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# Etiology and treatment outcome of traumatic brain injuries from assault

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## Abstract

Conflicts among humans have been for food, sex, and territory. The brain is the most targeted organ. Direct or indirect injury to the brain could spell disaster. Humans apply both blunt and penetrating trauma to the head for maximal brain damage. We prospectively studied the etiology and treatment outcome in traumatic brain injury patients from assault. Objective of the study was to determine the etiology and treatment outcome in patients with traumatic brain injuries from assault. It was a prospective observational study on traumatic brain injury patients from assault admitted and treated in our center. Data were collected using structured proforma which was part of our prospective data bank that was approved by our ethics committee. Data were collected in accident and emergency, intensive care unit, theater, wards and outpatient clinic. They were analyzed with Environmental Performance Index info 7software. There were 49 patients, and males were 41. Their mean age was 29.75 years. The commonest etiology was machete cut. The etiology determined intracranial pathology. Forty four patients had favorable functional outcome. Outcome was significantly determined by severity of injury. Machete cut was commonest etiology. Favorable outcome was seen in 44 patients. Severity of injury significantly determined outcome.

**Keywords**: Assault, etiology, outcome, traumatic brain injury

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## Introduction

It can only take one punch to ruin a life,[1] and the "knockout game"[2] typifies this. The head is the commonest receiving site in assaults. [3-5] In order to inflict more damage, people use iron bar, wood and machete,[6] as well as firearms.[7, 8] These injuries to the brain can reduce the quality of life in the victims[9, 10] and can lead to long lasting impacts on social and emotional development, besides employment. [11, 12] We prospectively studied the etiology and treatment outcome of assault-related traumatic brain injury patients admitted and treated in our center.

## Methods

It was a prospective, cross-sectional study involving patients with assault-related traumatic brain injuries (TBI) admitted and managed in our center from 1st August 2010 to 31st July 2014. The patients were managed in accident and emergency using primary and secondary surveys of advanced trauma life support protocols. Intravenous normal saline 1liter 8hourly for adult and 4.3%dextrose in 1/5saline in children based on their weight, intramuscular (I.M.) Paracetamol 900mg (15mg/kg in children) 8hourly, intravenous (I.V.) Ceftriaxone 1gm daily for adult and 70-100mg/kg once daily for children (those with open wounds), infusion or oral Phenytoin 14mg/kg loading dose, then 5-10mg/kg once daily (for seizures), oxygen by face mask or intranasal catheter aiming at saturation of ≥95% or endotracheal intubation for severe head injury, pressure dressing, and tetanus toxoid 0.5ml stat, were given based on their conditions at presentation. Unconscious patients were catheterized. Full blood count, serum electrolytes/urea/creatinine, urinalysis and computerized tomography (CT) scan of the brain (those who could afford) were done. Those with severe head injuries based on their Glasgow Coma

 

Scores (GCS) after resuscitation were admitted in intensive care unit (ICU). Those who did not require surgery were admitted to the wards. Patients requiring surgery were operated and admitted to the wards or to ICU (severe TBI). Surgery done included scalp debridement and suturing for only scalp wound, craniotomy for extradural hematoma and subdural hematoma, craniectomy and replacement of the bone pieces after washing them in normal saline and soaked them in 10% Povidone iodine gel. Contused brain was sucked out using low pressure sucking. Wound infection were treated based on culture and sensitivity.

High energy and high protein diet constituted thus: 500ml pap, 2 tablespoonful's powdered milk, 1 tablespoonful red oil, 2 tablespoonful's soya bean powder and 1 tablespoonful crayfish powder was given 5-6 times daily via naso-gastric tubes or orally (commenced on third day post-injury for unconscious patient). 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. Drugs were changed to oral or via naso-gastric tube once oral or tube feeding is commenced. On discharge, patients were followed up in out-patient clinic.

Data were collected with structured proforma which was component of our prospective data bank that was approved by our research and ethics committee. In accident and emergency we collected biodata, etiology, time and place of the assault, the injuries sustained, and GCS after resuscitation. Computerized tomography scan findings were documented once available. Other documentations were recorded in theater, ICU, wards, and in the clinic. The outcome was measured with Glasgow Outcome Score (GOS)[13]. 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 found that outcome score three months post-injury predicted long term outcome.[14] The data were analyzed using visual band of Environmental Performance Index (EPI) info 7 software (Center for Disease Control and Prevention, Atlanta, Georgia, USA).

Those treated in accident and emergency and sent home were excluded from the study. Those that ran away from the hospital during their treatment or left against medical advice were excluded from the study.

