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Animal and bird-related ocular trauma: a decade of experience from a tertiary referral eye hospital of Iran

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Abstract

Background This study aimed to explore ocular and periocular injuries resulting from animal and bird attacks among patients referred to a tertiary referral eye hospital of Iran over ten years (2014–2024).

Methods In this retrospective analysis, we collected data on patient demographics, the species of the attacking animal and bird, the nature of the ocular and periocular injuries, details of ophthalmological examinations, therapeutic interventions, and surgical treatments.

Results One hundred and twenty-nine patients, with an average age of 36 ± 23 years (range: 1–77 years), were included in this study, of whom 81 were male. Among these patients, 70 (54.3%) experienced open globe injuries, and seven were diagnosed with endophthalmitis during their hospital stay. Specifically, of the 60 injuries caused by birds, 47 patients (78.3%) experienced open globe injuries, whereas this rate was 21 out of 66 (31.8%) for injuries caused by quadrupeds (P-value ≤ 0.001). Rural patients had a significantly longer time interval from trauma occurrence to hospital admission (83.58 ± 31.46 h in the rural group vs. 29.85 ± 6.48 h in the urban group, P-value = 0.012) and from hospital admission to the first surgical intervention (8.8 ± 1.14 h in the rural group vs. 6.83 ± 6.13 h in the urban group, P-value = 0.020). Additionally, final visual acuity was significantly better in urban patients than in rural patients.

Conclusions Animal and bird-related ocular trauma in Iran predominantly involves injuries caused by birds, with rural patients experiencing worse visual outcomes and delayed referral.

Keywords Trauma, Animal, Ophthalmology, Endophthalmitis, Bird

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Background

Ocular trauma is a leading cause of preventable blindness globally, and animal and bird-related injuries pose an increasing public health concern worldwide [1, 2]. Human-animal and bird interactions occur in diverse contexts, often with underestimated associated hazards. Moreover, a noteworthy proportion of animal and bird-inflicted injuries remain underreported. Notably, ocular trauma resulting from animal and bird-related incidents usually culminates in severe outcomes such as visual impairment, blindness, and ocular deformities. The classification of animal and bird-related ocular injuries hinges on geographic prevalence, animal and bird species, behavior, and community accessibility [1, 2].

The majority of eye injuries occur in developing countries [3]. Based on a comprehensive literature review and previous studies, it is evident that young children are at a heightened risk of experiencing ocular injuries [4]. Bovines and canines, the most prevalent domesticated animals globally, are the primary instigators of animal-related injuries in numerous nations [5, 6]. Furthermore, the geographic distribution and human-animal and bird interface significantly influence the epidemiology of such traumas. For instance, research indicates a higher incidence of injuries caused by bovine encounters in rural regions of India [7]. Eye injuries from camel attacks are prevalent in Saudi Arabia, where camels are the most common domesticated animals, accounting for 77% of all animal and bird-related injuries [8].

Different patterns of interactions between animals, birds, and humans exist, depending on the age of the individuals involved. For instance, children are more susceptible to being bitten by dogs [5, 9]. This could be due to children's natural curiosity about their surroundings, leading them to interact more with animals and birds unconsciously. An American study revealed that almost 50% of children have experienced a dog attack during their childhood [10]. Frequently, injuries to the eyes caused by animals and birds are both intricate and serious. Occasionally, instances of bilateral eye damage resulting from animal and bird assaults have been documented [11, 12].

In response to the growing interaction between humans, animals, and birds, as well as the documented instances of animal and bird-related trauma in Iran, we conducted a comprehensive retrospective study. Our focus was on examining the clinical and demographic features of patients who experienced ocular and periocular injuries due to various animals and birds.

