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# Ocular Manifestations in Patients with Head Injury at a Tertiary Hospital in Dar es Salaam

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**Abstract**

***Background***

Head injury is a common presenting condition to most orthopedic and neurosurgical departments in the country. Head injuries are commonly associated with ocular adnexal and globe injuries, which can be visual threatening. Early recognition and intervention for ocular involvement can prevent devastating effects of visual disability and improve overall rehabilitations of affected patients. Currently in Tanzania, there is an increase in the use of motorcycles as a source of employment with a corresponding increase in road traffic accidents and head injuries. The aim of the study was to assess the ocular manifestations in patients with head injury.

***Methods***

This was a hospital based descriptive cross-sectional study among adult patients who were admitted at the neuro-surgery department at Muhimbili Orthopedic Institute between October 2019 and January 2020. We consecutively sampled and recruited 147 patients who had sustained head injury within one week. A short history was taken followed by a standard ophthalmological assessment to elicit different ocular manifestations. Data was analyzed using the Statistical Package for Social Sciences version 23 and presented as frequency tables. Chi squared test was used to compare differences between variables and a *p*-value of less than 0.05 was considered significant.

***Results***

A total of 177 patients with head injury were recruited for the study comprising of 147(82%) males. The age range was from 18 to 59 years with a median of 30 (26, 38) years. The commonest causes of head injury were road traffic accidents and assault which involved 117(70.1%) and 29(17.4%) patients, respectively. Ocular manifestations were found in 234 eyes of 117(70%) patients where more than 30% of patients had vision threatening ocular abnormalities. Eyelid ecchymosis and sub-conjunctiva hemorrhage were the commonest mild ocular manifestations. Severe vision threatening ocular manifestations included corneal epithelia defects, papilledema, pupillary abnormalities and orbital fractures.

***Conclusion***

Motor traffic accidents and assaults were the leading causes of head injury, where vision threatening ocular involvement is common. Concurrent evaluation and institution of appropriate management of these patients by an ophthalmologist is emphasized to avoid visual disability and improve overall rehabilitation of affected patients.

***Keywords:*** *Ocular manifestations, Head injury, Motor traffic accidents.*

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## Introduction

Head injury refers to any alteration in mental or physical functioning relating to a blow to the head with involvement of the brain including concussion, with loss of consciousness or post-traumatic amnesia, neurologic signs of brain injury or skull fractures (1). Head injuries are among the most common types of trauma encountered in emergency departments on daily basis (2). Road traffic accidents have been shown to be the commonest cause of head injuries(3). However, violence, construction accident, and sports are other causes of traumatic head injury(4).

The eye is frequently involved in head injury because of its proximity to the head as well as due to having neural connections with the brain (5), therefore ocular abnormalities are frequent manifestations of patients with head injuries. A number of potential visual impairing eye injuries occur in head injury but they may be missed during assessment of the patient in acute stage of trauma. However, early diagnosis and management of ocular conditions following head injury is essential to maximize the overall rehabilitation potential of patients with head injuries and prevent irreversible visual impairment.

Road traffic accidents are common in Tanzania where according to the World Health Organization, Tanzania ranked 9$^{th}$ country in position for road traffic accident in the world whereby 17820 deaths amounting to 4.78% of total deaths in 2017 were due to road traffic accidents (6). In Dar-es-Salaam, patients who sustain road traffic accidents are managed at the regional referral hospitals but those with head injury end up at Muhimbili Orthopedic (MOI) Unit which has a neurosurgery unit for managing such patients.

A previous study on ocular trauma in patients with head injury in this area was performed 10 years ago (7) and there is evidence that motor cycle traffic accidents have increased significantly with a corresponding increase in head injuries and presumably associated ocular injuries (8). However, the pattern of ocular manifestations in patients who sustain head injuries has not been studied. The aim of this study was to specifically determine the proportion and causes of and the type of ocular manifestations, in patients with head injuries admitted at MOI for planning purposes.

