Head Trauma in a Newly Established Neurosurgical Centre in Nigeria.

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Background: **Head trauma is a major cause of morbidity and mortality worldwide. The most active male age group (15 – 40 years) is the worst afflicted, and road traffic accident is the most common aetiologic factor. Computerized Tomograghy facilitates a comprehensive diagnosis and while treatment is mostly conservative, outcome depends on several factors. In one of Nigeria's six geopolitical zones, a new Centre for Neurosurgery was established one year ago. To objectively build our data base, we prospectively studied the pattern and outcome of head trauma in the new Centre.**
Method: **A 35-point questionnaire was designed to collect data, real time, on every patient diagnosed with head trauma, from the point of admission to the time of discharge.**
Results: **A total of 334 patients were treated in our Unit and 197 (59%) of them were due to head trauma. Males were 147 (74.6%) and females 50 (26.4%), giving a male:female ratio of 3:1. The adult:paediatric ratio was 3:1, and most had mild head trauma 132 (67%). Road traffic accident was the most common aetiologic factor 133 (67.5%) and diagnosis was mostly with x-ray studies 192 (97.5%). Basal skull fracture 86 (43.7%) was the most common pathology and spinal trauma was associated with 13 (6.6%) cases. Treatment was mostly conservative and outcome, good in 135 (68.5%).**
Conclusion: **Head trauma, mostly resulting from road traffic accident, constitutes more than half of our neurosurgical cases and young male adults were the most afflicted group, predominantly with basal skull fractures. The lack of Computerized Tomography scanning facilities contributed a great deal to our outrageous mortality rate of 19.8%.**

Introduction

Traumatic injuries are a major public health problem. Despite being the most preventable of the major public health problems, they still unfortunately, impose a greater burden on modern society than other diseases[1]. In children, and adults under the age of 45, these injuries remain the leading cause of death each year[2]. Head and spinal trauma in particular, are the leading causes of morbidity and mortality especially in patients with multiple trauma[3,4,5]. Head trauma is defined as injury to the brain and/or its coverings as a result of an applied external mechanical force. Most head injuries result from road traffic accident, followed by fall, assault and sport/recreation[6,7,8,3]. Males are more commonly afflicted than females with ratios of 3-4:1 and the young adults are the most vulnerable. In grading the severity of injury, the Glasgow Coma Scale (more appropriately, *Glasgow Consciousness Scale*) has proved very reliable and reproducible over the past 30years. Scores of 13-15 denote mild, 9-12 moderate and 3-8 severe head injuries, respectively. Injuries sustained at the moment of impact are regarded as primary, and those occurring as a consequence of the primary injury within a finite period of hours to days, constitute secondary injury. Primary injury to the scalp includes abrasion, contusion, laceration and avulsion; in the skull it includes calvarial fractures (linear, ping-pong ball and depressed) and basal fractures (anterior, middle and posterior fossae). All basal skull fractures are regarded as technically open or compound. The dura could be contused, lacerated or avulsed, whereas the blood vessels could be obstructed, lacerated or transected. In the brain, injury includes focal (contusion, laceration and avulsion) and diffuse (concussion and diffuse axonal injury). Focal brain injuries are found in approximately one-half of all patients with severe head injuries and are responsible for nearly two-thirds of deaths associated with head injury[9,10,11]. About 80% of patients with fatal closed head injuries have an associated skull fracture[12]. Also, the presence of a skull fracture increases the probability of an intracranial injury, with a 20-fold increase in the probability of an intracranial haematoma in a comatose patient[13,14].

Secondary injury includes those assaults that are preventable, reversible and treatable arising within a finite period from the primary injury but if ignored, would worsen the outcome from the original primary injury[15]. It includes hypoxia, hypotension, hypertension, brain swelling, haematoma collection, pyrexia/hyperthermia, toxaemia, electrolyte imbalance, metabolic derangements, azotaemia/uraemia and anaemia. With significant head injury, there is a 4-5% incidence of spinal injury. Fortunately, the incidence of associated unstable cervical spine injury is surprisingly low[16]. Clinical manifestations in head trauma depend mainly on the extent of the assault and the anatomic sites of the brain involved. Uncontrolled intracranial hypertension is a frequent cause of mortality in severely head injured patients, and brain oedema is an important component of this problem[17,18].