Methods

Study design and participants

This study is a descriptive retrospective analysis that includes all patients who reported ocular and periocular traumas resulting from animal and bird attacks between April 2014 and April 2024. Data on these patients was retrieved from the hospital information system (HIS). The primary eye examinations included a comprehensive ophthalmic assessment, encompassing uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA), anterior segment slit lamp microscopy, and fundoscopy. All visual acuities (VA) were measured in Snellen fraction and then converted to LogMAR. Following established protocols, visual acuities were converted to the LogMAR scale as follows: Count Fingers (CF) at 1 m (1.8), CF at 0.3 m (2.3), hand motion (2.6), light perception (2.9), and no light perception (3.1) [13]. Although some studies suggest that LP and NLP are not standard visual acuity measurements but rather indicators of stimulus detection, their inclusion in the analysis was considered essential to capture the full spectrum of ocular trauma severity. To address potential bias and align with standard practices, however, a secondary analysis was performed, excluding patients with LP and NLP [14].

The following data was gathered from patients who reported animal and birds attacks in the ocular and periocular regions: demographic details, type of attacking animal and bird, results of ophthalmological examinations, initial diagnosis (open vs. closed globe injury), the occurrence of endophthalmitis, any systemic disorders, history of other ocular diseases, pretreatment and posttreatment ocular examination details, details of any surgeries performed, the time elapsed between trauma occurrence and hospital admission, the time between hospital admission and the first surgical intervention, and visual outcomes at the time of discharge. The zone of injury in the open globe injuries was also recorded based on the Ocular Trauma Classification (zone I limited to the cornea and limbus, zone II affecting the anterior 5 mm of the sclera without reaching the retina, and zone III involving full-thickness scleral lacerations more than 5 mm behind the limbus) [15]. The Ocular Trauma Score (OTS) was determined for every patient based on their initial visual acuity and certain clinical factors, such as globe rupture, endophthalmitis, perforating injury, retinal detachment, and relative afferent pupillary deficit [16]. Any missing information was acquired through communication with the patients or their companions.

Treatment methods

In patients with closed-globe injuries, treatment was selected based on the initial diagnosis made by ophthalmologists in the emergency room. If there was a need for oculoplastic service consultation (involving lacrimal canaliculi, extensive eyelid injuries, etc.), treatment was conducted under the supervision of the oculoplastic service. In some cases, treatments were administered on an outpatient basis as appropriate. For all cases of

penetrating injury, primary repair was performed. If there was an anterior capsular rupture with released lens material into the anterior chamber, a lensectomy (Lensx) was performed concurrently with the initial surgical intervention. Upon detection of a posterior capsular rupture during surgery, an immediate anterior vitrectomy was conducted. A pars plana vitrectomy (PPvitx) was consistently performed as a secondary procedure when indicated, except for patients with endophthalmitis. All patients with open globe injuries were admitted and started on intravenous ceftazidime and vancomycin or oral ciprofloxacin, as per the treating physician's discretion. In patients with endophthalmitis, in addition to intravenous ceftazidime and vancomycin, intravitreal injections of the same antibiotics were administered during PPvitx. Fortified antibiotics (ceftazidime and vancomycin) were prescribed only after primary repair in patients where endophthalmitis subsequently developed.

Ethical consideration

All patients provided written informed consent to contribute their data to the database. To ensure privacy and confidentiality, patient identifiers were excluded and replaced with codes. The data were accessible solely to the researcher or the data collectors. The study was approved by the local ethics committee of the Tehran University of Medical Sciences in accordance with the ethical principles of the Helsinki Declaration (IR.TUMS.FARABIH.REC.1402.038).

Statistical analysis

We assessed the normal distribution of data using the Kolmogorov-Smirnov test and Q-Q plot. Descriptive statistics are presented as mean, standard deviation, median, and range. To compare results between the two groups, we employed the t-test, Mann-Whitney test, chi-square test, and Fisher's exact test. Pearson's correlation coefficient (r) was used to measure the statistical association between variables. Baseline adjustment was evaluated using analysis of covariance. All statistical analyses were conducted using SPSS software version 26 (SPSS Inc., version 26.0, Chicago, IL, USA). P-values less than 0.05 were considered statistically significant. All P-values are reported as two-sided.