## Methods

### *Study design and site*

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This was a hospital based descriptive cross-sectional study which was conducted at the neuro-surgery department of MOI and adult eye clinic at Muhimbili National Hospital (MNH) from October 2019 to January 2020. MOI provides tertiary care in traumatology and neurosurgery. On average twenty patients with head injury are treated at MOI per month.

***Study population, sample size and sampling technique***

Patients who sustained head injury within a week and were admitted at the Neuro-surgery department of MOI during the study period were consecutively recruited. Patients with history of pre-existing ocular comorbidity who would falsely increase the proportion of ocular manifestation and those who presented after one week of injury were excluded.

***Data collection procedures***

Patients were seen in the ward within the first 24 hours of admission where we retrieved information on the demographic data, causes of injury and Glasgow coma scale (GCS) from the case notes. The GCS was based on eye opening, verbal and motor responses to stimuli of different intensity. The patients were then interviewed for ocular symptoms. The investigator re-visited patients who during the initial visit were deeply unconscious and could not respond to questions in order to take history within a week. Patients who remained unconscious for more than a week after the initial visit were excluded from the study. Ambulant patients were transported to the eye department at MNH for a comprehensive eye examination.

In the eye clinic, uncorrected and corrected (with pin hole) visual acuity was taken using Snellen's chart for the literate, while tumbling E and Landolt C charts were used for the illiterate patients. Pupillary examination was performed using a pen touch to assess direct, consensual, and relative afferent pupillary defect (RAPD) light reflexes. Ocular motility was tested using a mobile fixation target to determine any extra ocular motility disorder. This was then followed by assessment of the visual field using the confrontational test. Slit lamp examination was performed to assess for corneal epithelial defects, corneal haziness and laceration, presence of hyphema, iris tears and posterior synechia. Assessment of the lens was done to determine lens clarity, opacity, subluxation and dislocation. Posterior segment examination was done using 90D and/or 78D lenses on slit lamp, or with indirect ophthalmoscopy using +20D lenses after pupillary dilatation using tropicamide 1% eye drops

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to evaluate the fundi for vitreous hemorrhage, retinal hemorrhage or detachment, papilledema, disc hemorrhage and optic neuropathy.

Eleven bedridden patients could not be transferred to the eye clinic and were evaluated in the neurosurgery ward where visual acuity was assessed with a tumbling E and ocular examination was performed using a torch and indirect ophthalmoscopy. Visual acuity was not taken in all patients who were unconscious or confused. Computerized tomography and MRI images of all patients were reviewed and all findings were recorded on a structured questionnaire. In patients who presented with multiple ocular manifestation, the most severe manifestation causing visual impairment was recorded as the definitive diagnosis for example a patient with globe rupture will have other ocular manifestation like hyphema and vitreous hemorrhage. Globe rupture will be the definitive diagnosis. All patients found with ocular conditions were managed accordingly.

***Ethical consideration***

Ethical approval to carry out this study was obtained from the MUHAS Senate Research and Publications Committee on 19th August, 2019. Permission to conduct the study in MOI was obtained from the Executive Director of MOI on 7th October 2019. The study was explained to the patients or caretakers who signed a written consent after willingly agreeing to take part in the study. All patients found with ocular manifestations were managed appropriately. All data collected was treated with strict confidentiality.

***Data handling and statistical analysis***

All questionnaires were checked for completeness before transfer. Data was transferred from the hand-written data forms into a data spreadsheet for analysis, and then analyzed using the Statistical Package for Social Sciences (SPSS) (version 23,) IBM LTD, Carolina, USA. Data was presented as frequency tables; a Chi-squared test was used to compare differences between variables. Ocular manifestations were associated with severity of head injury using Glasgow coma scale (GCS), P values <0.05 were considered statistically significant.

