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Study of Ophthalmic Injuries Encountered Following RTA in Rural vs Urban Tertiary Care Centre

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ABSTRACT

To investigate the demographic and clinical differences in ophthalmic injuries encountered from road traffic accidents (RTAs) between urban and rural tertiary care settings. The study was aimed to compare ocular manifestations in patients after RTAs in rural versus urban tertiary care centers, focusing on demographic profiles and causes of head injuries. This prospective observational study analyzed 100 patients with closed head injuries admitted to urban and rural tertiary care centers over an 18-month period. Patients were divided into urban (n = 53) and rural (n = 47) groups based on the location of the incident. Data collected included demographic information, cause of injury (RTA, fall, assault), ocular and neuro-ophthalmic manifestations, CT findings and visual acuity outcomes. Statistical analysis was performed to compare the incidence and types of injuries between the two settings. The study found that RTAs were the leading cause of head injuries, more prevalent in urban (50 cases) than rural areas (36 cases). Urban settings saw a higher rate of ocular injuries, while severe head injuries and their impacts, including visual acuity loss and were common across both environments. CT findings indicated orbital fractures were frequent in urban areas, but critical conditions like hematomas and cerebral edema were evenly observed in both settings. Urban and rural settings differ in the incidence and types of RTA-related head injuries, with urban areas experiencing more ocular trauma. Nonetheless, the presence of severe injuries in both contexts calls for improved trauma care and prevention strategies tailored to the distinct needs of these populations.

INTRODUCTION

The significance of the eyes far exceeds their relatively small physical proportion to the body, comprising only 0.1% of the total body surface area and 0.27% of the front body surface. Despite this, the impact of eye injuries, especially as secondary consequences of head trauma, on individual and societal health is profound. The eyes are the third most commonly injured organ and the prevalence of blindness due to ocular injuries from head trauma represents a significant health challenge. Often, the immediate concerns of head injuries on other vital organs overshadow the potential damage to the visual system, leading to its neglect[1]. The drive towards industrialization and the increase in fast modes of transport have escalated the incidence of head injuries, which not only affect the individual by potentially impairing intellectual and cognitive functions and causing vision problems but also impose a heavy burden on families and society. These injuries predominantly affect the young and productive segment of the population, who are more susceptible to road traffic accidents[2].

In the context of modern road transportation, head injuries are alarmingly common, occurring every 15 seconds, with fatalities every 12 minutes. Over half of all trauma-related deaths involve head injuries, with nearly 60% of deaths in vehicular accidents attributed to them[3]. The importance of correlating clinical findings, including ophthalmic assessments, is crucial for the early localization of injury sites, continuous evaluation and management, as well as for predicting outcomes for patients with head trauma[4]. Annually, head injuries result in the hospitalization of 200-300 individuals per 100,000 population, with about 25% presenting ocular and visual impairments[5]. The significant role of ocular injuries from trauma in causing blindness underscores the need for thorough eye examinations in neurological evaluations of head injury patients, primarily to assess the severity of the head trauma[6]. The complex mechanisms behind the ocular manifestations of head trauma remain not fully understood, leading to various theories to explain these conditions.

The eye's frequent involvement in head trauma can be attributed to its close proximity to the head and the neural connections between the eye and the brain. In cases of non-penetrating or closed head injuries, displacement, stretching and shearing forces can damage brain areas related to vision[7]. Additionally, eye movement disorders may arise from direct trauma to the orbital contents, cranial nerves and other brain structures. The study aims to compare ocular manifestations in patients after RTAs in rural versus urban tertiary care centers, focusing on demographic profiles and causes of head injuries.

MATERIALS AND METHODS

A prospective, observational study was conducted on patients with closed head injuries resulting from RTAs, referred to the Department of Ophthalmology at two sites, one rural Kamineni Institute Of Medical Sciences, Narketpally and one urban tertiary care center Sarojini Devi Eye Hospital, over a period of 6 months. A total of 200 patients (100 from each setting) were selected consecutively as they presented, adhering to the following inclusion and exclusion criteria.

Inclusion Criteria:

- All patients presenting with closed head injuries following RTAs were included

Exclusion Criteria:

- Patients with ocular manifestations due to tumors or other pathologies precipitated by head injuries were excluded

Method of Data Collection: Consent Process: Informed consent was obtained from patients or guardians (if the patient was unconscious or a minor).

Demographic and Injury Data: The demographic information and detailed history regarding the injury and its cause were collected. Medico-Legal Case (MLC) registration was completed as necessary.