Results

Our study included 129 patients with a mean age of 36±23 years (range 1–77 years), of whom 81 (62.8%) were male. Approximately 52% of patients experienced injuries to the right eye (OD), while 48% had injuries to the left eye (OS). In terms of systemic disease history, the majority of individuals (83.7%) had no history of systemic diseases. A history of eye disease was noted in 13 patients (10.1%), and 51.2% of the patients were from rural areas (Table 1).

The mean length of hospital stay for patients was 2.1±1.7 days, ranging from 0 to 8 days. Upon admission, patients had a BCVA of 1.29±1.19 LogMAR (range 0 to 3.1), which increased to 2.06±1.10 LogMAR (range 0 to 3.1) by the day of discharge. The mean time from trauma to hospital admission was 3.85±0.97 h, ranging from 1 min to 36 h. For patients undergoing surgery, the mean time between admission and the first surgery was 7.48±9.5 h, ranging from 15 min to 85.5 h. The mean time between the first and second surgeries for patients was 55.4±90.9 days, ranging from 2 to 365 days.

In analyzing injuries to the orbital and periorbital areas, out of 129 patients, 68 (52.7%) had no specific injuries in these areas, 30 (23.3%) had eyelid lacerations, 22 (17.1%) had canalicular lacerations, 6 (4.7%) had orbital wall fractures, 1 (0.8%) had eyelid laceration with retrobulbar hemorrhage, 1 (0.8%) had mucormycosis, and 1

Table 1 Baseline demographic and clinical characteristics of study participants

Parameters	Subgroup	Frequency (%)
Gender	*Male*	81 (62.8)
	Female	48 (37.2)
Side involved	*Right eye*	67 (51.9)
	Left eye	62 (48.1)
Past medical history of systemic disease	*Diabetes*	5 (3.9)
	Hypertension	4 (3.1)
	Ischemic heart disease	4 (3.1)
	Hypo/hyperthyroidism	2 (1.6)
	Other	6 (4.6)
	Negative	108 (83.7)
Past medical history of ocular disease	*Cataract surgery*	10 (7.8)
	Diabetic retinopathy	3 (2.3)
	Negative	116 (89.9)
Place of residence	*Urban*	63 (48.8)
	Rural	66 (51.2)

Table 2 The characteristics of ocular injuries in study participants

Clinical Characteristics	Subgroup	Frequency (%)
Open globe injury	*Yes*	70 (54.3)
	No	59 (45.7)
Intravenous antibiotics	*Yes*	51 (39.5)
	No	78 (60.5)
Zone of injury (only in open globe injuries)	*1*	49 (70.0)
	2	11 (15.8)
	3	4 (5.7)
	Not specified	6 (8.6)
Endophthalmitis	*Yes*	7 (5.4)
	No	122 (94.6)
Ocular Trauma Scores (OTS)	*0–45*	12 (9.3)
	46–65	27 (20.9)
	66–85	33 (25.6)
	86–100	39 (30.2)

(0.8%) experienced simultaneous canalicular laceration and orbital wall fracture.

Seventy patients (54.3%) had open globe injuries, and 7 (5.4%) were diagnosed with endophthalmitis during hospitalization. Seventy-eight patients (60.5%) did not require intravenous antibiotics during treatment. The OTS in the study ranged from 37 to 100, with a mean score of 72.08 ± 20.78. For the 11 patients (children under 4 years) who could not respond to VA measurements, OTS could not be evaluated. Other clinical characteristics of patients are presented in Table 2 (Table 2).

Forty-nine patients (38.3%) underwent primary repair initially. The lacrimal canalicular repair was performed on 22 patients (17.2%). Additionally, only 23 patients required more than one surgical intervention, with 11 (8.5%) undergoing lensectomy. Due to severe soft tissue damage in a patient with concurrent canalicular laceration and orbital wall fracture, lacrimal drainage system intubation was not possible in this patient (Table 3).

In our study, the myna was found to be the most common animal and bird causing injury, accounting for 30 patients (23.3%). Of the seven patients who developed endophthalmitis, four were injured by mynas, two by roosters, and one by a goat. Additional details regarding the types of animals and birds causing trauma can be found in Fig. 1 (Fig. 1).