## Results

Forty nine patients qualified for the study. There were 41 males and 8 females. Their ages ranged from two months to sixty three years with mean age of 29.75 years. The commonest age group was 20-30 years, table 1. The bulk of the patients were 20-50 years (33 or 67.35%) and there was only one female in this group. Most of the patients were attacked between 6PM and mid night, table 2. Commonest etiology was machete cut, table 3. Of note was the youngest patient who was two months old. He was violently thrown to the ground by the father who became depressed after losing his job. The child sustained depressed skull fracture. In those with gun-related injuries (fig 1), 80% occurred in the night, between 6PM and 6AM. High velocity bullets were involved in three out of seven gunshot injured patients.

| Age group (years) | Frequency | Percent (%) |
|---|---|---|
| **0-<10** | 6 | 12.24 |
| **10-<20** | 5 | 10.20 |
| **20-<30** | 14 | 28.57 |
| **30-<40** | 9 | 18.37 |
| **40-<50** | 10 | 20.41 |
| **50-<60** | 4 | 8.16 |
| **60-<70** | 1 | 2.04 |
| **Total** | 49 | 100 |

**Table 1:** Age group frequency

| Period | Frequency | Percent (%) |
|---|---|---|
| **>12Midnight-6AM** | 6 | 12.24 |
| **>6AM-12Noon** | 9 | 18.37 |
| **>12Noon-6PM** | 14 | 28.57 |
| **>6PM-12Midnight** | 20 | 40.82 |
| **Total** | 49 | 100 |

**Table 2:** Attack period

Only 25 patients afforded CT scan of the brain. The commonest intracranial lesion was brain contusion/intracerebral hematoma, and the injuries sustained were significantly related to the etiology, *P* = 0.0253, table 4. Of the 49 patients, 75.51% had skull fractures. Twenty two patients (44.90%) had depressed skull fracture, 28.57% (14) had linear fracture, while 2.04% (1) had elevated skull fracture. Among patients hit with wood, 33.33% (3) had depressed skull fracture, 33.33% (3) had linear fracture, while 33.33% (3) had no fracture. All patients hit with iron bar injury (3) had depressed skull fracture (fig 2). In patients with machete cut (fig 3 and fig 4), 50% (8) had linear fracture, 43.75% (7) had depressed skull fracture, while 6.25% (1) had

elevated skull fracture. In patients with gunshot injuries, 71.43% (5) had depressed skull fractures, while 28.57% (2) had no fracture but one of them had brain contusion beneath the scalp injury. One patient with axe injury had depressed skull fracture. One patient who had punches did not have fracture. In patients with stone injuries, two had no fracture, while one had linear and one had depressed skull fractures. Among other etiologies, one had depressed skull fracture, while four had no fracture. Overall there was no significant relationship between etiology and fracture production, $P = 0.1171$.

| Etiology | Frequency | Percent (%) |
|---|---|---|
| **Axe** | 1 | 2.04 |
| **Fist** | 1 | 2.04 |
| **Gun butt** | 3 | 6.12 |
| **Gun shot** | 7 | 14.29 |
| **Iron** | 3 | 6.12 |
| **machete** | 16 | 32.65 |
| **Others** | 5 | 10.20 |
| **Stone** | 4 | 8.16 |
| **wood** | 9 | 18.37 |
| **Total** | 49 | 100 |

**Table 3:** Etiology Frequency


**Figure 1:** High velocity gunshot to the head of a 14 year old girl around 6.30pm by robbers for not releasing her mobile phone fast.

Injury severity showed 71.43% (35) had mild, 18.37% (9) had moderate, and 10.20% (5) had severe head injuries. Favorable functional outcome was seen in 89.80% (44), while mortality was 10.20% (5). Among the dead, 40% (2) were from machete cut, 40% (2) from gunshot, and 20% (1) from butt of gun injury. All the dead were males. The severity of the injury significantly affected the outcome, $P = 0.0033$, table 5. Gender did not affect the outcome, $P = 0.5390$.

Overall infection rate was 8.16% (4), but 50% was from gunshot injuries. Seizure was seen in 6.12% (3) of the patients. The range of hospital stay was 1-93 days with a mean of 15.73 days.

