Original Article

ISSN (0): 2455-5274; ISSN (P): 2617-5207

Morphological Patterns of Traumatic Head Injury in Medicolegal Autopsies at Muhimbili National Hospital, Dar ES Salaam Tanzania

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Abstract

Introduction: Head injury is predicted to surpass many diseases as a major cause of death and disability by the year 2020. There is a limited documentations on morphological patterns of traumatic Head Injury and its prevalence specifically in Medical legal Autopsy in Tanzania population. The aim of this study was to determine the morphological patterns of Traumatic Head Injury (TBI) in Medical legal autopsies seen at Muhimbili National Hospital (MNH). **Subjects and Methods**: This was a hospital based cross-sectional study conducted at MNH mortuary. The postmortem examination was performed under Virchow method on 170 cases of TBI in which morphological patterns of TBI was recorded. Proportional of TBI frequencies on various morphological patterns in medical legal autopsies were recorded. Association between cause of death and etiology of TBI were established by Fisher-exact test. **Results:** The proportion of TBI among the medico-legal autopsy at MNH was 38.5%. All cases of TBI had scalp abrasion, and the majority had linear fracture 67(39.3%) and the commonest the parietal bone was commonly affected 85(55.6%). In closed TBI, majority had subarachnoid hemorrhage130 (84.9%). All cases of TBI had brain edema, with one coincidental finding of metastatic adenocarcinoma. A total of 42 cases of TBI had brain herniation, 51 brain laceration and 52, had brain contusion. The association between etiology of injury, wearing helmets among motor cycle user and cause of death was statistically significance ($p<0.05$). **Conclusion:** The higher proportion of TBI among medicolegal autopsies at MNH reflects the burden of head injury in our settings.

Keywords: Traumatic Head Injury, Medicolegal autopsy, Morphological patterns.

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Received: 30 November 2021 **Revised: 08 January 2022** **Accepted: 17 January 2022** **Published: 30 June 2022**

Introduction

Head injury has been replaced by the new term; traumatic brain injury [TBI].[1] TBI is defined as cerebral insult which is not degenerative or congenital in nature, caused by external mechanical force that results in a permanent, or temporary disabilities of cognitive, physical, and psycho social functions with or without altered level of consciousness.[1] Based on whether the dura matter is torn or not, the Traumatic Brain Injury could even be termed as open or closed type.[2]
Traumatic Brain Injury is predicted to surpass many diseases causing significant death and disability by the year 2020. The bulk of TBI cases are due to Road Traffic Accident, followed by falls, and violence.[3] The causes and pattern of head injuries vary worldwide due to variations in infrastructure, civil violence, wars, and crimes.[4] Within the United States (US), the incidence of head injury was recently reported to be 394 per 100,000 people, with male to female ratio of 1.8:1 with a death rate of 19.3 per 100,000 people.[5]

Traumatic head Injury result into the occurrence of a several morphological patterns either on the scalp, meninges or brain parenchyma depending on the impact of force and classification of injury. One study done on medical legal autopsies of motorbikes-pedestrian done in Barcelona, Spain showed that the most frequent injury was the subarachnoid hemorrhage, in 71.4% of cases, followed by cerebral contusions and skull base fractures (65.7%).[6,7] Other morphological pattern of head injury occurred in this study were cranial vault fracture (34.29%), subdural hemorrhage (54.29%), epidural hematoma 8.57% cerebral contusion 65.71% and brain stem hemorrhage (22.86%).[8]
In Tanzania, there is no published data on prevalence or morphological patterns of traumatic head injury in medical

legal autopsies. The aim of this study was to determine the prevalence and morphological patterns of Traumatic Head Injury in Medical legal autopsies at MNH in Dar-es-Salaam.[9]

Subjects and Methods

This was hospital based cross-sectional study done between July 2019 and January 2020 at Muhimbili National Hospital mortuary. A total number of 940 medical legal autopsies were performed at MNH during the study period, and 362 cases with TBI were assessed 362. Following exclusion, a total of 170 with TBI were recruited in the study.