Our analysis of the type of animal and bird causing the injury and the occurrence of open globe injury shows that out of a total of 60 injuries involving birds, 47 patients (78.3%) were diagnosed with open globe injury, while this rate was 21 out of 66 (31.8%) in injuries involving quadrupeds. The difference between the two groups was statistically significant (P-value < 0.001). However, the age and gender of the patients were not significant factors in the incidence of open globe injury (P-value = 0.280 and 0.320, respectively).

Table 3 Surgical interventions performed on study participants

Parameters	Subgroup	Frequency (%)
The first surgical intervention	*Primary repair*	49 (38.3)
	Lacrimal drainage system intubation	22 (17.2)
	Lid repair	21 (16.5)
	Primary repair + lid repair	5 (3.9)
	Exploration	5 (3.9)
	Orbitotomy	4 (3.1)
	Primary repair + lensx	4 (3.1)
	Primary repair + intravitreal AB	4 (3.1)
	FB removal + primary repair	2 (1.6)
	Primary repair + PPvitx + intravitreal AB	2 (1.6)
	Enucleation + lid repair	1 (0.8)
	Lensx	1 (0.8)
	FB removal	1 (0.8)
	Primary repair + PPvitx + intravitreal AB + lensx	1 (0.8)
	Lid repair + canthotomy and cantholysis	1 (0.8)
	Primary repair + DCR	1 (0.8)
Additional surgical intervention	*Lensx*	11 (8.5)
	PPvitx	6 (4.7)
	Lensx + PPvitx	3 (2.3)
	Orbitotomy	1 (0.8)
	PPvitx + intravitreal AB	1 (0.8)
	Exenteration	1 (0.8)

(**Lensx;** Lensectomy, **AB;** Antibiotics, **FB;** Foreign body, **PPvitx;** Pars plana vitrectomy, **DCR;** Dacryocystorhinostomy)

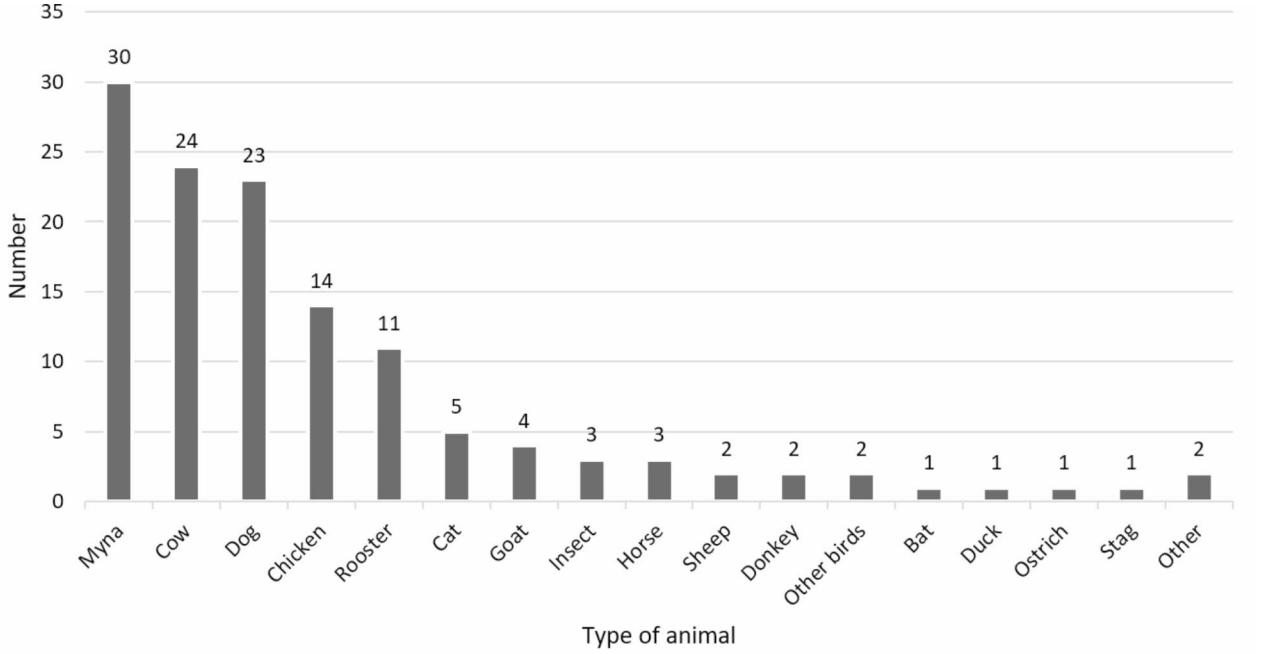

Fig. 1 Descriptive data of invasive animals and birds in patients with ocular injuries