Computerized Tomography (CT) is the diagnostic modality of choice in assessing head injury and almost without exception, an unenhanced CT of the brain suffices for patients seen in the emergency department presenting after trauma or with a new neurologic deficit[19,16]. The Magnetic Resonance Imaging (MRI) was found to be better than CT at detecting traumatic brain lesions in head injury, but despite this, there are no surgical lesions demonstrated on MRI that are not evident on CT[20,21,22,23], besides MRI"s scanty availability, slow speed and higher cost when compared to CT. Even though x-ray facilities are more widely available than both CT and MRI, they are of little value in the evaluation of head injury, only affecting management in an appalling 0.4–2% of patients in most reports, since they are only capable of elucidating bony lesions, and not brain lesions [24]. Significant intracranial injuries have been known to occur with normal skull x-ray studies, and such studies have been reported to be normal in 75% of minor head injury patients found to have intracranial lesions on CT, attesting to the insensitivity of x-rays[25]. In the latter half of the 20th century, the greatest impact on the management of head trauma has been made by CT; and since its clinical introduction in the 1970s has remained the primary diagnostic procedure in head trauma evaluation[23].

Treatment is mostly conservative, but with associated space occupying lesions, cerebrospinal fluid (CSF) fistula or marked intracranial hypertension, optimal treatment could only be attained with operative intervention. Persistent intracranial hypertension remains a constant worry in all cases of head injury and could be complicated by brain herniation and brain stem compression unless urgent measures are employed to ensure intracranial decompression[26]. Complications include seizures, residual neurological deficits, CSF fistula, intracranial sepsis, carotico-cavernous fistula, hydrocephalus, growing skull fracture (traumatic leptomeningeal cyst), cranial defects and endocrine dysfunctions.

Outcome from head trauma is easily assessed with the Glasgow Outcome Scale (GOS) which is graded 1-5 and best employed at least 6months after trauma. A score of 5 connotes good outcome with resumption of normal life despite minor deficits; 4 is moderate disability – disabled but independent, can travel by public transportation and work in sheltered setting; 3 – severe disability – conscious but disabled, dependent for daily support; 2 – persistent vegetative state – unresponsive and speechless after 2-3weeks, may open eyes and have sleep-wake cycles; 1 – death;

most deaths ascribable to the primary head injury would occur within 48hours [27].

A continental overview of ratios of neurosurgeon:patient reveal that North America has the best outlook with 1:81,000, followed by Europe 1:121,000, and worldwide ratios average 1:230,000; but the World Health Organization (WHO) recommends a maximum of 1:100,000 (28,29). In Africa, the paucity of specialists and social infrastructure has negatively impacted on the outcome from head trauma which incidence is thought to have escalated with widespread quasi-urbanization and internal population migrations coupled with local and regional conflicts in the face of sub-optimal road networks, vehicular road worthiness, health facilities and wealth distribution. In Nigeria, the neurosurgeon:patient ratio is 1:10million (30), a scandalous reality impacting heavily on the health of the nation.

In the past one year, a new Centre for Neurosurgery has been set up in one of Nigeria's six geo-political zones - the South East, in a Federal Government tertiary health facility. The Centre has potential catchments of about 25% of the country and its establishment is expected to impact significantly and positively on the health of about a quarter of Nigeria's population of 150million, over time. We, therefore, undertook a prospective study over the past one year to evaluate the pattern and outcome of head trauma in the Centre as we attempt to build a reference data base, and compare our findings with published literature.

Patients and Methods

Data on every patient with head injury was collected, real time, using a 35-point questionnaire designed to record all the necessary information from the point of admission in the Emergency Room, to the time of follow-up in our out-patient clinic, from April 21, 2006 to April 20, 2007. Emergency Room and out-patient clinic records were also used as back-up data bank to ensure accuracy. These data were collated and subsequently evaluated by simple analysis, and compared with work published in literature. All cases of chronic intracranial haematomata (>3weeks after incident) and cerebrospinal fluid fistula arising after discharge from a previous head trauma were not included in this study.