Demographic information were obtained from PF99 forms and inquired from identifier of the deceased. The routine Postmortem examination was conducted under Virchow method, and the respective reports produced as per normal procedure with special attention on the head. All gross morphological patterns were documented and photograph were taken for unique injuries. All brains were fixed on 10% Neutral Buffered Formalin for 4 weeks, and then section per protocol. Representative tissues were selected and processed and then stained by Hematoxylin and Eosin (H&E), and special stains when necessary. The autopsy was completed by dissecting the chest and abdominal regions to reveal any internal organ injury associated with trauma and for establishment of cause of death as per protocol. All associated findings from other parts were documented after full postmortem examination.

The data was analyzed by SPSS version 23, and data was summarized into proportion, frequency and association tables. Fisher-exact test used to statistical associations, and two-tailed p-value of less than 0.05 was considered statistically significant.

Ethical approval to conduct the study was obtained from MUHAS ethical clearance committee, and permission to conduct the study was obtained from the Executive Director of MNH.

Results

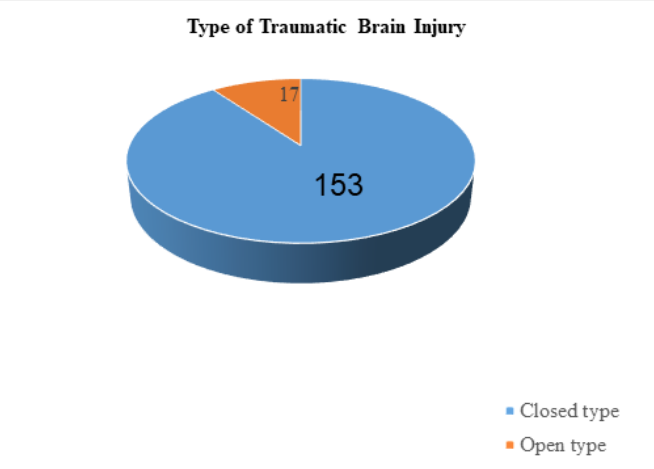

Figure 1: Type of Traumatic Brain

Out of 170 cases recruited in this study, most of the deceased persons were male 148/170 (87.1%) with male to female ratio of 6.7:1. The mean age of the deceased persons was 32.10 years + 14.63SD. The majority of the deceased were adult aged between 19-59 years old 143(84.1%) followed by adolescents between 13-18 years old 10(5.9%). Children 0-12 years old account for 9(5.3%) and senior adult (more than 60 years) accounted for 8(4.7%). Based on the clinical autopsy findings, 145 (94.7%) of the deceased brain weighed more than 1.4 kilogram with the mean brain weight of 1.48 kg +0.118SD. The majority 104(61.2%) death occurred within 24hrs, followed by 2 days in 25 (14.7%) of the cases.

The proportion of traumatic head injury among the medico-legal autopsy performed at MNH during the study period was 362/940 (38.5%). Of the 170 cases recruited in this study,153(90%) had closed head injury while 17(10%) cases had open head injury [Figure 1].