Of the seven patients with endophthalmitis, six resided in urban areas, though this variance was not statistically significant (P-value=0.058). The analysis indicated that the mean time from injury to hospital admission was 31.46±3.58 h in the rural group and 29.85±6.48 h in the urban group (P-value=0.012). The time from admission to the first surgical intervention was 11.14±8.8 h in the rural group and 6.83±6.13 h in the urban group (P-value=0.020).

Patients who developed endophthalmitis had a higher average time from trauma to hospital admission compared to those without endophthalmitis (70.15 vs. 24.7 h, P-value=0.22), although this difference was not statistically significant. The duration from hospitalization to surgery was shorter in the endophthalmitis group compared to the non-endophthalmitis group, but this difference was not statistically significant (7.41 vs. 9.13 h, P-value=0.84). The total time from trauma to surgery in patients with endophthalmitis was higher than in those without endophthalmitis (77.57 vs. 35.01 h, P-value=0.26), but this discrepancy was not statistically significant.

Of the seven cases of endophthalmitis, six occurred in patients with Zone 1 trauma, and one occurred in Zone 3. Gender was not found to be a determining factor affecting the zone of open globe injury (P-value=0.596). Six cases of endophthalmitis were linked to bird trauma, while one case was linked to quadruped trauma. All seven patients with endophthalmitis had a history of receiving intravenous antibiotics. The occurrence of endophthalmitis in the affected zones and the type of animals and birds involved did not show a statistically significant difference (P-value=0.310 and 0.532, respectively). However, there was a significant difference in the incidence of endophthalmitis between the group that received intravenous antibiotics (13.7%) and the group that did not (0%, P-value=0.027). The results of our analysis showed that with increasing age, the time interval between the occurrence of trauma and the visit to the hospital increased, although this relationship was not statistically significant (Z=0.587, P-value=0.557).

The BCVA at the time of admission was significantly better for urban patients (0.98±1.00 LogMAR) than for rural patients (1.60±1.28 LogMAR; P-value=0.008). Similarly, at discharge, urban patients had significantly better BCVA (1.43±1.11 LogMAR) compared to rural patients (2.44±0.91 LogMAR; P-value=0.002). Furthermore, patients with Zone 3 injuries had worse BCVA compared to those with Zone 1 and Zone 2 injuries, both at the time of admission (P-value<0.001) and discharge (P-value<0.001) (Fig. 2).

The effects of factors such as age, time from trauma to hospital admission, and time from admission to the first surgical intervention on patients' BCVA at discharge are summarized in Table 4. The results indicate that age has a statistically significant correlation with BCVA at discharge (correlation coefficient=0.359, P-value=0.015) (Table 4).

BCVA at discharge was significantly worse in patients with injuries from quadrupeds (2.80±0.57 LogMAR)