**Results**

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A total of 174 patients sustained head injury and all were admitted at neuro-surgery department during the study period. Seven patients were excluded. One hundred and sixty-seven patients were recruited for the study and were all included in the analysis.

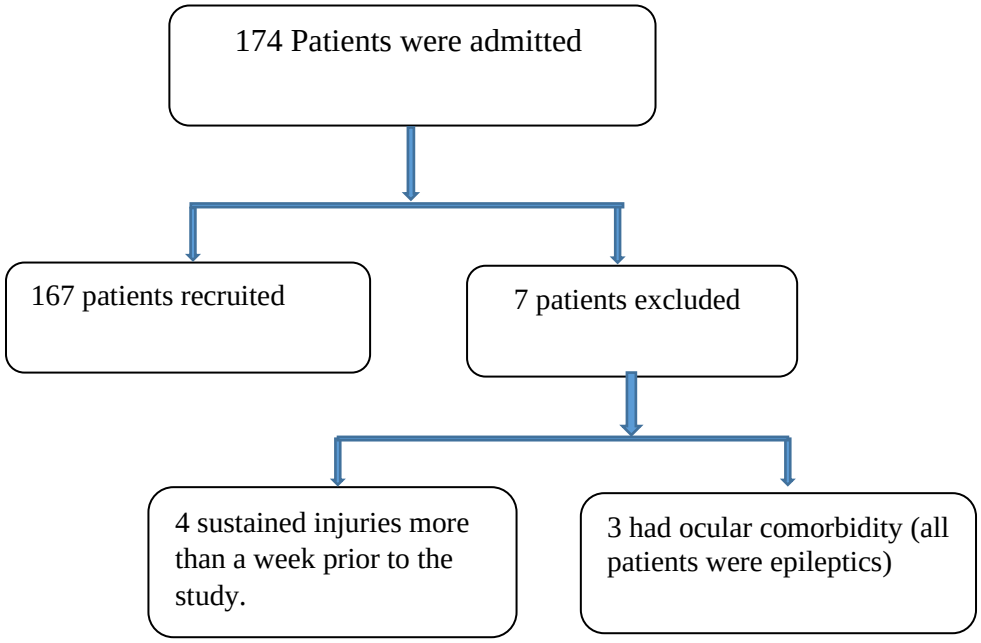


**Figure 1. Flow-chart of the study patients**

**Table 1: Demographic characteristics of study participants (n=167)**

| Characteristic | Category | Frequency | Percentage |
|---|---|---|---|
| Sex | | | |
| | Male | 137 | 82 |
| | Female | 30 | 18 |
| Age group (Years) | | | |
| | 18-27 | 54 | 32 |
| | 28-37 | 68 | 40 |
| | 38-47 | 38 | 22 |
| | 48+ | 7 | 4.2 |
| **Total** | | **167** | **100** |
| | Median (IQR) | 30 (26, 38) | |

The study population comprised of 137(82%) males. More than 72% of them were young adults between 18-37 years with a median (IQR) of 30(26, 38) (Table 1).

**Table 2: Ocular manifestations according to severity of head injury (n=167)**

| Severity of head injury | Presence of ocular manifestation | | Total |
|---|---|---|---|
| | Yes | No | |
| | n (%) | n (%) | n (%) |
| Mild | 90(70) | 39(30) | 129(100) |
| Moderate | 16(59) | 11(41) | 27(100) |
| Severe | 9(82) | 2(18) | 11(100) |
| **Total** | **115(70)** | **52(30)** | **167(100)** |

*Chi-square=2.07; p=0.35*

The proportion of ocular manifestations was higher (82%) in patients who had severe than those who had mild (70%) head injury. However, the difference was not statistically significant (P=0.35). (Table 2)