Results

Within the first year of our service, a total of 334 patients were treated by our Unit and 197 (59%) of them had head trauma. Males were in the majority 147 and females 50, translating to 74.6% and 25.4% respectively, a male:female ratio of 3:1. Adults were 14 (73.6%) and paediatric patients, 0 - 15years, were 52 (26.4%), a ratio of 3:1. Among these paediatric patients, 10 (5.08%) were 0 – 2 years of age. Patients aged >15 – 40 years were 91 (46.2%), >40 – 60 years 38 (19.3%), and >60 years 16 (8.12%). The most common aetiologic factor was road traffic accident 133 (67.5%), followed by fall 44 (22.3%), missile/falling object 10 (5.08%) and assault 10 (5.08%). We did not record any case of sport/recreation injury.

Table 1. Age and sex distribution of the patients

Age(years)	**No.**	**%**
0-15	52	26.4
>15-40	91	46.2
>40-60	38	19.3
>60	16	8.12
Total	**197**	**100**
Sex	**No**	**%**
Male	147	74.6
Female	50	25.4

Table 2. Outcome from management using the Glasgow Outcome Scale

GOS (Glasgow Outcome Score)	No.	%
5 Good; resumption of normal life	135	68.5
4 Moderate disability	3	1.52
3 Severe disability	2	1.02
2 Persistent vegetative state	1	0.51
1 Death	39	19.8
Unknown	17	8.63
Total	**197**	**100**

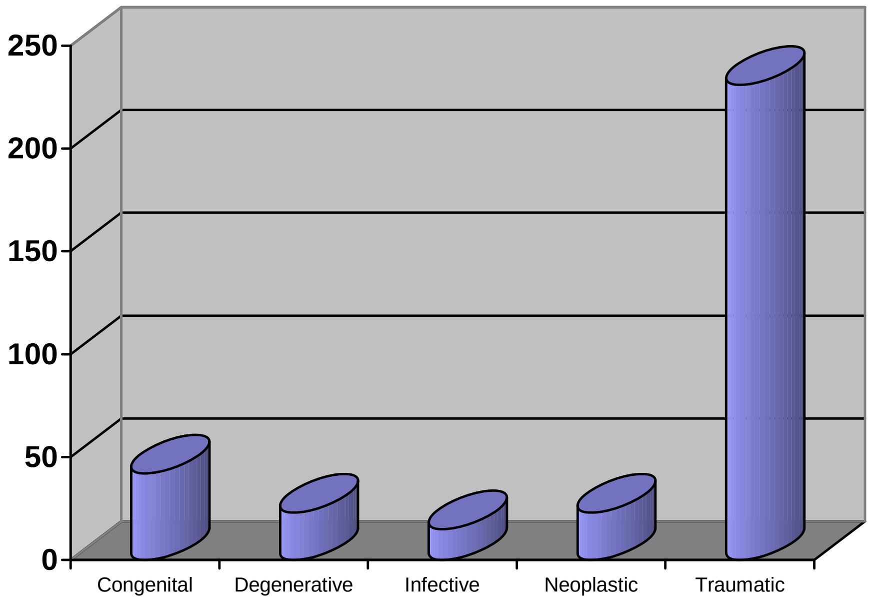

Figure 1. Distribution of Neurosurgical Cases treated in 1 year.