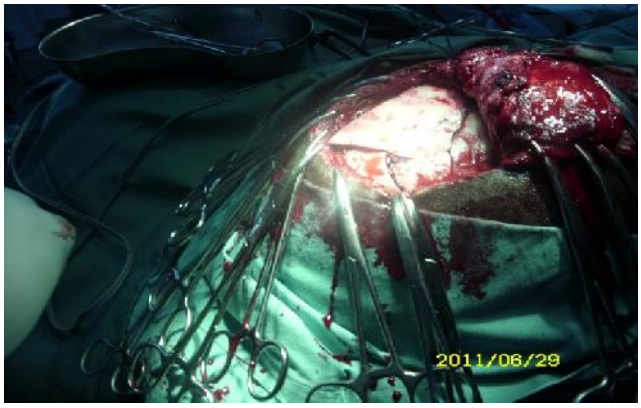


**Figure 2:** Comminuted skull fracture of unsuspecting young man from motorcycle exhaust pipe hit on his head by 'area boy' during 'area boys' inter-group fight.


**Figure 3:** Machete cut on the head of a concubine by her partner for refusing to pack out of his house.


**Figure 4:** Machete cut to the head sustained during fight that occurred during sharing of his late father's land with his step-brothers.

| Etiology | Intracranial lesions | | | | | | |
|---|---|---|---|---|---|---|---|
| | Contusions (%) | EDH (%) | Multiple (%) | None (%) | Others (%) | SDH (%) | Total (%) |
| **Axe** | 0 (0.0) | 0(0.0) | 0(0.0) | 1(100) | 0(0.0) | 0(0.0) | 1(100) |
| **Fist** | 0(0.0) | 0(0,0) | 0(0.0) | 1(100) | 0(0.0) | 0(0.0) | 1(100) |
| **Gun butt** | 1(33.33) | 0(0.0) | 1(33.33) | 1(33.33) | 0(0.0) | 0(0.0) | 3(100) |
| **Gun shot** | 6(85.71) | 0(0.0) | 0(0.0) | 1(14.29) | 0(0.0) | 0(0.0) | 7(100) |
| **Iron** | 1(33.33) | 1(33.33) | 0(0.0) | 1(33.33) | 0(0.0) | 0(0.0) | 3(100) |
| **Machete** | 5(31.25) | 0(0.0) | 1(6.25) | 10(62.50) | 0(0.0) | 0(0.0) | 16(100) |
| **Others** | 0(0.0) | 0(0.0) | 0(0.0) | 5(100) | 0(0.0) | 0(0.0) | 5(100) |
| **Stone** | 0(0.0) | 1(25.00) | 0(0.0) | 1(25.00) | 0(0.0) | 2(50.00) | 4(100) |
| **Wood** | 2(22.22) | 2(22.22) | 0(0.0) | 2(22.22) | 2(22.22) | 1(11.11) | 9(100) |
| **Total** | 15(30.61) | 4(8.16) | 24(4.08) | 23(46.94) | 2(4.08) | 3(6.12) | 49(100) |
| ***P*=0.0253** | | | | | | | |

**Table 4:** Etiology vs intracranial lesion

| Severity | Glasgow Outcome Score | | | |
|---|---|---|---|---|
| | 1(%) | 4(%) | 5(%) | **Total (%)** |
| **Mild** | 1(2.86) | 3(8.57) | 31(88.57) | 35(100) |
| **Moderate** | 1(11.11) | 1(11.11) | 7(77.78) | 9(100) |
| **Severe** | 3(60.00) | 0() | 2(40.00) | 5(100) |
| **Total** | 5(10.20) | 4(8.16) | 40(81.63) | 49(100) |
| ***P*= 0.0033** | | | | |