**Table 3: Proportion of patients with ocular manifestation by sex and age (n= 167)**

| Ocular manifestation | Sex, n (%) | | | Age group, n (%) | | | | |
|---|---|---|---|---|---|---|---|---|
| | Male n (%) | Female n (%) | Chi 2 (P-value) | 18-27 n (%) | 28-37 n (%) | 38-47 n (%) | 48+ n (%) | Chi 2 (P-value) |
| Yes | 96(70.1) | 21(70) | 0.001(0.994) | 43(79.6) | 45(66.2) | 24(63.2) | 2(28.6) | 3.716(0.294) |
| No | 41(29.9) | 9(30) | | 11(20.4) | 23(33.8) | 14(36.9) | 5(71.4) | |
| **Total** | **137(100)** | **30(100)** | | **54(100)** | **68(100)** | **38(100)** | **7(100)** | |

There were more males with ocular manifestations compared to females and this difference was statistically significant (p=0.001). However, there was no statistically significant difference (p=3.7) in the proportion of patients with ocular manifestations between the different age groups (Table 3).

**Table 4: Ocular manifestation by cause of head injury (n=167)**

| Cause of head injury | Presence of ocular manifestation | Total |
|---|---|---|

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| | Yes | No | |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| Motor Traffic Accidents | 87(74.3%) | 30(25.6%) | 117(100%) |
| Assault | 19(72%) | 10(28%) | 29(100%) |
| Fall from height | 6(54.5%) | 5 (45.5%) | 11(100%) |
| Domestic accident | 3(33.3%) | 6(66.7%) | 9(100%) |
| Others(sports) | **0(0)** | **1(100%)** | 1(100%) |
| **Total** | **115 (69%)** | **52(31%)** | **167(100%)** |

*Fisher's Exact p=0.025*

The leading cause of head injury was Motor traffic accidents. Most (74.3%) patients who sustained head injury due to motor traffic accidents presented with ocular manifestations. This association was statistically significant at P= 0.02. (Table 4).

**Table 5: Ocular manifestation in patients with head injury (n=229 eyes)**

| Ocular diagnosis | No (%) |
|---|---|
| **Ocular adnexa** | |
| Lid Ecchymosis | 51 (22.3) |
| Lid laceration | 13 (5.6 |
| Chemosis | 20 (8.7) |
| Sub-conjunctival hemorrhage | 44 (19.2) |
| **Anterior segment** | |
| Corneal Epithelial defect | 18 (7.8) |
| Scleral laceration | 2 (0.9) |
| **Posterior segment** | |
| Vitreous hemorrhage | 4 (1.7) |
| Retinal hemorrhage | 9 (3.9) |
| Commotio retinae | 3 (1.3) |
| **Neuro-ophthalmic** | |
| Pupillary abnormalities | 31 (13.5) |
| Papilloedema | 12 (5.2) |
| Optic neuropathy | 6 (2.6) |
| 3rd nerve palsy | 3 (1.3 |
| 6th nerve palsy | 2 (0.99 |

| | |
|---|---|
| **Others** | |
| Orbital fractures | 13 (5.7 |
| Globe rupture | 3 (1.3) |
| **Total** | **229 (100%)** |

A total of 117 (70%) patients with 229 eyes presented with ocular manifestations. Bilateral ocular manifestations occurred in 112 patients while five patients were affected in one eye only. The commonest manifestations were eye lid ecchymosis (22.3%), sub-conjunctival hemorrhage (19.2%), pupillary abnormalities (13.5%), corneal epithelial defects including traumatic corneal abrasions and ulcer (7.8%) and papilledema (5.2%) of affected eyes. Three eyes (1.3%) of two patients had globe rupture. Other serious and/or visually impairing ocular manifestations that required immediate intervention by an ophthalmologist included: eyelid laceration 13(5.6%), scleral laceration 2(0.9%), commotion retinae 3(1.3%) (Table 5).

**Discussion**

This study assessed the proportion and causes of ocular manifestations occurring in head injury patients at MOI. The main focus was to determine whether there were visual threatening ocular manifestations that needed immediate care by an ophthalmologist to ensure appropriate care is provided, to maximize the overall rehabilitation potential of patients with head injuries and prevent irreversible visual impairment.