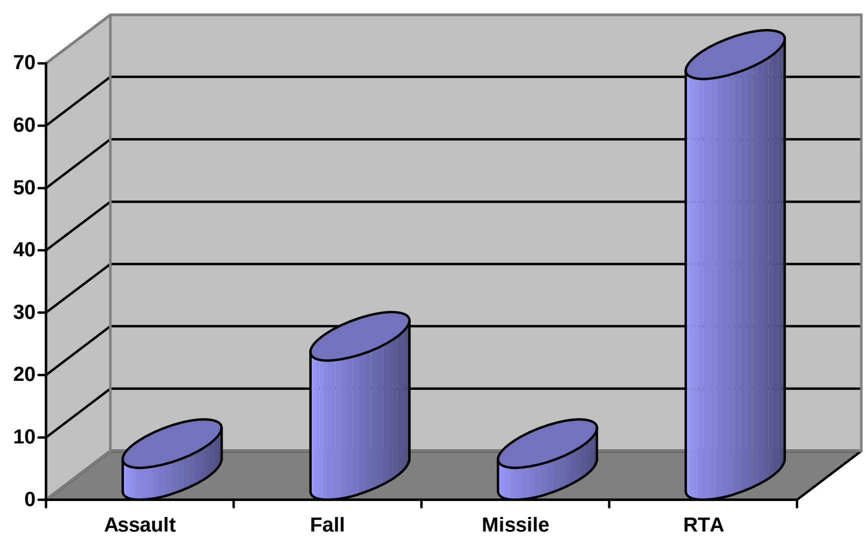

Figure 2. Incidence of aetiologic factors (%)

Majority had mild head injury 132 (67%), followed by severe 39 (19.8%), and moderate injury 26 (13.2%). Pathologically, basal skull fracture constituted 86 (43.7%), multi-focal cerebral contusion with cerebral oedema 70 (35.5%), scalp injury 61 (31%) and cerebral concussion 55 (27.9%). Others were compound depressed skull fracture 10 (5.08%), acute extradural haematoma 9 (4.57%), linear skull fracture 7 (3.55%), subarachnoid haemorrhage 4 (2.03%), simple depressed skull fracture 3 (1.52%), acute subdural haematoma 2 (1.02%), subdural hygroma 2 (1.02%) and intracerebral haematoma 2 (1.02%). Many patients had more than one pathology, each. There were 17 (8.63%) undetermined cases. Fractures were present in a total of 106 (53.8%), mostly basal skull fracture of the anterior cranial fossa 64 (32.5%). There was associated spinal injury in 13 (6.6%), 11 (5.58%) of which were cervical and 2 (1.02%) thoracic.

Treatment was non-operative in a majority of cases 137 (69.5%), and operative in 43 (21.8%), out of which craniectomy was 12 (6.09%), craniotomy 10 (5.08%), exploratory burr hole 9 (4.5%), elevation/debridement of depressed fractures 9 (4.57%) and wound debridement/exploration 3 (1.52%). Seven (3.55%) of the 9 burr holes led to more than one procedure, 5 (2.54%) of which were exploratory burr holes proceeding to either craniectomy or craniotomy, and 2 (1.02%) had exploratory burr holes, craniotomy and decompressive craniectomy combined. Among the 17 absconders, treatment modalities could not be ascertained.

Outcome as measured both at discharge and follow-up was good (Glasgow Outcome Score 5) in most of the cases 135 (68.5%), moderate neurological deficits 3 (1.52%), severe deficits 2 (1.02%), persistent vegetative state 1 (0.51%), and death 39 (19.8%). Complications included calvarial defects 28 (14.2%), cranial nerve deficits 18 (9.14%), residual motor deficits10 (5.08%), late post-traumatic seizures 3 (1.52%), meningitis 2 (1.02%) and wound dehiscence 2 (1.02%) – one of whom also had wound infection. We treated all scalp wounds with antibiotics after debridement. There was still 1 (0.51%) case of CSF fistula in a 13-year old male, in the 10^{th} post-traumatic week.

The patient with GOS 2 also had post-traumatic hydrocephalus and had to undergo ventriculo-peritoneal shunting, which was not included among the operative procedures done for head trauma in this study. Follow-up was possible in about 20% of our cases, with a range of 4-12 weeks.