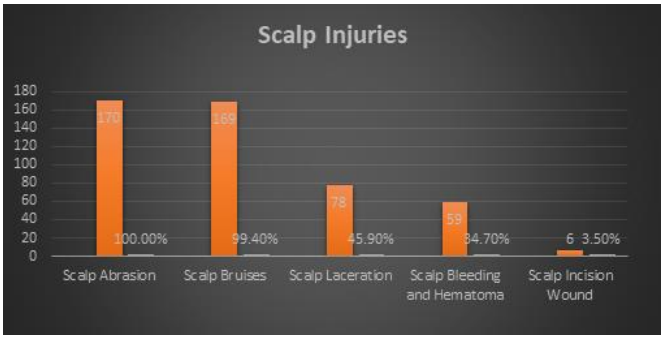

Figure 2: Scalp injury

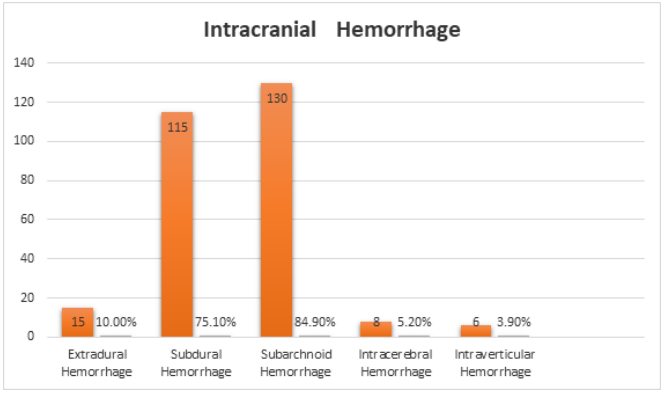

Figure 3: Intracranial Hemorrhage

Table 1: Types of skull fractures and location in different cranial bones

Skull fracture and the location	Frequency n (%)
Type of skull fracture	
Linear	67(39.4%)
Comminuted	42(24.7%)
Basilar	36(21.2%)
Hinge	20(11.8%)
Crushed	17(10%)
Depressed	7(4.1%)
Fracture along the suture line	1(0.6%)
Location of the fracture	
Parietal bone	85(55.6%)
Temporal bone	35(22.9%)
Frontal bone	21(13.7%)
Occipital bone	18(11.8%)
Anterior cranial fossa	12(7.8%)
Middle cranial fossa	22(14.4%)
Posterior cranial fossa	3(2.0%)
Intact skull with no fracture	20(13.1%)

All the victims of head injury had scalp abrasion, while 169(99.4%) of the victims had scalp bruises, and 78(45.9%) of the victims had scalp laceration [Figure 2]. For skull fractures, 67(39.3%) were linear fracture, followed by comminuted fracture in 42(24.7%) of the victims. Others types of fractures are shown in [Table 1]. The majority 85(55.6%) of the fractures were located in the parietal bone, followed by temporal bone in 35(22.9%) of the cases. Fractures of the base of skull, middle, anterior, and posterior cranial fossa were 37(21.8%) [Table 1]. Out of 153 examined closed traumatic brain injury cases, 130 (84.9%) had subarachnoid hemorrhage. Subdural hemorrhage was seen in 115(75.1%) of the cases, and extradural hemorrhage seen in 15(10%) of the cases. The Intracerebral hemorrhage was seen on 8(5.2%), and 6(3.9%) had intraventricular hemorrhage [Figure 3].

Table 2: Associated Injuries

Associated Injuries	Frequency (n%)
Multiple abrasion	169(99.4%)
Multiple bruises	169(99.4%)
Multiple laceration	83(48.8%)
Fracture of ribs and clavicles	43(25.3%)
Injury to the heart, lungs and hemothorax	39(22.9%)
Fracture of Tibia and Fibula	29(17.1%)
Dislocation of joints	28(16.5%)
Multiple incision wound	27(15.9%)
Fractures of upper limb bones	27(15.9%)
Injury to the liver and spleen	26(15.3%)
Fracture of the femur	21(12.4%)
Injury to other abdominal viscera	21(12.4%)
Fracture of spine	13(7.6%)
Fracture of the pelvic bones	7(4.1%)
Amputation of limbs	5(2.9%)
Decapitation	1(0.6%)

Figure 4: Comminuted fracture of parietal and temporal bones pointed by arrows

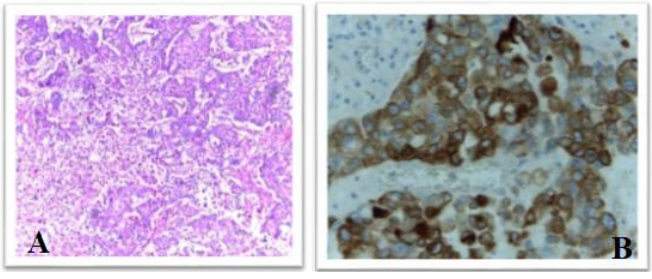

Figure 5: Different histomorphological pattern of TBI

A- H&E section showing brain infiltrated with metastatic adenocarcinoma x10

B- Immunohistochemical stain showing epithelia membrane antigen (EMA) membranous positive stain in tumor cells for metastatic adenocarcinoma x40