Clinical Examination: Included assessment of visual acuity (with and without correction, bedside for bedridden patients and in the ophthalmology outpatient department for ambulatory patients), pupillary examination, ocular alignment, extraocular movements (ductions, versions, convergence, saccades and pursuits), anterior segment examination (using a bright flashlight or slit lamp) and posterior segment examination (using direct and indirect ophthalmoscope). Intra ocular pressure was measured with Schiotz indentation tintometer or Goldmann's applanation tonometer as required. Diplopia charting, forced duction and generation tests were conducted for indicated cases. Gonioscopy and radiological investigations were ordered as necessary.

Urban vs. Rural Considerations:

- **Recruitment:** Efforts were made to ensure that the study population accurately represented the demographics of RTA victims in both rural and urban settings.
- **Data Collection:** Special attention was given to the accessibility of care, time to presentation after

injury, and differences in the cause of injuries (e.g., high-speed vs. low-speed collisions, pedestrian accidents)

- **Analysis:** The data were analyzed to identify disparities in ocular injury types, severity, outcomes and access to care between rural and urban centers

Statistical Analysis: Data were statistically analyzed to compare the frequency, nature and outcomes of ocular manifestations following RTAs in rural versus urban settings. Descriptive statistics, chi-square tests for categorical data and t-tests or ANOVA for continuous variables were used to assess differences between groups. $P<0.05$ was considered to be significant.

RESULTS AND DISCUSSIONS

The (Table 1) reflects the sex distribution of 100 patients with closed head injuries following road traffic accidents (RTAs), now with a modified division between urban (53 cases) and rural (47 cases) tertiary care settings. In the urban setting, there were 45 male patients and 8 female patients. In contrast, the rural setting had 42 male patients and 5 female patients. This distribution still shows a majority of cases being male (87 out of 100), indicating a higher prevalence of RTA-related head injuries among males compared to females (13 out of 100), across both urban and rural areas. (Table 2) reveals the age distribution of 100 head injury cases from RTAs, showing a concentration in younger to middle-aged adults, particularly those aged 30-39 in urban areas and similarly aged groups in rural settings, indicating a higher risk associated with their active lifestyle and mobility. Both urban and rural areas show a broader age impact, but with fewer injuries in children under 10 and older adults above 60, suggesting lower exposure to RTA risk factors in these age groups.

(Table 3) outlines the causes of 100 head injury cases, showing a higher incidence of road traffic accidents (RTAs) in urban areas (50 cases) due to more traffic and potential risks, compared to 36 cases in rural settings. Falls from height were more common in rural areas (5 cases), likely reflecting regional occupational hazards, while assault cases were evenly distributed between urban and rural areas (3 cases each). This distribution (56 urban, 44 rural) underscores RTAs as a primary cause of head injuries in urban environments, whereas rural areas show a more varied cause profile, including falls and assaults. (Table 4) shows the distribution of ocular adnexae injuries across urban and rural settings, revealing a trend towards more incidents in urban areas. Ecchymosis, lid lacerations (Fig. 1) and periorbital edema were more prevalent in urban environments, likely due to the increased risk of traffic accidents and interpersonal violence. Meanwhile, proptosis and ptosis had low occurrences and were evenly split between settings, suggesting these types of injuries are less common and not heavily influenced by location. Despite the urban prevalence, the data also indicate significant ocular trauma risks in rural areas, highlighting the need for effective eye injury prevention and care strategies across all regions.

(Table 5) shows a higher occurrence of anterior segment eye injuries in urban (33 cases) compared to rural areas (25 cases), with subconjunctival hemorrhage (Fig. 2) being the most common across both settings. Urban areas saw more cases of chemosis and scleral perforation, suggesting a higher rate of accidents or activities leading to these injuries. Other conditions like exposure keratopathy, traumatic uveitis and lens subluxation were evenly distributed, indicating a universal risk across environments. The unique reporting of a sphincter tear in a rural setting hints at specific regional risks. This distribution underscores the universal need for accessible eye care to manage ocular trauma effectively in any setting. (Table 6) shows the distribution of posterior segment eye injuries, revealing a slightly higher incidence in urban (5 cases) compared to rural settings (3 cases). Urban areas reported more cases of Berlin's Edema and exclusive instances of papilledema and subretinal hemorrhage, likely due to the nature of urban accidents and better diagnostic capabilities. Conversely, the rare Purtscher retinopathy was identified in a rural case, possibly related to specific

Fig. 1: Showing full thickness lid laceration of right eye with peri orbital edema and ecchymosis

