate, and severe head injuries with CT scan lesions not requiring surgery, and those unable to do CT scan were managed non-operatively. We gave broad spectrum antibiotics (to those who had open tissue injuries), multivitamins, high energy and high protein diets constituted thus: 500ml pap, 2 tablespoonful powdered milk, 1 tablespoonful red oil, 2 tablespoonful soya bean powder and 1 tablespoonful crayfish powder. The diet was given 5-6 times daily via naso-gastric tubes or orally. Their daily fluid requirements were calculated and factored into the fluid content of the diet. We used locally prepared diet because most of our patients could not afford Complan or Casilan, and there was no functional dietetic unit in the hospital.

Patients with lesions requiring surgery such as extradural, subdural, and intracerebral hematomas/contusions, and depressed skull fractures had surgical care. Surgical procedures included craniotomy for acute extradural, acute subdural and intracerebral hematomas/contusions, Burr hole for sub-acute and chronic subdural hematomas, and craniectomy with primary bone fragment replacement or elevation for depressed skull fractures. Superficial temporal artery pseudoaneurysm had excision.

Associated injuries were managed by appropriate specialist units. After their discharge, we followed them up in out-patient clinic. Data were collected using structured proforma which was component of our unit prospective data bank that was approved by our hospital's research and ethics committee. In accident and emergency, the demographic data, history, including time and etiology of accidents, and the physical signs were documented. The Glasgow Coma Scores were assessed and documented after resuscitation. CT scan findings were documented once it was done. The progress of the patients was documented in ICU, wards and out-patient clinic. Glasgow Outcome Score[7] was used to determine the outcome. It classifies patient into 5 categories: 1 death, 2 vegetative state, 3 severe disability, 4 moderate disability, and 5 normal recovery. The scores were documented three months post-injury as it had been documented that outcome score three months post-injury predicted long term outcome.[8]

Statistical analysis: The data were analyzed using Environmental Performance Index (EPI) info 7 software (CDC Atlanta, Georgia, USA, EPI info 7 version 7.0.8.0 of 2011). We used visual band method of analysis. In the analytical gadgets we used frequency, mean and MXN/2X2 with its advanced option if need be. At 95% confidence interval, $P \leq 0.05$ was considered significant.

RESULTS

There were seventy three patients in the study. Males were forty eight, while females were twenty five. Their ages ranged from a year and six months to seventy years with a mean of 25.08 years. There were only three elderly patients, table 1. Highest numbers of patients were involved in crashes between 6AM and 10AM, table 2. There was no significant relationship between age group and period of accident, $P = 0.1297$. The commonest etiology was vehicle, but there was no significant difference among the etiological agents in terms of injury severity, $P = 0.1213$, table 3.

Thirty one patients did CT scan of the brain. Among extra-axial lesions seen, there were seven subdural hematoma, three extradural hematoma, and two subarachnoid hemorrhages. Fourteen patients had skull fractures. The commonest cerebral injury was contusion/intracerebral hemorrhages, but no significant difference among the causative etiologies, $P = 0.5737$, table 4. Twenty six patients had major organ associated injuries. Fifteen (57.58%) of them were musculoskeletal injuries, mainly fractures of limb bones. There was no significant association of major organ injuries with outcome, $P = 0.6994$.

Sixty four patients were managed conservatively, while nine had surgery. One patient had surgery for extradural hematoma, 4 for subdural hematoma, 3 for depressed skull fractures, and one for superficial temporal artery pseudoaneurysm.

Favorable functional outcome (≥4) was seen in 82.19% of patients, while the mortality was 17.81%. One of the three elderly patients died. Two patients died among those that did CT scan, while 11patients died among those that could not afford CT scan. The severity of injury significantly affected the outcome, $P = 0.00$, table 5. Etiology did not have any significant effect on the outcome, $P = 0.7897$, table 6.

Table 1: Age group frequency

Age group	Number	Percent (%)
Children	35	47.95
Adult	35	47.95
Elderly	3	4.11
Total	73	100

Table 2: Accident period frequency

Accident period	Number	Percent (%)
>6AM – 10AM	22	30.14
>10AM – 2PM	12	16.44
>2PM – 6PM	20	27.40
>6PM – 10PM	17	23.29
>10PM – 6AM	2	2.74
Total	73	100

Table 3: Etiology vs Severity

Etiology	Mild (%)	Moderate (%)	Severe (%)
Motorcycle	9 (60.00)	3 (20.00)	3 (20.00)
Tricycle	3 (100)	0 (0.00)	0 (0.00)
Vehicle	20 (36.36)	11 (20.00)	24 (43.64)
Total	32 (43.84)	14 (19.18)	27 (36.99)
P = 0.1213			

Table 4: Etiology vs Cerebral injury

Etiology	Contusion/hemorrhage	Diffuse axonal injury	Edema	None
Motorcycle	4	0	0	2
Tricycle	1	0	0	0
Vehicle	8	7	1	8
Total	13	7	1	10
P = 0.5737				

Table 5: Severity vs Glasgow Outcome Score

Severity	1 (%)	4 (%)	5 (%)	≥4 (%)
Mild	1 (3.13)	0 (0.00)	31 (96.88)	31 (96.88)
Moderate	1 (7.14)	1 (7.14)	12 (85.71)	13 (92.85)
Severe	11 (40.7)	6(22.22)	10 (37.04)	16 (59.26)
Total	13(17.81)	7 (9.59)	53 (72.60)	60 (82.19)
$P = 0.00$				