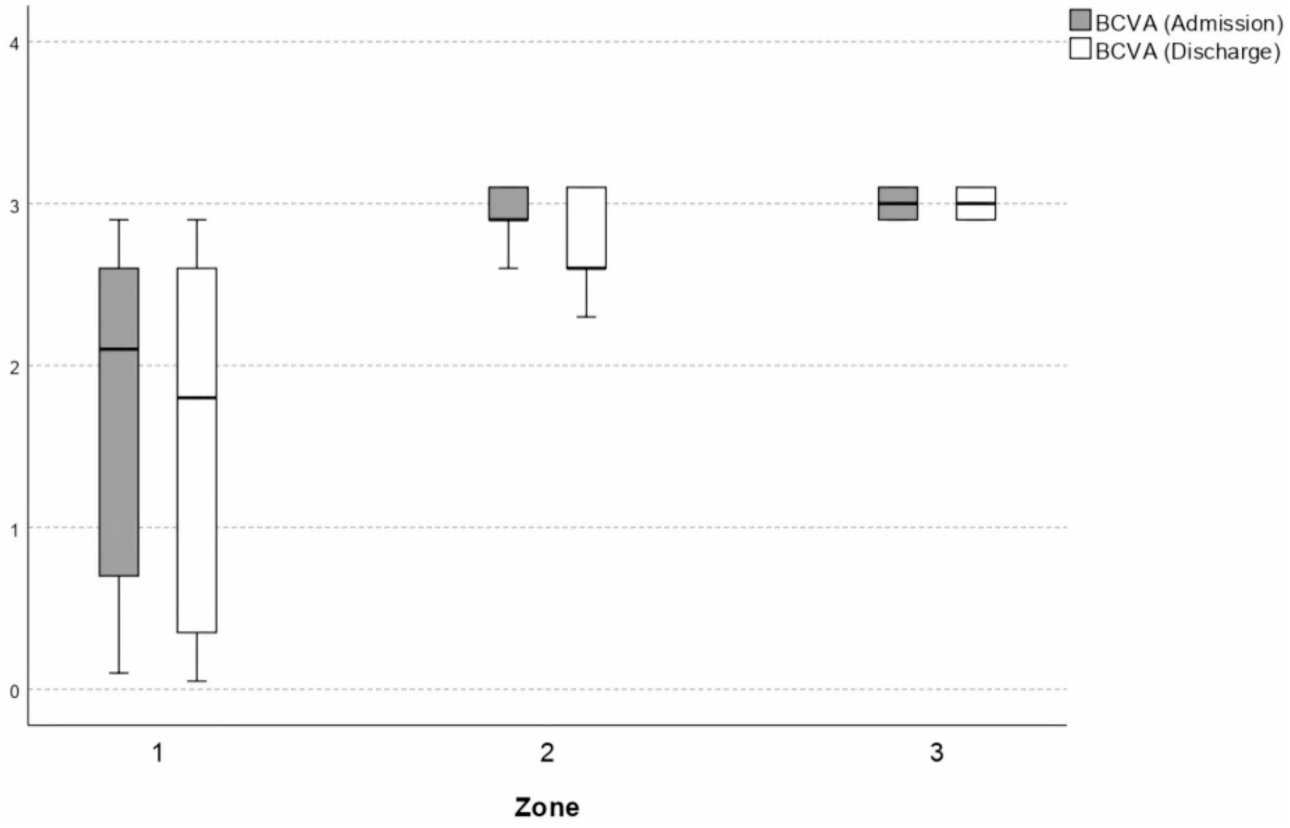

Fig. 2 Visual acuity of patients at the time of admission and discharge based on the injured zones in open globe injuries

Table 4 Correlation between age, time of referral, and surgery with visual acuity during discharge

Parameters	Correlation Coefficient	*P*-value
Age	0.359	0.015
Time from injury to hospital admission	0.184	0.262
Time from admission to first surgical intervention	0.194	0.213

Table 5 Correlation between age, time of referral, and surgery with visual acuity during discharge (after excluding patients with LP and NLP)

Parameters	Correlation Coefficient	*P*-value
Age	0.174	0.415
Time from injury to hospital admission	-0.015	0.949
Time from admission to first surgical intervention	-0.190	0.397

compared to those with injuries from birds (1.37±1.04 LogMAR; P-value<0.001). Also, our analysis revealed that a lower OTS is significantly correlated with worse BCVA at discharge (P-value=0.031). Furthermore, the group that received intravenous antibiotics had worse visual acuity compared to the group that did not receive intravenous antibiotics (2.33±0.85 and 1.31±1.66 LogMAR, respectively), although this difference was not statistically significant (P-value=0.157).