The gross morphology of the brain was examined in all cases with closed traumatic brain injury. All 153 (100%) victims had brain edema, 42(27.5%) had brain herniation, 52(34.1%) had brain contusion, and 51 (33.3%) had brain laceration.

Histology of brain showed majority 117 (76.5%) of the cases had mild edema and congestion, 35 (22.9%) had severe edema and congestion, while only one autopsy showed metastatic adenocarcinoma with mild edema and congestion. Other associated types of injuries are summarized in [Table2].

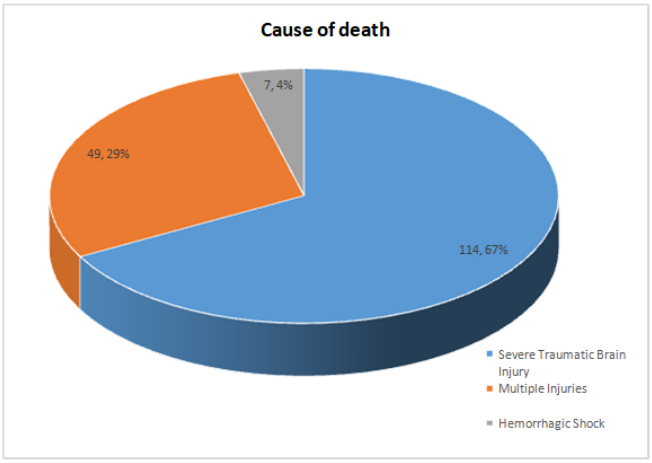

Figure 6: Cause of death in TBI

Table 3: Etiology of head injury

Specific Cause of Injury	Frequency(n%) N=170
Road traffic accident	108(63.5%)
Physical assault	19(11.2%)
Fall	4 (2.4%)
Railway accident	4(2.4%)
Mob lynching	30(17.6%)
Child abuse	3(1.8%)
Falling with heavy objects	2(1.2%)
Type of vehicular involved in Motor traffic accident	Frequency(n%) N=108
Motor cycle	31(28.7%)
Motor vehicle	31(28.7%)
Both motor cycle and motor vehicle	46(42.6%)
Road traffic user	Frequency(n%) N=108
Pedestrians	47(43.5%)
Cyclist	44(40.7%)
Driver	0(0.0%)
Motor vehicle passenger	1(0.9%)
Motor cycle passenger	16(14.8%)
Wearing helmet among cyclist and their passenger	Frequency(n%) N=60
Yes	11(18.3%)
No	49(81.7%)

This study also assessed the association between the cause of injury and the cause of death. More than 64.8% of the victims involved in the motor traffic accident died due to severe TBI, and 94.7% of the victims of physical assault died due to severe TBI. Half of the victim who falls died of severe TBI, while the other half died due to multiple injuries. For the victims involved in railway accident, all died due to multiple injuries, and all the abused child victims died due to severe TBI. All victim injured by heavy falling objects died due to

multiple injuries, and 70% of victims of mob lynching died due to severe TBI.

The study showed 70.5% of the motor cyclist and about 69% of the motor cycle passenger died due to severe traumatic brain injury. Majority (81.7%) of victim in this study did not wear the helmet as previously stated. Of note, 73.6% of the deceased who did not wear the helmet died due to severe TBI. [Table 4]

Table 4: Association of cause of death with the cause of injury, road traffic user and wearing helmet on TBI Traumatic Brain injury.