Discussion

Findings from our series revealed an alarming incidence of head trauma, nearly 60% of all neurosurgical cases treated in our Centre in the past one year which also included congenital anomaly 42 (12.6%), degenerative nervous system disease 23 (6.89%), neoplasm 23 (6.89%) and infection 15 (4.49%). If the other forms of traumatic lesion like spinal trauma and chronic post-traumatic disease are added, the total figure for trauma would rise to 231 (69.7%). And with this level of occurrence, mortality in our service, therefore, leaned mostly towards trauma as the most common aetiological factor, corroborating the findings by several other workers (1,2,3,4,5). Unfortunately, our new Centre does not have facilities for CT and this, impacts heavily on the quality of our service. We depend on a private CT facility located 100kilometers away on a highway that is half smooth and half rough. And for our patients to get to this private facility, get the scanning done, films printed and findings reported, and then come back to us, takes an average of 8hours – an unacceptable period of time lag - long enough to portend severe secondary assaults and unfavourable outcome from the primary injury. Occasionally, telephone contact with the CT facility enables us prepare for intervention ahead of the patients' return. But, on four different occasions, as the patients returned and we were getting ready to operate, they variously deteriorated and suddenly went into cardio-pulmonary arrest from obvious brain stem herniation.

On account of this huge handicap, we developed a low threshold for surgical intervention preferring instead to combine meticulous serial clinical evaluations with x-ray findings to intervene in >50% of the operated cases. Of the 9 cases of exploratory burr holes, 7 gave a positive yield of acute intracranial haematoma, requiring extension to craniectomy or craniotomy for evacuation, or both, whereas 2 were negative. Also, 8 of the 10 cases of compound depressed skull fracture had elevation and debridement based on clinical and x-ray findings, and only 1case was operated based on CT findings, while 1 left against medical advice. Five cases of craniotomy followed exploratory burr holes, whereas 10 craniotomies were *de novo* for the evacuation of haematoma or decompression of intracranial tension diagnosed by CT.

The demographic pattern of our cases, correlated strongly with published work with a male:female of 3:1, adult:paediatric of 3:1, and predominantly young adult age group with nearly half (46.2%) aged >15 – 40years. At the extremes of age, head trauma expectedly has a lower incidence 5.08% for 0 – 2years and 8.12% in >60years.

The role of road traffic accident in our series appears to exceed previously published reports (rates of 40 – 50%), reaching nearly 68% in ours, an alarming finding reflecting possibly, the bad state of roads and poor compliance with traffic regulations in Nigeria's South-East zone. This part of Nigeria has only two carriage highways that are dualized. A third road being currently dualized, barely 100kilometers long, has taken the half-hearted Federal Government a total of 8years now to get off the drawing board and enter the construction stage; and even at that, construction has barely gone half-way in an entire 8years. This is a classical example of how government priorities affect the lives of a nation's citizens. Reports from WHO have previously noted that the bad state of roads round the country and deplorable health facilities have become the hallmarks of Nigeria's health system (31).

A majority of our cases were mildly head injured (67%), correlating strongly with the recent publication by Csepregi, *et al*, in Hungary whose series has 71.3% mild, 19.4% moderate and 9.4% severe head trauma (32). It is not unusual therefore, that conservative management (69.5%) was the most commonly employed treatment modality, and operative intervention in 21.8%, with a correspondingly good outcome in 68.5% of our cases.

An unusual finding was the large number of basal skull fractures recorded (43.7%), which was far higher than multi-focal cerebral contusion and scalp injury. Focal contusions are known to be the most common reason for deaths in closed head injury (9,10,11). We made our diagnosis of basal skull fracture mainly based on clinical and x-ray findings, but in 13 (6.6%) of cases that had CT, ready diagnosis was also made. Computerized Tomography appears to be handicapped in evaluating basal skull fracture, and plain skull x-rays and clinical evaluation have been documented as usually more sensitive than CT (16).

The unavailability of CT facilities in our Centre, inasmuch as it would have significantly contributed to our high mortality rate, appeared to have also inadvertently improved our clinical surveillance which further underscored the fact that a great deal of head injury cases could be successfully managed without hi-tech imaging since a majority, basically, require conservative treatment. If we compare the 69.5% good outcome and the 19.8% mortality incidence, and the fact that about half 21 (10.7%) died before any definitive diagnosis could be made, 11 (5.58%) of whom died within 6hours of presentation to the ER (5 deaths within 1hour and 2deaths within 2hours) - probably suggesting that even with ready imaging such cases could still have had a poor outcome, our results compared satisfactorily with the incidence of such early mortalities in United States of America which has been put at 5% (2). In fact, about three-quarters of the mortality, 29 out of 39 (14.7%) had severe head injury, while 5 (2.54%) each had moderate and mild injuries, respectively.