Table 6: Etiology vs GOS

Etiology	1 (%)	4 (%)	5 (%)	≥4 (%)
Motorcycle	2 (13.33)	2 (13.3)	11(73.33)	13 (86.67)
Tricycle	0 (0.00)	0 (0.00)	3 (100)	3 (100)
Vehicle	11 (20)	5 (9.09)	39(70.91)	44 (80)
Total	13(17.81)	7 (9.59)	53(72.60)	60 (82.2)
$P = 0.7897$				

DISCUSSION

In this study, there were more males (65.75%) than females. In Bangalore, India, Pruthi et al[9] in their study of 529 pedestrians with traumatic brain injuries, found 70.3% males. The high incidence in males was due to males being more active in search of means of livelihood for the families. High percentage of males with traumatic brain injuries from road traffic accident had been documented by other authors.[10-12] There were only three (4.11%) elderly patients in this study, while the rest were 35 children and 35 adults. The low percentage of elderly is a reflection of life expectancy in developing countries like ours. High percentage of elderly were seen in developed countries where life expectancy are high.[13,14] High number of pedestrian with traumatic brain injuries mirrors poverty level in our society where the poor trek their ways to school and work. Dandona et al[15] found that children of highest household income were significantly less likely to sustain pedestrian injury when compared to children from low household incomes.

Majority of the patients were injured between 6AM and 10AM, and between 2PM and 6PM (57.53%). These are peaks hours when people go to school and work, and when they come back home after school and work. These are the two major periods we experience traffic hold-ups in our city. During these periods pedestrians and commuters movement at T-junctions appear chaotic, trying to avoid one another. In places with traffic light, the same scenario occur because the lights do not have pedestrian phase. The same thing is seen near schools, where children cross roads at random, competing with vehicles. In few places with Zebra-crossings, majority of the children as well as majority of the drivers do not understand the meaning. In few places where we have footbridges, iron barriers were built under them, stretching up to two meters on both sides to encourage pedestrians to use the bridges, still they trek to the end of the barriers to run across the roads. Another high incidence was between 6PM and 10PM. This could be explained by high social life in our city. There is high level of clubbing in the night with periods ranging from 6PM to early hours of the morning. Most of the excluded patients were picked up on the roads during this period. These people, under the influence of alcohol tried to cross the roads and were knocked down. Lack of street lights makes it difficult for the drivers to see them, especially those wearing dark clothes. McElroy et al[13] in Wisconsin, USA, found highest incidence between 6PM and midnight. Pruthi et al[9] in India, found highest incidence during peak traffic hours, between 4PM and 9PM. Other studies also found highest frequency between 6PM and midnight.[16, 17] They were attributed to peak hours in their areas. The commonest etiology was vehicular crashes. In London, Baldwin et al[18] found that 74% of all pedestrian injuries involved either a bus or a car. Umaru et al[19] in Azare, Nigeria, found motorcycle crashes as the commonest etiology. The similarity and difference in above findings was the banning of commercial motorcycles in our city before our study started. Pedestrians had been documented as very highly vulnerable group among motor vehicular trauma patients with very high mortality.[20] There are three force transmissions in vehicular/pedestrian crash: the impact by the bumper to the limbs; the wrapping of the body around the vehicle with hitting of the head on the windscreen or hood; the impact on falling to the ground.[5,21]

Only 31(42.47%) patients afforded CT scan of the brain. This showed that many of the patients were poor. Among those who afforded CT scan 2 patients died, while those who could not afford CT scan (42), 11 patients died. The cause of death might have been operable lesions such as hematomas. Among those who afforded CT scan, the commonest cerebral lesion was contusion/intracerebral hemorrhage (41.94%). Pruthi et al[9] in their study also found contusion commonest (47.2%). The commonest major organ associated injuries were in musculoskeletal system (20.55%). This is because vehicular crashes formed the commonest etiology and first impact site in most cases occur in the lower limbs.

In this study, 82.19% had favorable functional outcome but the mortality was 17.81%. The high mortality in pedestrians depicts the triple impact mechanism of injury discussed above. Tokdemir et al[14] in their study found mortality of 18.3% among pedestrian with traumatic brain injury. In Nepal, Mandal et al[22] found 12.5% mortality among pedestrians with traumatic brain injuries. Highest mortality among pedestrian with traumatic brain injury was seen among the elderly. In this study 33.33% (1/3) of our elderly patients died. This is due to the frail nature of patients in this age group. Munivenkatappa et al[23] in their study found mortality of 22.8% among elderly pedestrians with traumatic brain injuries. Severity of injury was the only significant factor that determined the outcome. Like in many series of traumatic brain injuries, severity of injuries had been key significant factor in determining outcome [24-28].

CONCLUSION

Majority of patients in this study were males and vehicle was the commonest etiology. Peak hours for commuters were when the majority of patients were injured. Less than 50% could do CT scan of the brain, and the commonest cerebral lesion was contusion/intracerebral hemorrhage. Favorable functional outcome was 82.19% while mortality was 17.81%. Severity of the injury significantly affected outcome.

Recommendations: Traffic lights without pedestrian phasing currently in our city should be replaced with those with exclusive pedestrian phasing. Sidewalks, pedestrian refuge islands, underpasses, and footbridges should be provided in areas with heavy traffics. Increased intensity roadway lighting is essential. Flyovers and single lane roundabouts will also help reduce crashes in our city. Provision of zebra crossings in roads adjacent to schools cannot be overemphasized. In designing vehicles, tricycles, and motorcycles, safety of the pedestrian should be taken into consideration. Most importantly, education of road users is essential in their understanding of the safety measures. These measures had been found to be effective by some authors.

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