The analysis excluded LP and NLP patients, resulting in no significant differences in the BCVA at discharge compared to pre-treatment measurements (P-value=0.686). Nonparametric correlations indicated a lack of correlation between BCVA at discharge and factors including age, time to referral, and surgery (P-value=0.415, 0.949, and 0.397, respectively) (Table 5). Zone-based and animal category analysis revealed no significant changes in BCVA at discharge (P-value=0.352 and 0.334, respectively). We noted no statistically significant differences in BCVA at discharge between individuals receiving intravenous antibiotics and those who did not (P-value=0.085). The location of residence did not significantly affect the BCVA at discharge (P-value=0.252), although rural patients experienced longer referral delays (P-value=0.029).

One unique patient included a one-year-old child who experienced penetrating injury with a rooster. The child had fever, lethargy, and swelling of the eyelids seven days following primary repair. Even after receiving systemic antifungal treatment with a diagnosis of mucormycosis, the infection did not improve. Consequently, exenteration was performed.

Discussion

Injuries caused by bird pecking are infrequent, with owls and roosters being the most commonly reported culprits in the literature [10, 17]. Interestingly, in our study, we found that over half of the patients had open globe injuries, with mynah birds being the most common cause. Our results confirmed that injuries caused by birds, as opposed to quadrupeds, were significantly more likely to result in penetrating injuries, attributed to the sharp beaks of birds causing full-thickness corneal laceration. Our report originates from a tertiary referral eye hospital in Tehran, the capital of Iran, where the prevalence of injuries attributed to pet birds, such as the mynah, is high due to their widespread popularity. In contrast, various studies in the United States indicate that dogs are the most common cause of animal related ocular injuries [18–21]. Conversely, in India, injuries resulting from cow attacks represent a prevalent cause of ocular trauma inflicted by animals [7, 22]. The incidence of injuries resulting from camel attacks is notably higher in the Persian Gulf countries [8, 23, 24].

In the present study, the time between trauma and referral and surgery was significantly shorter in urban patients than in rural ones. The shorter time in the urban group suggests that patients in urban areas may have better access to medical facilities or faster transportation. Additionally, individuals in rural areas are often more susceptible to eye injuries because of their lower level of education and socioeconomic status, which can lead to delays in seeking medical care, as reported by other studies [2]. This study also suggests that urban patients generally had better vision before being admitted to the hospital. Our findings imply that at discharge, urban patients achieved better visual acuity compared to their rural counterparts.

Differences in visual outcomes between rural and urban patients with ocular trauma can be attributed to several factors. Urban areas generally provide better access to eye care services, facilitating earlier diagnosis and treatment. Additionally, urban patients often have higher socioeconomic status and education levels, which positively influence their health-seeking behavior and outcomes. In contrast, rural patients may face delays in seeking medical attention due to lower socioeconomic status, less education, and greater distances to healthcare facilities. In rural areas, heightened levels of environmental pollutants, such as dust, agricultural chemicals, and biomass smoke, are common and may worsen secondary infections or complications related to ocular injuries [25, 26]. Water pollution and insufficient sanitation can increase the likelihood of microbiological contamination, leading to more severe infections and poorer patient outcomes [27]. Exposure to these toxins, along with limited access to clean water and sanitation services, can significantly worsen the prognosis of patients with ocular injuries [25, 27]. Improving patient referral systems and access to specialized medical centers is essential to mitigate the impact of ocular trauma in rural populations.

The incidence of animal and bird-induced injuries among men in our study was nearly twice that among women, consistent with findings from previous research covering both occupational and animal and bird-related traumas. The higher prevalence of eye injuries in men can be attributed to their greater involvement in outdoor and hazardous activities, as well as work-related accidents [2, 28–33].

Our study also revealed that zone 3 injuries are correlated with poorer visual outcomes in animal and bird trauma compared to zone 1 and 2 injuries. This finding has been similarly observed in other trauma studies [34, 35]. This can be due to retinal involvement, vitreous hemorrhage, optic nerve damage, choroidal and ciliary body disruption, and surgical challenges that are associated with zone 3 injuries [36].