The proportion of ocular manifestations reported among patients with head injury differs from country to country as well as on the causes of injury ranging from 25% in Nigeria (9), 70% in Kenya (10) and 83.5% in India (3). In this study 117 (70%) patients had ocular manifestations. This proportion is higher than in the previous study in Tanzania by Stanlaus et al which showed that 65% of patients were affected (7). Additionally, our study showed that although ocular manifestations occurred in all causes of head injury, the highest frequency was seen in motor traffic accidents (74.2%) followed by assault (72%). The eye was involved either because of direct trauma to its structures or indirectly through injury to the ocular adnexae.

In this study motor traffic accidents were the most frequent cause of head injury at 70%, and were responsible for the greater proportion of head injuries associated with ocular manifestations. Reports from literature indicate that road traffic accidents constitutes the

leading cause of head injuries as shown in studies by Odebode (9), Masila (10) and Kulkarni (3). In Tanzania, motorized transportation has been on increase in recent years without a corresponding increase in road infrastructures and this has led to the increase in road traffic accidents. Higher numbers of motor vehicle accidents may also be due to unlicensed, reckless driving that is often treated with laxity by some law enforcers. Poor compliance to safety rules and riding motorcycles without formal training were identified as the commonest causes of motorcycle accidents in Morogoro region, in Tanzania in a study by Museru et all (11). The increase in motor-traffic accidents has therefore increased the proportion of ocular manifestations in patients with head injury. The importance of reducing these accidents cannot be over-emphasized.

In this study eye lid ecchymosis and sub-conjunctival hemorrhage were the commonest findings seen in the ocular adnexae. Lid ecchymosis occurred in 22%, which is comparable to 22%–27% in other studies (3,9). Lid ecchymosis is common due to the fact the eyelids are exposed to trauma. Eyelid ecchymosis is produced by blood tracking into periorbital tissues, which is a frequent presentation following traumatic injuries to the head and neck, including basal skull fractures, soft tissue injuries and facial fractures, which occurs due to the contusion and stretching of capillaries (12). Moreover, findings from this study indicate that sixteen patients had corneal epithelial defects, while two had scleral laceration. The finding that corneal epithelial defect occurred frequently indicates the need for early ophthalmological review and immediate institution of therapy in affected patients. This is because if infected a corneal epithelial defect could end up with corneal ulcer that can either heal with a scar or perforation if not treated in time, with subsequent visual impairment or loss of the eye. The commonest posterior segment manifestations included vitreo-retinal hemorrhage which is of grave consequences.

Among the neuro-ophthalmic features, pupillary abnormalities were the commonest observation at 12%. The eye and its adnexa are innervated by half of the cranial nerves, and 38% of all fibers in the central nervous system are concerned with visual function, so clinical findings of neuro-ophthalmological interest are frequently noted in head injury (9). Pupillary signs including size and reaction to light are of grave importance in indicating the site and severity of injury and in the prognosis of head injury. Pupillary manifestations could also indicate optic neuropathy that could slowly progress to optic atrophy and visual impairment.

The six eyes found with optic neuropathy in the acute phase of injury indicated the possibility of a pre-existing optic neuropathy which is a common condition in young patients in Dar es Salaam (13). On the other hand, it is possible that these patients were in early stages of traumatic optic neuropathy. It is important to ascertain and manage optic neuropathy in time to prevent progression to optic atrophy which presents with irreversible visual impairment. An early ophthalmological review is therefore recommended for patients who have head injury. Often times, patients who did not show obvious ocular injury during the acute phase, are discharged through the eye clinic for ocular evaluation after management of head injury, which could be a late intervention and could lead to visual impairment.