	Cause of death				Fisher Exact Test
	Severe traumatic brain injury	Multiple injuries	Hemorrhagic shock	Total	(P- value)
Cause of injury					
Road traffic accident	70(64.8%)	31(28.7%)	7(6.5%)	108(100%)	0.007
Physical assault	18(94.7%)	1(5.3%)	0(0.0%)	19(100%)	
Fall	2(50%)	2(50%)	0(0.0%)	4(100%)	
Railway accident	0(0%)	4(100%)	0(0.0%)	4(100%)	
Mob lynching	21(70%)	9(30%)	0(0.0%)	30(100%)	
Child abuse	3(100%)	0(0.0%)	0(0.0%)	3(100%)	
Fallen by heavy object	0(0.0%)	2(100%)	0.0%)	2(100%)	
Road traffic user					
Pedestrian	27(57.4%)	15(31.9%)	5(10.6%)	47(100%)	0.629
Motor cyclist	31(70.5%)	12(27.3%)	1(2.3%)	44(100%)	
Vehicle passenger	1(100%)	0(0.0%)	0(0.0%)	1(100%)	
Motor cycle passenger	11(68.8%)	4(25.0%)	1(6.2%)	16(100%)	
Wearing helmet among road traffic user.					
Yes	6 (54.5%)	3 (27.3%)	2 (18.2%)	11 (100%)	0.030
No	36 (73.6%)	13 (26.5%)	0 (0%)	49 (100%)	

Discussion

This study showed a prevalence of 38.5% of TBI among medicolegal autopsy done at MNH, and road traffic accident was the commonest cause. Study done in developing countries showed the same findings of road traffic accident as a leading cause of injury among severe traumatic head injury of all cases brought for medico legal autopsy.[10] This high rate is due to the poor condition of roads, vehicles and human errors. However, in developed countries the fall is the leading cause of injury among traumatic brain injury followed by road traffic accident.[10,11] In this study, severe traumatic brain injury was the foremost most common cause of death. One study done by Dhattarwal et al in developing country showed the leading cause of death was hemorrhagic shock followed by intracranial hemorrhages, and severe brain injury was third one among medicolegal cases. Reason for discrepancy of these findings was the previous study involves only MTA cases while in our study several etiologies of injuries were involved.[12,13]

This study show high number of deceased whom were not wearing helmet die due to severe traumatic brain injury. Studies done by Kigera et al in Uganda and Kudebong et al in Ghana differ with our study and have low number of deceased died due severe traumatic injury for those who were not wearing helmet.[12,14] The smaller figure reported in those countries compared to this study may be due to a higher level of helmet use in both Uganda and Ghana.[12,14]

In this study, more age group sustain TBI was adult. A study done by Kigera et al in Uganda, a developing country on traumatic brain injury among motorcycle user found that more affected age group were adults below 40 years of age.[14] One study done in China on TBI in medical legal autopsy majority(more than 2/3) of affected group range from (18-65) years.[15] The probably reason for this age group to be involved than other age group is likely involvement of various economic activities which exposed them to various forms of injury. In this study, most of the deceased were males, the same as seen in studies by Faduliye et al in Lagos Nigeria, and Kigera et al in Uganda.[14,16] The main reason for men to sustain injury than women is that they are predominantly earning member of the family, so they engaged in various activities, and highly exposed to injury than women.[17]

This study showed various pattern of the scalp injury in which all the victims had scalp abrasion, and the majority present with scalp bruises. This is contrry to study by Chang et al in China, and Lakshmanan et al in India, both studies found that the majority of the scalp injury were contusions. However, these studies involved medicolegal autopsy with only blunt traumatic head injury, and road traffic accident cases, while our study involve both blunt and penetrating injuries with several etiologies of injuries.[15,18,19]

In victims with skull fracture, linear fracture was the commonest in this study, and this concurs with a study done by Rahman et al in Bangladesh, and the majority of the fractures were located on parietal bone followed by temporal bone. The reason for linear fracture to be dormant is due to a head strikes by forcible contact with broad resisting surface during injury which commonly occur in road traffic accident.[20]

For intracranial hemorrhage, the commonest type of hemorrhage was subarachnoid hemorrhage followed with subdural hemorrhage. The findings above, coincides with other studies of traumatic brain injury done before in which showed that SAH was the commonest intracranial hemorrhage observed.[21,22] This finding was expected because SAH was common intracranial hemorrhage in both traumatic and non-traumatic intracranial injury.[8] The probably reason may be to rupture of cerebral aneurysm or atrial venous cerebral malformations.