**Table 5:** Severity vs Glasgow Outcome Score

## Discussion

Our results showed that majority of the patients were males, 83.67%; the majority of the patients were aged twenty to fifty years. The period 6PM-12 midnight had the highest incidence, 40.82%. Nkombua [15] in Mpumalanga, South Africa found that 71.8% of assault victims were males and 68% of the cases were in the night. Downing et al. [16] in Birmingham, UK, found that 84.28% of admitted assault victims were male. In their review of hospitalized head injuries due to assault among indigenous and non-indigenous Australians, Jamieson et al.[17] found that females among the indigenous people had more head injuries than males, while more males was seen among non-indigenes. They also found that 88% of indigenes and 83% of non-indigenes were 15-44 years. They attributed the variance to higher alcohol consumption and possibly alienation of the indigenes. In our city, the high social life with its attendant alcohol consumption starts around 6PM and end early in the morning. Clashes do occur in the clubs do to effects of alcohol. Some authors have documented that aggression is greater in communities where alcohol is easily obtained.[18] Alcohol use is well documented as a contributory factor in assaults [19-21]. In their study of effects of alcohol on the lateral orbitofrontal cortex which control behavioral flexibility and judgment, Badanachi et al.[22] found that in mice, acute alcohol decreased the frequency of current-evoked action potentials in lateral orbitofrontal cortex cells, and it was accompanied by modest hyperpolarization which were only slightly dose dependent. The concentration of alcohol tested was similar to the range found in humans from light to heavy drinking. These effects were similar to effects of trauma in orbitofrontal cortex in human which leads to disinhibition with resultant behavioral inflexibility and poor judgment. Another contributing factor was high cult activity in low economic area of our city where the majority of machete cut came from. Economic deprivation is a contributing factor. MacCallum et al.[23] in their study in Scotland found that head injury from assault in lowest economic people was four times that of those in highest economic position. Similar finding had been documented by other authors. [6, 16] Of the gunshot and gun butt injuries 80% were in the night and were mainly robbery and cult attacks. The remaining 20% was from kidnapping attempt which happened in the day. Nkombua [15] found in his study that firearm formed 3.5% among assault victims. Chattopadhyay et al. [24] study, firearm was the commonest etiology. Other authors found high percentage of firearm in their series. [25] Blunt trauma from wood, iron and stone with high energy impact in localized areas produced all the extradural



 

hematomas. Extradural hematoma is produced by high energy impact in a localized area strong enough to strip the dura off the inner table of skull. Ford et al.[26] used animal experiment to demonstrate that the higher the force of impact, the higher the stripping of the dura, and the higher the volume of hematoma formed. They also found that the hematoma was not related to duration of the impact. The high impact that can produce hematoma most of the time produce skull fracture from skull deformation.[27] Yavuz et al.[28] in their study found that the degree of deformation and fracture produced depended on the striking force. The youngest patient as a victim of mental illness and showed the risk of a child have coming to a parent with depressive illness. But for the intervention of the mother, the child could have been killed by the father. Filicide is common with parents with depression. In their study of 200 filicide of children less than 15 years, Kauppi et al.[29] found that 32% of 38 involved mothers and 7% of fathers had depressive illness. In Canada, Bourget et al. [30] studied 60 fathers that were involved in 77 filicide and found 52% of them had major depression. In Finland, Lewis et al.[31] examined 55 mother tried for filicide and found 34.5% of them had depression. These showed the magnitude of danger children face when any of the parent is depressed.

In this study, 48.98% of the patients could not afford CT scan of the brain. This depicts the level of poverty among them. Relatives of a patient with gunshot wound took the patient out of the hospital to herbalist, claiming that it would be cheaper for herbalist to suck out the bullets by herbalist than doing CT scan. All advice to the contrary fell on deaf ears. Many of them ran away after the surgery to avoid paying hospital bills. Only few of them did CT scan. The commonest intracranial lesion was brain contusion/intracerebral hematoma (30.61%), produced mainly by machete cut and gunshot wounds. Crandon et al.[6] in their study of machete cut injuries found contusion in 7.5% and brain evisceration in 10%. Their results appeared confusing as contused brain was the eviscerating brain seen clinically. However these depicted the extent of force applied with the machete which was intended for maximal damage. High level of contusion along bullet tract and the injury by the cavitation wave lead to very high mortality, which is the usual intention of the assailants. In this study, 40% of the dead was from gunshot injuries. Chattopadhyay et al.[24] found 76.19% mortality among gunshot injuries to the head. The difference may likely be the type of firearm used. They did not specify the types, but in this study, four out of the seven were low velocity type and all survived.

The favorable functional outcome was 89.80% and mortality was 10.20%. In those with machete cuts, favorable outcome was 87.5%, and mortality was 12.5%. Crandon et al.[6] in their study of machete head injuries found favorable functional outcome of 82.5% and mortality of 7.5%, although GOS was wrongly assigned. The length of hospital stay in their series was 11.3 days which was comparable to 15.73 days in this study.

## Conclusion

The commonest etiology in this study was machete cut to the head. The type of etiology significantly determine the lesion produced. The favorable functional outcome was 89.80% and the mortality was 10.20%. The severity of injury significantly determined the outcome.

**Recommendations**

1. Conflict resolution should be introduced to junior secondary school curriculum so that students can understand the important of dialogue in resolving differences as they grow to adult. This will help reduce violence in adulthood.
2. Children should be taken away from depressed parent.
3. Universal health insurance coverage is essential to ensure adequate care and prevent patients from running away while being treated.

**Conflict of interest**: None

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