The study showed five patients who presented with traumatic ocular motor abnormalities. Three eyes had 3$^{rd}$ cranial nerves palsy while two had 6$^{th}$ nerve palsy. Third cranial nerve was the commonest nerve involved in the study by Van Stavern et al (5). Our study reports a lower incidence of ocular motor nerve involvement compared to a study by Sharma et all who reported 11.6% ocular motor involvement (14) in India. Oculomotor nerve palsy following head injury is a worrying neurological sign and is often associated with an expanding space occupying lesion, such as extradural or acute subdural haematomas (15). Even when there is no space occupying lesion, occulomotor palsy is often considered as a devastating prognostic factor in the context of diffuse axonal injury (16).
Orbital fractures were seen in 13 eyes (3.8%), globe rupture in three eyes (0.8%). All the three eyes which sustained globe rupture underwent evisceration due sustaining extensive damages. Such severe ocular manifestations with potential for visual loss or loss of the eye like globe rupture and vitreous hemorrhage occurred mainly in severe head injuries mainly due to motor traffic accidents.

This study has shown a significant number (82%) of the head injuries occurred in males. Similar findings were reported by Kulkarni (3) and Pelletier (17) who reported head injuries in 97%, and 81% males, respectively. The higher number of males in the current study relate to the various outdoor activities that predispose males to head injuries. More males operate motor vehicles and motorcycles than females and thus are more vulnerable to motor traffic accidents. However, in the previous study in Tanzania by Stanslaus et al, there was no difference in the proportion of head injuries associated with ocular trauma between gender (64.4% male and 69% female) (7). The increase in the use of motorcycles as an opportunity

for employment by younger men has resulted in a corresponding increase in motor traffic accidents that cause head injury associated with ocular involvement.

The commonest affected age group in this study was between 28-37 years. Other studies also showed similar finding. Kulkarni (3) found young adult males (21–30 years) to be more vulnerable to head injury. Odebode et al (9) showed 21–30 years as peak group for head injuries while Sharma et al. reported a peak during 21–40 years **(**14). The vulnerability of this young age to head injuries is due to involvement of young males in risky occupations including motor-cycle riding, building and construction where falls from the height is common. Young males may also be involved in fights and assaults in different circumstances.

**Conclusion**

The proportion of ocular manifestations among patients with head injury at MOI is high. They commonly occur in younger males who have sustained severe head injury and have comparatively increased by 5% in the past 10 years. Motor traffic accidents and assaults are the leading causes of both head injury and ocular manifestations. Eyelid ecchymosis and sub-conjunctiva hemorrhage were the commonest mild ocular manifestations. Severe visual threatening ocular manifestations constituted globe rupture, vitreous hemorrhage, corneal epithelia defects, papilledema, pupillary abnormalities and orbital fractures. Efforts are required to ensure that these patients are examined for eye injuries by an ophthalmologist for early detection and institute early and appropriate therapy in order to avoid consequent visual impairment.

**Ethics approval and consent to participate**

The aim of this study was clearly explained to all patients or guardians of the participants involved. They were informed that there were no risks involved, and patients would be managed for the identified ocular manifestation. Confidentiality was maintained throughout the study and collected information was used only for research purposes. Ethical approval to conduct the study was obtained from the MUHAS Senate Research and Publications Committee. Permission to conduct this study at the selected facility was granted by the Managing director of the facility. The written consent from a patient or guardian was sought before enrolling participants.

**Competing interests**

The authors declare that they have no competing interests.

**Authors' contributions**

RKM participated in conception, research design, data collection and data analysis. MMM, JK, SM participated in research design, data analysis and interpretation, and drafting the manuscript, CM contributed in revising the manuscript. All authors read and approved the final manuscript.

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**Availability of data and materials**

The datasets used and analyzed during the current study is available from the corresponding author on a reasonable request.

**Funding**

Not applicable

**Abbreviations**

| | |
|---|---|
| GCS | Glasgow coma scale |
| MUHAS | Muhimbili University of Health and Allied Sciences |
| MNH | Muhimbili National Hospital |
| MOI | Muhimbili Orthopedic Institute |

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