In this study, gross morphological examination of the brain found edema in all cases, and one case had metastatic carcinoma with mild edema and congestion on histological examination. The main reason to found one case of metastatic adenocarcinoma was due to late clinical presentation of

symptoms and patient may stay with disease if no checkup and intervention was not done. Study done by Vernooij et al in general population on incidental findings of brain by MRI showed brain infarct were common findings followed by cerebral aneurysm. The least common were primary brain tumor, and metastatic tumors.[23]

Road traffic accident was the commonest cause of injury in this study, followed by mob lynching. Study done by Akhiwu et al in Nigeria and Meel et al in South Africa showed the same findings in which road traffic accident was the leading etiology of injury among severe traumatic head injury.[10,11] The reasons for this is poor condition of roads and vehicles, which are worsen by the poor economy compared to developed countries in which road traffic accident is second leading cause of injury among traumatic brain injury victims.[10,12]

In this study 71% of the motor cyclist and about 69% of the motor cycle passenger died due to severe TBI as the cause of death. Studies done by Faduliye et al in Nigeria and Kigera et al in Uganda showed 20-40% of the motorcycle user died due to severe TBI. The smaller figure reported in Nigeria, Ghana, and Uganda can be explained by a better level of helmet use compared to Tanzania.[14,16]

This study showed that, the majority of motorcycle accident victims did not wear the helmet, the same findings has been observed by Vafaee-Najar et al in Iran in which 92% of motorcycle user did not wear helmet.[24,25] Study done by Heydari et al showed similar results in which 87.1% of motorcycle user who did not wearing helmet died of severe traumatic head injury.[18,26]

Limitation

This study failed to establish individual pattern of Diffuse Axonal Injury (DAI) due to logistical challenges in our mortuary to get the deceased body who died exactly within 2-24 hours, because in this study more than145 (85.3%) corps enrolled time interval before postmortem examination was more than 24hrs. Also storage of the body at constant temperature of 4 degree as the required condition for evaluation of DAI by immunohistochemistry is mandatory.[27,28] But setting in our mortuary did not favor this constant temperature of 4degree to establish DIA by Immunohistochemical stain as gold standard. Failure to establish the individual pattern of DAI did not affect any other morphological patterns obtained from this study.

Conclusion

The higher proportion of traumatic head injury among all medico-legal autopsies at MNH reflects the burden of head injury in our setting. Appropriate documentation of morphological patterns of traumatic brain injury enable us to improve on recording postmortem findings of TBI and the establishment of correct cause of death in our daily practice. This had medico-legal implications. Road traffic accidents (RTA) was the most common etiology of TBI and also a high number of motorcycle users who died of severe traumatic brain injury was not wearing helmets.

Acknowledgment

We would like to thank Muhimbili National Hospital(MNH) who gave permission to conduct this study at their hospital. Our sincere appreciation goes to Central Pathology Laboratory(CPL) histopathology unit and MNH Mortuary unit for providing us all cases of medical legal support and extreme support during data collection.

We would like to thank express sincere thanks to all staff of Histopathology Unit at MNH and MUHAS pathology department.

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How to cite this article: Ottoman O, Mwakigonja AR, Rambau PF. Morphological Patterns of Traumatic Head Injury in Medicolegal Autopsies at Muhimbili National Hospital, Dar ES Salaam Tanzania. Acad. Anat. Int. 2022;8(1):6-11.

DOI: dx.doi.org/10.21276/aanat.2022.8.1.2

Source of Support: Nil, **Conflict of Interest:** None declared.