Out of 70 patients with open globe injuries, 7 experienced endophthalmitis (6 of whom had trauma caused by birds). The prevalence of traumatic endophthalmitis has been reported to be between 2 and 20% in different studies [37–39], and our study indicates a similar prevalence. Different cases of endophthalmitis after animal trauma, such as cats, camels, etc., have been reported in different countries [12, 22, 40]. However, it seems that the main cause of endophthalmitis in our country is secondary to bird trauma, although our statistical analysis indicated that the type of animal and bird is not related to the incidence of endophthalmitis. The analysis also indicated that patients who received intravenous antibiotics had a higher rate of endophthalmitis. It should be noted that receiving intravenous antibiotics is often justified in patients with open-globe injuries, and not receiving them in patients with closed-globe injuries plays an important role in this finding [41, 42].

In our study, we observed that patients' visual acuity at the time of hospital discharge was notably worse than their visual acuity during admission. This observation may be attributed to ocular surgeries and procedures, such as silicone oil tamponade, corneal edema, and hyphema. To elucidate this finding, it is imperative to assess patients' vision during their long-term follow-ups. Regrettably, many patients performed their long-term follow-ups at local healthcare facilities rather than returning to our institution, limiting our ability to conduct a comprehensive analysis of long-term visual outcomes.

It is important to acknowledge the limitations of our study. The retrospective design presents a significant limitation, and the single-center setting further restricts the findings. As our hospital is a referral center located far

from other provinces, regular patient follow-up is challenging. Consequently, patients often receive follow-up care at nearby facilities, leading to incomplete follow-up data and a loss of crucial information regarding their final visual outcomes. Despite our efforts to gather missing data, including contacting patients or their companions, we were unable to obtain comprehensive information on long-term visual outcomes, even with telephone follow-ups. Additionally, the relatively low incidence of animal and bird-related open globe injuries results in an even lower rate of subsequent endophthalmitis, which significantly reduces the number of patients available for analysis, thereby limiting the strength and generalizability of our findings. However, it is essential to note that the data presented in this study reflect the actual situation in the region covered by the hospital, which is undoubtedly influenced by local culture and customs. It is strongly recommended that a more extensive study, encompassing a larger sample size and involving collaboration with multiple centers across provinces, be undertaken to comprehensively investigate the dimensions of ocular traumas caused by animals and birds. Such an initiative would provide invaluable insights to healthcare providers and policymakers in this domain.

Conclusions

In summary, our investigation encompassed 129 patients who sustained injuries to the orbital and peri-orbital regions due to animal and bird-related trauma over a 10-year duration at Farabi Eye Hospital. The findings revealed that 54.3% of the patients experienced open globe injuries, with a 5.4% incidence of endophthalmitis. The majority of open globe injuries and endophthalmitis were caused by birds, especially mynahs. Patients injured by quadrupeds had lower visual acuity than other patients. Additionally, urban patients had shorter visit times compared to rural patients, and also better visual outcomes.

Abbreviations

HIS	Hospital Information System
UCVA	Uncorrected Visual Acuity
BCVA	Best-corrected Visual Acuity
VA	Visual Acuity
CF	Count Fingers
HM	Hand Motion
LP	Light Perception
NLP	No Light Perception
Lensx	Lensectomy
PPvitx	Pars Plana Vitrectomy
OD	Right Eye
OS	Left Eye
OTS	Ocular Trauma Score

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Author contributions

M.M & S.A.T & Z.M prepared the idea and E.A & F.M prepared a proposal, E.A & F.M & H.A collected data, H.A & A.R analyzed data and prepared the primary draft. All authors read and proofed the final article.

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Data availability

Data supporting the findings of this study can be provided upon request from the corresponding author.

Declarations

Ethics approval and consent to participate

The study received approval from the local ethics committee at Tehran University of Medical Sciences, in alignment with the ethical guidelines of the Helsinki Declaration (IR.TUMS.FARABIH.REC.1402.038). All patients provided written informed consent to contribute their data to the database.

Consent for publication

We secured consent from the patients through a consent form, allowing us to publish their information without revealing their identities.

Competing interests

The authors declare no competing interests.

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