Fig.2: Showing Right eye Sub-conjunctival hemorrhage with sutured lower lid laceration

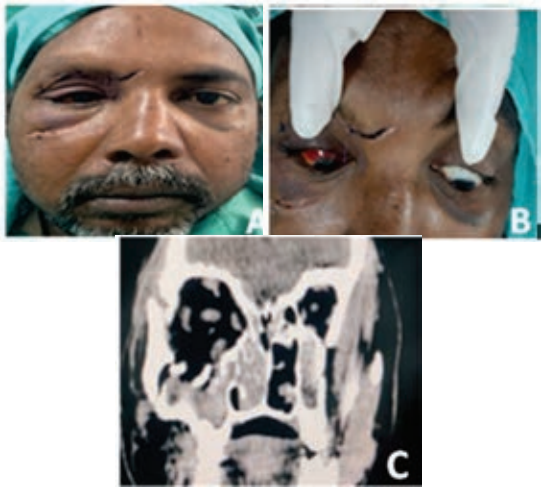

Fig. 2: (A) Right eye Enophtaimos with sub conjuctival hemorrhage and Ecchynosis with sutured lid laceration, (B) limitations of Right eye depression on downgaze, (C) CT orbit of the same patient with fracture of the right eye orbital floor and lateral wall

Table 1: Sex Distribution in Urban and Rural Settings

Setting	Sex	Number of Cases
Urban	Male	45
	Female	8
Rural	Male	42
	Female	5
Total	Urban	53
	Rural	47

Table 2: Age Distribution in Urban and Rural Settings

Age Group	Urban Cases	Rural Cases	Total Cases
<10	4	3	7
10-19	6	5	11
20-29	12	12	24
30-39	15	14	29
40-49	8	7	15
50-59	5	4	9
60-69	3	2	5
Total	53	47	100

Table 3: Causes of Head Injury in Urban and Rural Settings

Cause of Head Injury	Urban Cases	Rural Cases	Total Cases
RTA	50	36	86
Fall from Height	3	5	8
Assault	3	3	6
Total	56	44	100

Table 4: Trauma to Ocular Adnexae in Urban and Rural Settings

Type of Injury	Urban Cases	Rural Cases	Total Cases
Ecchymosis	30	23	53
Lid Laceration	12	8	20
Periorbital Edema	24	18	42
Proptosis	1	1	2
Ptosis	2	2	4

Table 5: Anterior Segment Manifestations in Urban and Rural Settings

Type of Injury	Urban Cases	Rural Cases	Total Cases
Subconjunctival Hemorrhage	22	17	39
Chemosis	6	4	10
Exposure Keratopathy	1	1	2
Scleral Perforation	2	1	3
Traumatic Uveitis	1	1	2
Subluxation of Lens	1	0	1
Sphincter Tear	0	1	1
Total	33	25	58

Table 6: Posterior Segment Manifestations in Urban and Rural Settings

Type of Injury	Urban Cases	Rural Cases	Total Cases
Berlin's Edema	2	1	3
Vitreous Hemorrhage	1	1	2
Papilledema	1	0	1
Purtscher Retinopathy	0	1	1
Subretinal Hemorrhage	1	0	1
Total	5	3	8

Table 7: Neuro-Ophthalmic Manifestations in Urban and Rural Settings

Type of Injury	Urban Cases	Rural Cases	Total Cases
III Nerve Palsy	2	1	3
Traumatic Optic Neuropathy	3	1	4
VI Nerve Palsy	1	0	1
VI Nerve Palsy + VII Nerve Palsy	0	1	1
III, IV, VI, VII Nerves Involved	1	0	1
Total	7	3	10

Table 8: CT Findings in Urban and Rural Settings

CT Finding	Urban Cases	Rural Cases	Total Cases
Orbital Fractures	8	6	14
Extradural Hematoma	2	1	3
Subdural Hematoma	1	1	2
Cerebral Edema	1	1	2
Total	12	9	21

Table 9: Visual Acuity in Urban and Rural Settings

Visual Acuity Status	Urban Cases	Rural Cases	Total Cases
Vision greater than 6/60	42	35	77
Vision less than 6/60	6	5	11
Vision could not be recorded (due to altered sensorium)	7	5	12
Total	55	45	100

rural activities or accidents. The data suggests urban environments might see more posterior segment injuries due to varied trauma types, but severe conditions in rural areas emphasize the need for specialized ocular trauma care across all regions.