Indicting, however, was the fact that whereas most of the patients that had CT (29 out of 34) 14.7% had good outcome, most of the patients that died (34 of 39) 17.3% did not have CT. In other words, only 5 of the patients that died actually had CT, but most of those that had CT survived. And, since CT imaging is easily regarded as the greatest development in Neurosurgery in the second half of the 20th century, its value in our practice could be readily extrapolated, not in the sense that irreversible brain damage would be reversed but that avoidable deaths could be averted by precise diagnosis and timely intervention. Of the 72 (36.6%) cases that we considered as having met the criteria for CT scanning, less than half of them 34 (17.3%) were able to afford it, while the rest could not, either because of cost or on account of lack of proximity. For the 38 (19.3%) who could not do the requested scanning, majority did not have readily available funds and usually needed several days to source for funds within which period some of the patients eventually died.

Our incidence of acute extradural haematoma appeared to be higher, 4.57%, than observed by other workers, 1% (16), and if CT had been done in all cases where it was prescribed, this figure could rise even further. Perhaps, this was a local variation, and further prospective studies would likely make the picture clearer in our subsequent series. The incidence of spinal injury was low among our head injury cases, 6.6%, corroborating previous findings (16). High cervical spinal injury resulted in death in 2 of our mildly head injured cases.

The low level of follow-up in our service 20%, could be due to a preponderance of mild injuries with good outcome, but could still arguably have accounted for the low incidence of complications we recorded especially in terms of chronic intracranial collections, late post-traumatic seizures or hormonal imbalances. However, it would be expected that if such complications had arisen, such patients if they survived, would very likely turn up for re-evaluation. There was a range of 4 -12 weeks, with a median of 4weeks and a mean of 6.8weeks amongst our follow-up cases. The case of persistent vegetative state is still in rehabilitation 10months post-trauma.

We did not operate on any of the 3 (1.52%) cases of simple depressed skull fractures, but we did elevation and debridement for 9 of the 10 cases of compound depressed skull fractures most of which cases were elevated only after 72hours of trauma, when the bone fragments were regarded as already infected; and even the 2 that had elevation within 12hours actually had impaled contaminated foreign bodies; thus, the fracture fragments in all such cases were discarded. We, therefore, had cranial defects from 12 (6.09%) cases of decompressive craniectomy, 9 (4.57%) of compound depressed fracture, 4 (2.03%) of exploratory burr holes and 3 (1.52%) cases of simple depressed skull fracture that did not undergo surgery. Meningitis complicated only one case of basal skull fracture, and was vigorously and successfully treated with antibiotics, though we did not routinely use prophylactic antibiotics in basal skull fracture. None of our basal skull fracture cases had prophylactic antibiotics unless there was some other indication for such.

The lone case of persistent vegetative state, aged 9years, *ab initio* had exploratory burr holes extended to craniotomy and craniectomy for closed severe head injury with extensive multi-focal cerebral contusion and acute extradural haematoma, and later, post-traumatic hydrocephalus; while the 3 (1.52%) with late post-traumatic seizures are presently on anticonvulsants. We did not use prophylactic anticonvulsants since this had been documented not to prevent the late development of post-traumatic seizures and found not to be useful except in certain circumstances (33). We recorded one case of CSF fistula after discharge from hospital which is still being followed-up 10weeks post-trauma, for possible craniotomy and duroplasty, later on.

Conclusion

Neurosurgery has come to stay in our new Centre and despite throwing up data which, for the greater part, correlated with published work on head trauma, some significant new observations in this prospective study would deserve close follow-up, especially with the incidence of road traffic accident, basal skull fracture and extradural haematoma. It also makes a strong case for meticulous clinical evaluation, need for CT with a careful selection of cases, and the occasional value of exploratory burr holes in carefully selected cases, especially in regions without facilities for modern imaging. Nonetheless, there remains an urgent need to provide modern imaging like CT and MRI facilities in all tertiary health institutions in Nigeria, more especially, for the new Centres of Neurosurgery.

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