(Table 7) highlights the division of neuro-ophthalmic manifestations post-head injuries between urban and rural areas. Urban settings saw a higher incidence of conditions like III nerve palsy and traumatic optic neuropathy, likely reflecting the increased frequency or severity of incidents, including traffic accidents. Conversely, rural areas reported a case of combined VI and VII nerve palsy, underscoring that severe injuries also occur in less urbanized regions, possibly due to activities unique to these areas, such as agricultural work. The documentation of multiple nerve involvement in an urban case points to the significant trauma associated with dense traffic or

high-risk urban activities. With a distribution of 7 urban to 3 rural cases, the findings underscore the necessity for readily available, specialized neuro-ophthalmic and trauma care across both settings, highlighting the complex nature of these injuries and the critical need for targeted medical response irrespective of geographical location. (Table 8) illustrates the CT findings in head injury patients across urban and rural settings. Orbital fractures (Fig 1a-c) were the most frequent finding, more prevalent in urban areas, possibly due to the increased risk of accidents and violence in these densely populated regions. Extradural hematomas were notably more common in urban cases, reflecting the specific nature of urban accidents. Meanwhile, subdural hematomas and cerebral edema were distributed evenly, suggesting that severe traumas requiring CT scans are a concern in both settings. This distribution highlights the necessity for accessible CT imaging and comprehensive trauma care in all healthcare facilities, emphasizing the ubiquity of serious head injuries and the critical need for efficient diagnostic and treatment capabilities regardless of location.

The visual acuity findings from head injury patients indicate that the majority, in both urban (42 cases) and rural (35 cases) settings, maintained vision greater than 6/60, suggesting generally favorable outcomes. Urban areas reported slightly more cases of severe visual impairment (vision less than 6/60) and instances where vision couldn't be recorded due to altered sensorium, hinting at more complex traumas or better diagnostic capabilities. Despite some differences, the overall trend shows that a significant number of patients across both settings preserve good vision post-injury, emphasizing the importance of accessible and thorough trauma and eye care services everywhere.

Our study focused on examining various ocular manifestations observed in patients with closed head injuries, finding that road traffic accidents (RTAs) were the predominant cause of head injuries associated with ocular complications[8]. This finding aligns with global research, including studies by Kulkarni *et al*. Odebode *et al*. and Masila *et al*. which also identified RTAs as the leading cause of head injuries[3,4]. The increase in motorized transportation in recent years, especially in developing countries like India, has led to a higher risk of automobile accidents. Such accidents significantly impact the young, working-age population, contributing to physical disabilities. The study revealed notable differences in the distribution of head injuries and associated ocular conditions between urban and rural settings, which is in accordance with earlier study[9]. The majority of injuries were attributed to road traffic accidents (RTAs), with a higher prevalence of male victims in both settings. Urban areas saw a slightly higher incidence of ocular and neuro-ophthalmic injuries, which could reflect the increased traffic and potential for high-velocity accidents. In contrast, rural settings, while having fewer cases overall, still presented a significant share of severe injuries, indicating that the nature and impact of trauma may differ rather than the sheer frequency[10].

The predominance of RTAs as a cause of head injuries aligns with global trends, where RTAs are cited as a leading cause of trauma-related hospital admissions (World Health Organization, 2018). The gender disparity observed, with males being more affected, is consistent with literature suggesting that males are at higher risk for engaging in high-risk behaviors leading to accidents[3,4]. The findings on ocular injuries, specifically the higher rates of orbital fractures and anterior segment manifestations in urban areas, could be correlated with studies indicating that urban environments, due to denser traffic and faster-moving vehicles, are associated with more severe trauma cases[11]. Rural settings, while having a lower incidence of such injuries, demonstrated a significant presence of serious conditions like Purtscher retinopathy, which has been less documented in the literature, suggesting a gap in the understanding of rural trauma dynamics[12]. The division of neuro-ophthalmic manifestations, with a higher occurrence in urban areas, might reflect the immediate availability of diagnostic tools in these settings, as well as the different mechanisms of injury prevalent in urban versus rural areas. This is supported by literature emphasizing the importance of rapid assessment and imaging in diagnosing such conditions [13].

CONCLUSION

The study underscores the need for targeted injury prevention strategies that consider the unique environmental and societal factors at play in urban and rural areas. Additionally, the significant number of cases with vision impairment post-injury highlights the critical need for integrating ophthalmologic care into trauma response protocols, particularly in urban settings where the severity of ocular injuries may be greater. To conclude, study's findings contribute valuable insights into the epidemiology of head injuries and their ocular complications, with clear distinctions observed between urban and rural settings. These results call for a nuanced approach to trauma care and prevention, tailored to the specific needs and contexts of different populations.

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